Magnetic Island's World Heritage Values

A Preliminary Assessment

Compiled by members of
Magnetic Island's resident scientific community under the auspices of the
Magnetic Island Community Development Assoc. Inc.
and
Magnetic Island Nature Care Assoc. Inc.

Preface

Long before Magnetic Isle was named by Captain Cook, it had been attractive to indigenous inhabitants, notably the Wulgurukaba People. After the establishment of Townsville, the Island's proximity, and its natural characteristics, made it a favoured exploration ground for many scout troops and sporting and recreational groups over the years, and always a day or weekend visiting spot for many Townsville families. With developing technologies, including much faster vessels plying between the mainland and the Island, Magnetic Island emerged from a sleepy and 'secret' holiday location, to a favoured site for major tourism developments. Tourist brochures hail the Island as the "jewel in the crown" for the entire tourism region.

Magnetic Island, a distinctive gem in the dry tropics of the Great Barrier Reef World Heritage Area (GBRWHA), is important to Townsville, to Queensland, to Australia, and to the world, as a site worthy of protection, despite the current emphasis on coastal modification and development. Perhaps more importantly, it is significant to many ordinary people who have enjoyed its natural beauty over decades of growing up in Townsville. For me, as one of those people, it was first a place to visit with my parents, and, later, to visit with my wife and children - without disturbing its natural living and non-living features. It was also a wonderful resource for our research, which has allowed society to better understand past climatic circumstances and the ecology of land and sea.

The question is "Can developement planning for Magnetic Island ensure retention of its natural character - on land and in the water - and allow for its protection as part of the GBRWHA? ". Magnetic Island features equally prominently in the profile of the GBRWHA as it does in the profile of the city of Townsville!

However, the slight sea barrier, which previously protected the natural attributes of Magnetic Island from over-exploitation, has, as mainland populations increased, become almost a highway to development.

We now know that development and clearing of vegetation in riparian zones can dramatically increase erosion and water run-off from already water-stressed lands, and we know that excessive sediment can kill coral reefs. Such knowledge should allow designation of areas that are not to be disturbed, and of others that are to be rehabilitated. Cultural areas must be protected and one would hope that building developments will not dominate, and hopefully not even disturb, the natural and rugged profile of the island, viewed from land or sea. The Island has approximately half of its land area declared as National Park, and this area must only be increased and not disturbed by excessive human presence. Coastal areas, featuring the interactions and interdependencies between land and sea, require protection and respect from human developments and developers.

Smart selection of available technologies, rather than blind acceptance of all technologies, should allow for balanced development within the requirements of protection of natural, built, cultural and aesthetic values of World Heritage Areas such as Magnetic Island. It is essential that such management actions are based on a thorough foundation of knowledge about those values and likely impacts on them. I commend the scientific community of Magnetic Island for producing this document, and commencing the process towards World Heritage management planning on Magnetic Island.

Joe Baker AO, OBE, FTSE, MSc, PhD, FRACI, C.Chem
20th June, 2004.

Dr Joe Baker

During his rich and distinguished career Dr Baker has been appointed to a number of significant positions, including Director of the Australian Environmental Council; President of the Federation of Australian Scientific and Technological Societies (FASTS); Executive Chairman of the Queensland Food and Fibre Science and Innovation Council; honorary research fellow with CRC Reef; Director of the Australian Institute of Marine Science (AIMS), Adjunct Professor of James Cook University, Chairman of the Australian Heritage Commission, and Chairman of the North Queensland Economic Development Board. He is a founding Board Member of the Queensland Academy of Sport, where he has assisted in the development of the sports science and sports medicine services. In his current role as Chief Scientist for Queensland, Dr Baker advises the government on strategic policy issues related to government-based research, development and extension services. He also has a significant involvement in science and technology policy setting at the national and international levels.

He was a resident of Townsville during the periods 1940-1945; 1961-1974; and 1981-1994. As a Foundation Member of the GBRMPA, he personally appeared before UNESCO's World Heritage Committee to present the case for Inscription of the Great Barrier Reef Region on the World Heritage List

Dr Joe Baker is a 'Queensland's Great' and a Centenary Medal recipient.



Acknowledgements and disclaimer

Despite their academic credentials in their respective fields, and professional affiliations with organisations including Government departments, the authors wish it noted that they have prepared their respective contributions in their own time on a voluntary basis, and that the opinions expressed are their own and not necessarily those of their employer or associated professional organisations.

In addition to acknowledgements made within individual chapters, the authors wish to note the important contributions made by the following individuals and organisations.
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The authors thank Dr Joe Baker for contributing a preface to this document, and adding his long-term personal and expert perspectives on these issues.

This document is produced under the auspices of the Magnetic Island Community Development Association Incorporated, with assistance from Magnetic Island Nature Care Association Incorporated.

Executive Summary

In 1974 Australia became one of the first countries to sign and ratify UNESCO's *Convention Concerning the Protection of the World Cultural and Natural Heritage,* commonly known as the World Heritage Convention.

In 1981, The Great Barrier Reef World Heritage Area (GBRWHA) was accepted as a World Heritage property, and the Commonwealth of Australia accepted its legal obligation to protect and conserve the area to the best of its ability for the benefit of present and future generations throughout the world. Although only a relatively small part of the 35 million hectare GBRWHA, Magnetic Island, 8km off Townsville, contributes features and values that are found nowhere else within it. Thus, the Island's size belies its significance.

This document contains evidence of how Magnetic Island meets all four natural world heritage criteria; how it offers (i) outstanding examples of the earth's evolutionary history; (ii) outstanding examples of ongoing geological processes, biological evolution and man's interaction with his natural environment; (iii) unique, rare and superlative natural phenomena, formations and features and areas of exceptional natural beauty; and (iv) habitats where populations of rare and endangered species of plants and animals still survive. This document also contains evidence that some of Magnetic Island's features and values are unique within the GBRWHA. This means that loss or degradation of those values from Magnetic Island would also mean loss or degradation of those values from the GBRWHA, and a violation of Australia's international legal obligation.

Magnetic Island is the only large continental island within the Northern Brigalow Belt bioregion. It is a microcosm of many of the geologies, landforms, soils and ecosystems found on the coastal and near coastal part of the wet/dry tropics of North Queensland. The close proximity of these different formations and systems on the Island, as well as the 22 terrestrial species of plants and animals recorded on the Island that are listed as endangered, rare or vulnerable under the Queensland Nature Conservation Act, provide a unique and outstanding opportunity for conservation and study. This opportunity is increased by the size of the island; its relatively good condition in terms of past land uses, weeds and feral animals; the potential for the island to be relatively easily managed to contain or reduce the deleterious effects of threatening processes on the natural ecosystems; the existence of areas and items of great cultural significance; its stunning physical beauty; and the extensive and diverse interface between the terrestrial and marine ecosystems.

Due to its location in Cleveland Bay, these marine ecosystems are diverse, ranging from very wave-protected shallow muddy environments on the leeward sides to wave-exposed windward coastlines with clearer and deeper water. The ecosystems contain a broad range of marine communities, ranging from one of the most extensive colony stands of *Montipora digitata* ever recorded on the Great Barrier Reef to massive coral colonies hundreds of years old. Magnetic Island's marine realm also contains the only stands of the rare soft coral *Nephthyigorgia* sp to be recorded within the GBRWHA.

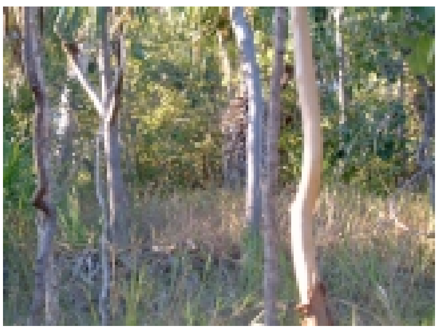
Marine turtles, sea snakes, several species of whales and dolphins, and the endangered dugong (*Dugong dugong*) are regularly seen in the surrounding waters. Several Magnetic Island beaches are also known to be regular nesting sites for the protected Green Turtle (*Chelonia mydas*). Nests of ospreys and white-breasted sea eagles are well established on several headlands and their nesting sites have been continuously used for years if not decades. In addition, many bays are also seasonally inhabited by small flocks of Torres Strait Pigeons, and regularly visited by frigate birds.

The World Heritage values of the GBRWHA do not rely solely on non-human features. Indeed, one of the criteria by which the Great Barrier Reef was inscribed on the World Heritage List notes that human interactions with the natural environment are a consideration.

In this regard, Magnetic Island contains a plethora of evidence of past and present use – shell middens, pigment art, quarry sites, stone artefact scatters, burials, fish traps, rock shelters with cultural deposits, contact sites and historic camping and fishing locations.

Despite its varied and significant values, there is widespread and growing concern that the World Heritage values of the Island and surrounding waters, and therefore of the GBRWHA, are being, or will be, irrevocably damaged or destroyed by inappropriate incremental development. With almost all the lowland habitats unprotected and potentially available for development, the potential for this is high. Jurisdictional complexities for management actions further contribute to this potential.

A World Heritage Management Plan, an instrument available under Commonwealth and State legislation, would facilitate the essential integrated management approach so critical if degradation or loss of values are to be avoided. However, partly because there has been no scientific interpretation of the World Heritage values as they apply to Magnetic Island, no such plan has yet been developed for the Island.



This document, compiled by local scientific experts, provides such an interpretation. It provides a solid foundation on which to develop and implement a system of management worthy of, and necessary for the protection of, the World Heritage values of Magnetic Island, and of their contribution to the values of the Great Barrier Reef World Heritage Area.

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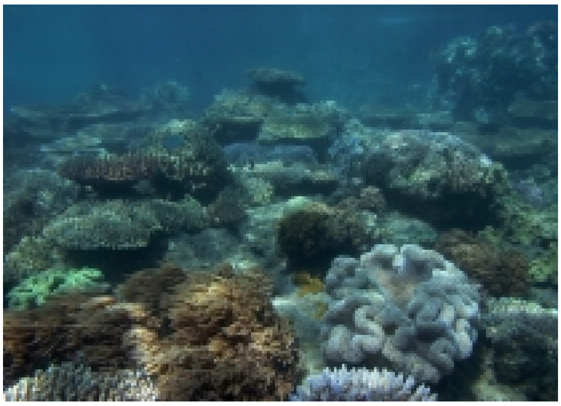


About the authors (in alphabetical order)

Gillianne Brodie

Dr Gilianne Brodie is a Magnetic Island resident, tropical benthic ecologist and senior lecturer in marine invertebrate biodiversity at James Cook University. She is a world authority on molluscan biology, taxonomy and ecology, and has worked extensively on the reefs of Magnetic Island and elsewhere on the GBR, as well as other regions of the South Pacific, including Fiji. Through her teaching role at university and by extension to high schools, Gilianne has been instrumental in communicating the importance of invertebrate marine biodiversity to generations of professional marine biologists.

Libby Evans-Illidge

Elizabeth Evans-Illidge is a Magnetic Island resident and marine biologist who has worked in the Great Barrier Reef World Heritage Area for 20 years. Since 1994, she has worked with a multidisciplinary team in the marine biotechnology research group at the Australian Institute of Marine Science (AIMS), seeking new commercial applications for molecular elements of Australia's marine biodiversity. She is a renowned biodiversity policy expert, and frequently represents Australia in international fora related to the conservation, equitable benefit sharing, and sustainable use of biodiversity. Libby maintains an active research interest in maximising the conservation outcomes of biodiscovery research, and the sustainable production of species of interest.

Katharina Fabricius

Dr Katharina Fabricius is a coral reef ecologist currently working at AIMS in Townsville, and a resident of Magnetic Island. She is a world authority on coral reefs of the Great Barrier Reef and has worked on the GBR and many other Indo-Pacific regions, the Red Sea and the Caribbean since1988. Her research is predominantly focused on how environmental conditions and human activities influence the biodiversity and ecology of coral reefs. She presently leads a research team investigating the effects of water quality on the health of inshore reefs of the Great Barrier Reef. Katharina is a world-renowned expert on reef-inhabiting soft corals, and has published widely in academic and popular media. She was the chief researcher and on-air presenter for the SBS documentary 'Muddy Waters; the Life and Death of the Great Barrier Reef', which screened nationally and sold internationally. Katharina is a Councillor of the International Society for Reef Studies and a member of numerous national and international scientific advisory committees and exert panels.

Melissa George

Melissa George is a Wulgurukaba woman and a Traditional Owner of Magnetic Island and Townsville areas. She has written widely on issues related to indigenous ownership and co-management; and is in demand as a speaker on indigenous issues at conferences around Australia and overseas. She is also acclaimed for her extensive and effective role regionally and locally with terrestrial and marine natural resource management, including with the Great Barrier Reef Marine Park Authority and the Burdekin Dry Tropics Board.

"It is important to realise that as Indigenous people the environment and culture are one and the same, they co-exist and are not separate". *Melissa George 1999*

Gethin Morgan

Gethin Morgan has worked in the field of landscape ecology for almost 30 years, undertaking landscape classification, land assessment and conservation planning at local, regional, state and national scales. Gethin was co-author of the first bio-regionalization in Australia in Queensland in 1977, and assisted the eventual development of a complementary classification for the balance of Australia in 1995. He is also the major author of the 1999 publication that describes the regional ecosystems and bioregions of Queensland, and of a 2001 national study of Landscape Health.

Gethin has completed detailed assessments of landscapes across all of NSW, and of most of the bioregions of central and northern Queensland. Most of these assessments have included analyses of land degradation and other threatening processes, and the identification of areas significant for the conservation of biodiversity. Associated publications include regional and subregional plans that integrate conservation planning with the establishment of sustainable patterns of land use, and management plans for conservation reserves.

Peter Veth

Adjunct Acting Professor at James Cook University Dr Peter Veth is currently Director of Research, at the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS), an independent commonwealth government Statutory Authority and Australia's premier institution for information about the cultures and lifestyles of Aboriginal and Torres Strait Islander peoples. Until recently, he was a resident of Magnetic Island. Dr Veth's research interests include the archaeology and anthropology of desert societies; the emergence of maritime cultures in Southeast Asia and Australia; Native Title and the use of social science evidence; cultural heritage management and accreditation; and models for cultural continuity and complexity.

Peter is National President of the Australian Association of Consulting Archaeologists Incorporated; Public Liaison Officer for the Australian Archaeological Association; and on the Editorial Board of *Archaeology in Oceania*. He is also a Member of the AIATSIS Executive Management Board, Research Advisory Committee, Native Title Reference Group and Information and Technology Advisory Committee. Peter is a Full Member of the Australian Association of Consulting Archaeologists Incorporated; Member of AIATSIS; Member of the Australian Institute of Maritime Archaeology; Member of the Australian Archaeological Association and Member of the Society of American Archaeologists.

Introduction
– the World Heritage status of Magnetic Island

Elizabeth Evans-Illidge

The concept of World Heritage is clear and simple. It acknowledges the existence of properties that are of such immense natural and/or cultural importance from a global perspective, that they should be protected and conserved as the common heritage of all humankind.This collective interest in, and responsibility for, the identification, protection and conservation of these globally significant properties was legitimised in 1972, when the General Conference of the United Nations Educational Scientific and Cultural Organisation (UNESCO) opened the *Convention Concerning the Protection of the World Cultural and Natural Heritage* for signature (Lucas et al., 1979).

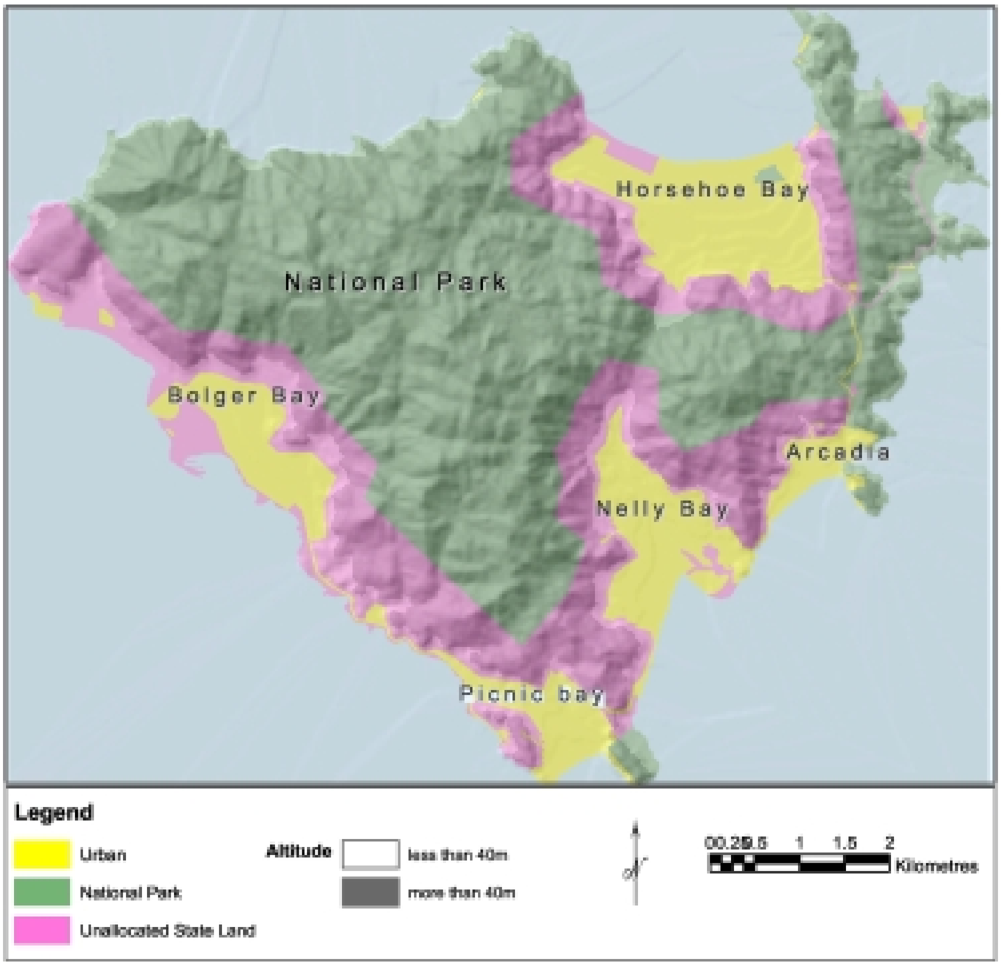
In 1974 Australia became one of the first countries to sign and ratify this international treaty, more commonly known as the World Heritage Convention. As a party to the convention, Australia became obliged to *'do all it can…to the utmost of its own resources'* to ensure *'the identification, protection, conservation, presentation and transmission to future generations of the cultural and natural heritage…on its territory.'* (UNESCO 1972).

The major instrument provided within this international law is the World Heritage List of properties afforded protection by the convention. Countries that have adopted the convention are responsible for nominating properties within their territory for registration on this List. Nominations are rigorously examined, by experts, against set criteria, and, if the nominated properties are accepted on to the list, nominators are legally obliged to protect and manage them according to World Heritage principles.

In January 1981, The Great Barrier Reef World Heritage Area (GBRWHA) was accepted onto the World Heritage List (Lucas et al., 1997), and the Commonwealth of Australia accepted the international legal obligation to protect and conserve the area to the best of its ability for the benefit of present and future generations throughout the world. The GBRWHA is joined on the list by over 800 other iconic and globally significant properties, including the Grand Canyon, Yellowstone National Park, the Great Wall of China, and the Galapagos Islands (UNESCO, 2004). However, with 35 million hectares, spanning 2000 km of Queensland's coastline, the GBRWHA remains the largest World Heritage property (Wachenfeld et al., 1998).

While most identify the GBRWHA as the over 2800 individual reefs that make up the Great Barrier Reef, the GBRWHA is much more than just coral reefs. Below the high water mark, the GBRWHA also includes mangroves, seagrass beds, the deeper habitats between the reefs, and the continental slope. Much of these 'wet' parts of the GBRWHA fall within the boundary of the Great Barrier Reef Marine Park, and hence enjoy the protection and management afforded by the *Great Barrier Reef Marine Park Act 1975*. However, approximately 7% of the total area of the GBRWHA falls outside the boundary of the GBRMP (GBRMPA, 1994), including the 540 high continental islands and over 500 coral cays (Talbot and Steene, 1984). Many of these islands are at least partially 'declared national parks', and as such are protected and managed under appropriate Queensland legislation. However, many islands, at least in part, fall outside the reach of Australian protected area legislation. One of these islands is Magnetic Island.

Magnetic Island lies about 8km off the coast to the north of the coastal city of Townsville. Just over half (55%) of the Island is Magnetic Island National Park; a further approximately 25% is under the control of the State; the remaining approximately 20% of the land mass is privately owned and immediately available for urban development under the control of the Townsville City Council. This latter 'at risk' land constitutes almost all the lowland habitat of the Island.



Tenure map of Magnetic Island, showing that lowland habitats almost exclusively occur in the urban areas, and are almost absent from the Island's protected area.

There is a high, widespread and increasing level of concern that domestic legal arrangements do not deliver compliance with Australia's World Heritage obligations when it comes to this component of the Island. This situation echoes a concern raised in 1981 during the review of the nomination of the GBRWHA, that, due to the complexity of jurisdictional divisions, the existing management regime might not ensure the long-term integrity of the area (Lucas et al., 1997).

The Commonwealth*'s Environment Protection and Biodiversity Conservation Act 1999 (*the EPBC Act*)*, allows for referral and assessment of proposed actions that will have, or are likely to have, a significant impact on the World Heritage values of a declared World Heritage property. However, this provision requires the case-by-case referral of specific development proposals that are then assessed on their own merits. Thus, in order to trigger the EPBC Act, a single development must have the potential to effect World Heritage values. This approach does not take into account the cumulative impact of multiple developments on these values. Thus, Magnetic Island is at risk of suffering a 'death by a thousand cuts', whereby no one single 'cut' destroys a value but 1000 cuts do.

Nevertheless, the EPBC Act and Queensland's *Nature Conservation Act 1994*, do make provision for a holistic approach to management of World Heritage values. They do this through the declaration of World Heritage Management Areas and the development of plans to allow for the integrated management of such areas. Unfortunately, these tools have not, as yet, been employed for Magnetic Island..

To effect implementation of legal measures for management and protection of the World Heritage values of Magnetic Island, it is necessary to clearly articulate those values. The original nomination document (GBRMPA, 1981), and subsequent analyses of the values of the GBRWHA (eg., Whachenfeld et al., 1998), are necessarily broad because they focus on the entire 35 million hectare area as a whole.

This document provides an interpretation of the GBRWHA World Heritage values as they relate to Magnetic Island. It has been compiled by Magnetic Island residents past and present, who both know the Island intimately and are experts in their field. It is not an exhaustive treatment of the subject, but lays a solid foundation for the future fulfilment of our international legal obligation to the global community.

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World Heritage values of Magnetic Island's terrestrial environment

Gethin Morgan

The Great Barrier Reef World Heritage Area

The Great Barrier Reef Region, including Magnetic Island, was inscribed on the World Heritage List on 30th October 1981. This list is the main instrument of the *Convention Concerning the Protection of the World Cultural and Natural Heritage*, which was adopted by the General Conference of the United Nations Educational Scientific and Cultural Organization (UNESCO) in 1972.

The Great Barrier Reef World Heritage Area (GBRWHA) encompasses a vast array of marine and terrestrial environments, and it is this size and variety, and its potential for protection by an affluent and democratic nation, that make the GBRWHA internationally significant (Lucas et al., 1997).

In listing the Great Barrier Reef World Heritage Area, the values of the region were assessed against four major World Heritage criteria:

- ***Criterion (i)*** *an outstanding example representing a major stage of the earth's evolutionary history.*
- ***Criterion (ii)*** *an outstanding example representing significant ongoing geological processes, biological evolution and man's interaction with his natural environment.*
- ***Criterion (iii)*** *contain unique, rare and superlative natural phenomena, formations and features and areas of exceptional natural beauty.*
- ***Criterion (iv)*** *provide habitats where populations of rare and endangered species of plants and animals still survive.*

Its World Heritage values against the criteria were clearly demonstrated in the nomination document, which was reviewed by 5 international experts (International Union for the Conservation of Nature 1981, quoted in Lucas et al., 1997) as part of a technical review by the International Union for the Conservation of Nature (now known as the World Conservation Union). The review stated that "if only one coral reef site in the world were to be chosen for the World Heritage List, the Great Barrier Reef is the site to be chosen".

Ninety-three percent (93%) of the Great Barrier Reef World Heritage Area is contained within the Great Barrier Reef Marine Park, two percent (2%) is in Queensland waters outside this park, and five percent (5%) of the area is made up of islands. In the values listed for the Great Barrier Reef World Heritage Area, the islands are particularly important in adding to the overall natural diversity and values of the World Heritage Area (Lucas et al., 1997).

The natural values of the islands largely relate to their geomorphological features, their flora and fauna, their aesthetic values, and the record they provide of significant natural processes. These natural values cover all four natural heritage criteria for which the Great Barrier Reef and its islands were listed as World Heritage.

The Natural Heritage Values of Magnetic Island

Lowland seasonal swamp, Bolger Bay

The values for which the Great Barrier Reef was listed as World Heritage relate to the size and complexity of the World Heritage Area as a whole, the value of the whole being greater than the sum of its parts. Individual areas, however, do make a significant contribution to the diversity of the Great Barrier World Heritage Area, and Magnetic Island is one of these areas.

The World Heritage values of Magnetic Island are outlined below, according to the four criteria under which the Great Barrier Reef World Heritage Area is listed. These criteria were revised in 1996, and the current definitions are used below.

Criterion (i) be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features

Islands and the adjoining marine habitats are centres of geomorphological diversity within the World Heritage Area. The interaction between terrestrial and marine elements and processes makes islands particularly important in understanding the relationships between the natural elements of north-eastern Australia and the Great Barrier Reef region, and their ongoing evolution.

Magnetic Island lies off the wet/dry topical coast of Queensland, and is the northern extremity of the Northern Brigalow Belt bioregion (Thackway and Creswell, 1995). It is the only large continental island within this bioregion, the Palm Islands to the north being part of the Wet Tropics bioregion, and the islands to the south being within the Central Queensland Coast bioregion (Sattler and Williams, 1999).

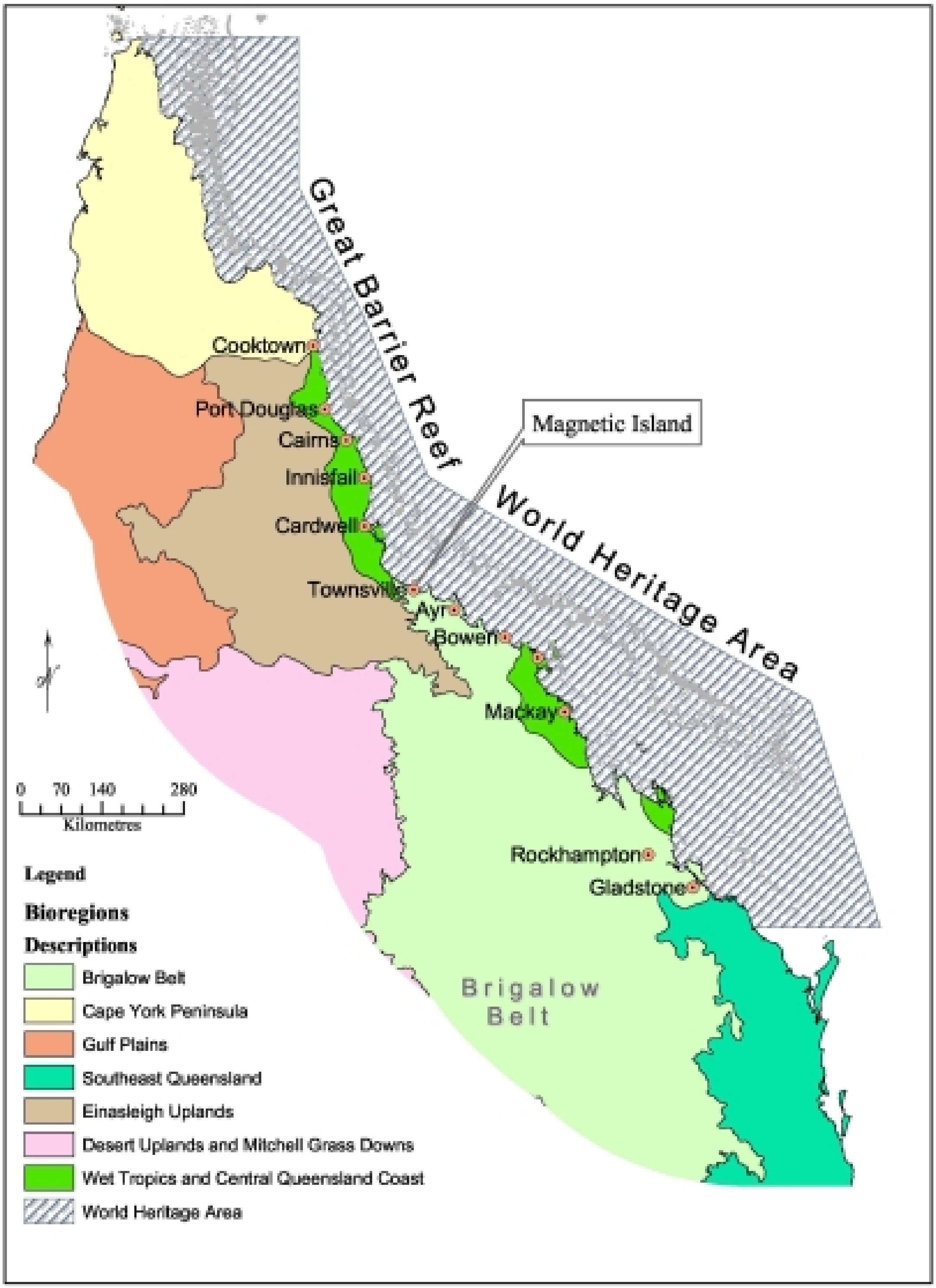
This unique position of Magnetic Island within the Great Barrier Reef World Heritage Area is strengthened by its geological and geomorphological diversity. This diversity includes bedrock, alluvial, aeolian, estuarine and marine components (Department of Mines, 1986).

The bedrock geologies on Magnetic Island include:
- Permian volcanic rocks (Julago Volcanics), typical of a wide belt of similar rocks between Central and Northern Queensland
- Permian intrusive rocks (Magnetic Island Granites), one of a wide suite of similar granitic intrusions in North Queensland
- Exposures showing the relationship between the volcanic and granitic rocks, and demonstrating that the Magnetic Island granite and related Permian granites are younger, and intrusive into the volcanics
- Dolerite dykes intruding the granites.

Generally speaking, the volcanic rocks form low domed hills with skeletal soils, and the granitic rocks form ranges and low hills with much rock outcrop including tors, and deeper, coarser-textured soils. The dykes weather more easily to form valleys and saddles within the granitic landscape. Other landforms include perched valleys, captured watercourses, boulder screes, and talus slopes. Mudslides are an irregular and continuing occurrence, demonstrating a major form of mass movement in the wet/dry tropics.

Julago volcanics exposed, Liver Point

Weathered Magnetic Island granite, southeastern coastline



Map of the Great Barrier Reef World Heritage Area, showing Magnetic Island's status as the only island within the area in the Brigalow Belt bioregion

Dolerite intrusion into Magnetic Island granite, Arthur Bay.

The Island also has a wide range of more recent unconsolidated alluvial and aeolian geologies. These include:

- Alluvial landscapes derived from the previous bedrock geologies, with at least three different age sequences, each having distinctive soils and landforms
- Wetlands, including a diversity of freshwater systems lying between alluvial fans and dune systems, swales in dunes, and wetlands that alternate between fresh, brackish and saline, depending upon seasons and tides
- Coastal aeolian landscapes, including at least three different age sequences of sand dune systems, varying in number and form according to the aspect and scale of each bay around the Island

These landscapes include old shorelines, reflected in the different aged dune systems, cut benches in higher alluvial systems, and in silicified, calcified or ferruginized beach rock. Magnetic Island is particularly unusual in eastern Australia in having a western shoreline with a diversity of dunal systems. Remnants of an older, laterized surface also occur in some areas.

Estuarine and marine geomorphological diversity includes:

- Tidal flats, with zones of frequency and duration of inundation expressed by salt couch or samphire communities, algal or bare saline flats, various mangrove forest zones, and offshore tidal sand and mud flats with extensive sea grass beds
- Reef flats, with associated landforms, and fringing reefs, varying in form and extent according to aspect and prevailing environmental conditions
- A wide variety of beaches, varying in width and slope according to aspect and relative wave energies.

Magnetic Island is a microcosm of many of the geologies, landforms and soils found on the coastal and near coastal part of the wet/dry tropics of North Queensland. Their close proximity on the Island, relative to a similar range in landscape diversity on the mainland, provides a unique and outstanding opportunity for the conservation and study of these interrelated and interdependent geomorphological elements, and of their associated plants and animals. In the case of this biological evidence of evolution, Magnetic Island is also particularly significant, being an environment where the impact of stock grazing, feral animals and introduced weeds is relatively minor compared with most of the mainland. These biological aspects are discussed below, with ecosystems and communities outlined in criterion (ii) and species outlined in criterion (iv).

Criterion (ii) be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals

The geomorphological diversity described above, and its associated ecosystems and species, make Magnetic Island an outstanding location to conserve and study the evolution and continuing processes of a wide range of coastal, near-coastal and marine ecosystems and communities.

Of the over 500 continental islands in the GBRWHA, Magnetic Island is representative in terms of its dominant granitic geology, but unique in terms of its latitude and climate. Magnetic Island and Gloucester Island are the only substantial continental islands within the Dry Tropics, one of five floristic regions recognized for continental islands in the WHA (Batianoff and Dillewaard, 1995).

Seasonal freshwater wetland,, Horseshoe Bay

The ecosystems of Gloucester Island are, however, more closely related to the islands of the Whitsunday Group, in the Central Queensland Coast bioregion (Young, 1999), and that island is almost entirely composed of bedrock geologies. In contrast, the ecosystems of Magnetic Island are similar to adjacent mainland granitic inselbergs and associated landscapes of the Brigalow Belt North bioregion, such as Cape Cleveland, Cape Upstart and Mount Elliot, and the Island has relatively extensive areas of lowland geomorphologies and ecosystems.

Magnetic Island is particularly valuable for the conservation and study of ecosystems in the wet/dry tropics. This outstanding value largely relates to the diversity and close proximity of these ecosystems on the Island, the extensive and diverse interface between the marine and terrestrial ecosystems, the size of the Island, its relatively good condition in terms of past land uses, weeds and feral animals, and the potential for the Island to be relatively easily managed to contain or reduce the deleterious effects of threatening processes on the natural ecosystems. These values are discussed below.

Diversity and close proximity of ecosystems

The most detailed map of ecosystems for the whole of Magnetic Island is that of Sandercoe (1990), who identifies 23 vegetation types at a scale of 1:25,000. Thirteen of these types are well represented in Magnetic Island National Park or Horseshoe Bay Lagoon Conservation Park, and a further four are contained within the tidal areas of the adjacent Marine Park.

The remaining types are those typical of the lowlands on the Island, including the dune systems, the alluvial fans and piedmont deposits, and the wetlands. Detailed survey of Bolger Bay, the least developed of the major bays of the Island, identified seven different land types within these alluvial and dunal systems (Morgan and Terrey, 2001). Variations of these, and additional types, occur in the other bays of the Island.

Although urban development and past clearing for agriculture means that in some bays much of the natural lowland vegetation has been lost, the presence of significant areas of remnant vegetation on lowlands in even the most developed bays means that the Island still retains much of its natural diversity.

Interface between marine and terrestrial biodiversity

The long shoreline of Magnetic Island, and its many aspects, provides the setting for a diverse range of interactions between the terrestrial and marine environments. Except for the major urban bays of Picnic Bay, Alma Bay and Geoffrey Bay, most of this interface is in relatively good condition. Even in the most populated bay, Nelly Bay, the protection of a small area of dunes and a tidal creek mouth in the Townsville City Council Nelly Bay Habitat Reserve means that a natural component of this interface remains.

Terrestrial/marine interface at Bolger Bay, showing mangroves, salt flats, offshore tidal mudflats, and remnant lowland vegetation.

Magnetic Island is essentially triangular in shape, with northern, south-eastern and south-western coastlines.

The northern coast of the Island is a high energy coastline, with steep rock faces plunging into relatively deep water, broken by small bays of steeply sloping beaches and relatively high sand dunes, or, in the north-west, cobble and pebble shores. Only the more sheltered parts, such as the eastern end of Horseshoe Bay, and the smaller Balding and Radical Bays, have lower dunes and more gently sloping offshore sand flats. Reefs are relatively small and restricted in distribution. Most of this northern coastline is relatively undeveloped, with the exception of the eastern end of Horseshoe Bay.

The south-eastern coastline receives the dominant weather for much of the year, including the winter months. It is also characterized by plunging rock faces, but it also includes a number of bays with beaches with gently sloping offshore sand flats, and with well developed reef in sheltered areas. Although sand dunes back each of the bays, they tend to be less well developed than the northern shore, and, at least in the southern more settled bays of Alma, Geoffrey, Nelly and Picnic, are largely developed for housing or parks.

The sheltered south-western coastline is the most complex, having extensive offshore reef flats, mudflats and seagrass beds at a relatively shallow depth, and extensive mangrove forests. Behind the mangroves, which are zoned according to inundation characteristics and the influence of freshwater from the adjacent island catchments, are flats of hyper-saline clays, vegetated along their landward side by samphires and finally by salt couch, with either a mangrove or *Melaleuca spp.* tree-story. There are also extensive areas of *Elaeocharis spp*. sedgelands. Fringing this tidal or brackish complex is a sequence of dune systems, largely related to prior sea levels. These abut the older alluvial surfaces, but are broken by the younger ones. Most of this shoreline is undeveloped, with the exception of parts of the older dune systems, and the low dunes at West Point on the north-west extremity of the Island.

The size of Magnetic Island

The total area of Magnetic Island is approximately 5184 ha. Batianoff and Dillewaard (1995) found that plant species diversity increased linearly with island size up to 5000 ha., beyond which other factors such as habitat diversity, remoteness, palaeoclimates and fire history begin to play important roles in determining species richness. Similar factors influence faunal diversity, the stability of the population of a particular species being largely related to the territory size, the population size enabled by the extent of suitable habitats, and the threatening processes affecting the habitats or individuals of the species. The potential for interbreeding with other populations, and for recolonization of habitat by the species should it be temporarily depleted or made locally extinct by extreme events such as fire or severe drought, is largely related to the mobility of the species, and the proximity of other populations to provide a source of individuals which can recolonize the vacant niche.

Species data for Magnetic Island is relatively good for birds, plants and the larger mammals, but insects, reptiles, amphibians and the smaller mammals are still only superficially known.

Despite this, 578 native plant species (Jackes, 2003) and 146 native birds (Wieneke, 1996) have been recorded on the Island. Of the birds, 18 are seabirds, 24 are waders and other shore-frequenting birds, and 32 are associated mainly with freshwater wetlands. At least 50 species are considered resident species, and a further 32 are regular summer or winter migrants. Sixteen native mammals, 34 native reptiles and 13 native amphibians have also been recorded (Morgan and Terrey, 2001). Only one species is believed to have become extinct on the Island, the northern quoll *Dasyurus hallucatus* (Johnstone et al., 1968).

The species numbers currently recorded compare favourably with similar mainland ecosystems for the less mobile species, particularly plants (Dillewaard, pers. comm.) and non-bird vertebrates (Kutt, pers. Comm.). As the Island has been isolated from the mainland for at least 6000 years, the species currently present are likely to be able to survive on the Island for the foreseeable future, providing sufficient suitable habitat is maintained and threatening processes are managed. The value of Magnetic Island as a refuge for some of these species is discussed under *Criterion (iv).*

The relatively good condition of Magnetic Island

The relative difficulty of accessing islands compared to accessing mainland areas, usually means that islands tend to be less degraded and are able to be more closely managed. While there are some exceptions to this rule, it is certainly true for Magnetic Island.

Sandercoe (1990) records 45 introduced plant species for the Island, but most of these have a relatively restricted distribution, or are almost invariably associated with disturbed areas (eg. roadside verges). Only mint weed (*Hyptus suaveolens*) and lantana (*Lantana camara)* occur to any great extent in natural areas, although rubber vine (*Cryptostegia grandiflora*) occurs sparsely in remote areas along the northern shoreline. This relatively low proportion of introduced species (approximately 9% of total recorded flora) compares with the mainland average of 13-14% (Johnson, 1983 and 1995).

Feral animals are also limited on the Island, only cats and cane toads being widespread in natural areas. Pigs, although once common on the Island, were eradicated about 20 years ago. Sparrows and Indian mynahs have been recently introduced to the Island but their current very small populations mean that eradication is still possible. Other feral animals present in nearby areas of the mainland, such as dogs, foxes, hares, goats and deer are not on the Island.

Although parts of Magnetic Island have been lightly grazed, cattle have not been grazed on the Island for over 30 years. Most remnant vegetation shows no sign of past grazing, and the surface soils show no signs of compaction from hooves. Such a situation is particularly rare for lowland ecosystems, with similar areas on the mainland usually having a long and continuing history of cattle grazing.

Potential for effective management

Eucalypt dominated woodland on granite foothills

Magnetic Island lends itself to effective quarantine from animal and plants pests, and where non-native species have been introduced, the eradication of these species. The small size of the Island community increases the likelihood of public support for conservative measures, and of the likelihood of their success.

Most of the catchments of the major tributaries on Magnetic Island are within crown land or national park, so that the water quality of these watercourses can be easily maintained.

The limited extent of flat land on the Island means that the ultimate population size of the Island can be kept to a relatively low number, and its impacts on the Island's natural values can be relatively well contained.

The Island provides an outstanding opportunity for strategic conservation initiatives to protect significant World Heritage values through cooperation across all three tiers of government and with private landholders. The protection of the remaining natural areas on the largely freehold lowlands of Magnetic Island is essential for the conservation and on-going evolution of the Island's natural ecosystems, and for the protection of the natural diversity of the Great Barrier Reef World Heritage Area.

Criterion (iii) contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance

Lucas et al. (1997), and most people to visit the area, assert that the Great Barrier Reef World Heritage Area provides some of the most spectacular scenery on earth. However, as noted by Lucas et al. (1997), aesthetic values are not measured by simple reference to scenic beauty. Rather, they require an analysis of the range of values placed on the area by the community. Unfortunately, such a detailed analysis of the aesthetic values of Magnetic Island was unable to be completed within the timeframe of this document. Nevertheless, it can be noted here that studies conducted worldwide provide evidence of the, often immense, contribution of non-marketed goods and services to societal well-being. Using a variety of evaluation tools, it will be possible to estimate the existence and nature of the values of Magnetic Island included in this criterion. Such an analysis is urgently required.

Pending such data for Magnetic Island, initial indications of the perceived importance of the aesthetic values of Magnetic Island are evidenced by opinion surveys. A 1997 Heritage Commission 'Places of the Heart' project identified Magnetic Island as one of the top locations regarded as 'special' in the nation. Similarly, a 2004 survey of 352 national and international visitors to Magnetic Island conducted by Magnetic Island Community Development Association found that the most appealing aspects of the Island were: (1) its relaxed, peaceful, tranquil, quiet nature; and (2) its scenery and beauty. The most common answer to the question on suggested improvements to the Island was to just keep it as it is and not over develop it and let it become spoilt.

Lucas et al. (1997) provide a number of examples of ways in which the GBRWHA meets Criterion (iii), which all apply to Magnetic Island. These include:

- Islands, ranging from towering forested continental islands complete with freshwater streams, to small coral cays with rainforest and unvegetated sand cays
- Coastal and adjacent islands with mangrove systems of exceptional beauty
- The rich variety of landscapes and seascapes including rugged mountains with dense and diverse vegetation and adjacent fringing reefs

- Spectacular breeding colonies of seabirds and great aggregations of over-wintering butterflies.

In the absence of academic data and analysis, the following pictures provide a glimpse of the overwhelming evidence of Magnetic Island's claims against this criterion.

Brilliant yellow kapok flowers stand out against the Island's signature Hoop pines and boulders and frame a spectacular view of Arthur Bay

Imposing formations of weather-cracked rocks tumble down to the often mirror-like waters in all of the Island's 22 bays

Lush understorey vegetation softens the impact of towering bloodwoods and eucalypts

Twisted by the elements, white-trunked Eucalypts make dramatic statements

In summer freshwater streams create cooling waterfalls hidden amongst tumbled boulders

Angular pandanus counter the curves of a spreading canopy on the Island's lowlands

Coexistence of the human and non-human environments – a birdseye view of Picnic Bay

A sheltered cove enjoys respite before the coming storm

Criterion (iv) contain the most important and significant natural habitats for in situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation

Islands provide significant refugia for biodiversity, by virtue of their isolation from many threatening processes. The significant values of Magnetic Island as a refuge for biodiversity and for its *in situ* conservation at the habitat and ecosystem scales, are outlined above. The values of Magnetic Island for the conservation of rare and threatened species, and of other species of conservation significance, are outlined below. As species level surveys on the Island area could at best be termed reconnaisance, this can only be considered a preliminary assessment.

Species of conservation significance include species that are:

- Rare or threatened due to a limited natural distribution
- Endemic to Magnetic Island (i.e. their natural distribution is restricted to the Island)
- Species whose occurrence on the Island is significantly disjunct from their normal distribution
- Species which have declined elsewhere in their range but still remain abundant on the Island
- Species that occur in atypically high abundances compared to other parts of their distribution, suggesting Magnetic Island is a significant population stronghold for the species
- Species whose biology and distribution is very poorly known and sampled across the state, and new records on Magnetic Island represent important new localities

Rare and threatened species

Threatened species include those listed under either the *Queensland Nature Conservation Act (1992)* or the Commonwealth *Environment Protection and Biodiversity Conservation Act (1999).*

Twenty-two terrestrial species of plants and animals recorded on the Island are listed as endangered, rare or vulnerable under the Queensland Nature Conservation Act. The listed animals, which spend all or part of their life cycle on the Island, are:

Sterna albifrons little tern (Endangered)
Delma labialis single-striped delma (Vulnerable)
Esacus neglectus beach stone-curlew (Vulnerable)
Taphozous australis coastal sheathtail bat (Vulnerable)
Acanthophis antarcticus common death adder (Rare)
Accipiter novaehollandiae grey goshawk (Rare)
Collocalia spodiopygius white-rumped swiftlet (Rare)
Ephippiorhynchus asiaticus black-necked stork (Rare)
Haematopus fuliginosus sooty oystercatcher (Rare)
Lampropholis mirabilis saxicoline skink (Rare)
Menetia sadlieri Sadliers dwarf skink (Rare)
Numenius madagascariensis eastern curlew (Rare)
Varanus semiremex rusty monitor (Rare)

The lowlands of the Island provide the major extent or the entire extent of the habitat of most of these species. The Island is a significant refuge for the single-striped delma, the saxicoline skink, Sadliers dwarf skink and the rusty monitor, species with a naturally restricted distribution.

The listed plants are:

Croton magneticus (Vulnerable)
Marsdenia brevifolia (Vulnerable)
Acacia jackesiana (Rare)
Bonamia dietrichiana (Rare)
Cassia sp. (Paluma Range G.Sankowsky+ 450) (Rare)
Corchorus hygrophilus (Rare)
Grewia graniticola (Rare)
Peripleura scabra (Rare)
Solanum sporadotrichum (Rare)

Most of these plants are restricted to the hills of the Island.

Endemic species

Most of the continental islands in the Great Barrier Reef World Heritage Area were only separated from the mainland between 12,000 and 6,000 years ago, and, therefore, generally speaking, have similar plant and animal communities to corresponding environments on the mainland. For example, about 25% of Queensland's vascular flora is known to occur on the continental islands of the Great Barrier Reef World Heritage Area (Batianoff and Dillewaard, 1995), and all of the regional ecosystems listed for the Island are recorded from the mainland (Young et al., 1999).

Consequent to this isolation from the mainland, the smaller islands have tended to lose terrestrial species due to their isolation from sources of replenishment. This is particularly so for larger animal species, and for plant species that are typical of the drier woodlands and forests. In contrast many rainforest species have fruit which are eaten and the seed spread by birds and bats. Plant species loss has been most significant on islands of less than 5,000 hectares (Batianoff and Dillewaard, 1995).

Due to the relatively short time of isolation, endemism in plants on the continental islands cannot be expected to be high. Only three species are known to be endemic, two of which occur in the Whitsunday Region and one in the Wet Tropics Region. Most islands are however only poorly surveyed (Batianoff and Dillewaard, 1995). Sandercoe (1990), who provides the most detailed flora survey information available for Magnetic Island, found ten plants she considered could be new species. These are largely restricted to boulder-strewn slopes or higher parts of the Island, environments that would have been already isolated from comparable habitats prior to the higher sea levels that formed the Island. More recently a possible new species of Tephrosia has been identified on the Island, which, if confirmed, is likely to be an endemic species (Jackes, pers.com.).

The fauna of the continental islands is similarly poorly surveyed, and no comprehensive regional assessments are available. However, one lizard species collected from Magnetic Island is believed to be endemic to the Island. This is Sadliers dwarf skink (*Menetia sadlieri*), which is one of only three Island endemic reptiles in Queensland. In contrast to the plants, Sadliers dwarf skink has a major part of its habitat on the lowlands of the Island. Other endemic fauna species could be expected to occur on the larger continental islands, including Magnetic Island. Such endemic species could be expected to be restricted to rocky habitats, as these have been isolated for extended periods by grassy lowlands prior to sea-level impacts.

Disjunct species

The Island supports a large population of the common death adder, instead of the northern death adder (*Acanthophis praelongus*) which is the death adder species on the adjacent mainland. Recently the legless lizard *Anomalopus gowi* was also caught on the Island. This is a species more typically found inland from the coastal ranges.

Magnetic Island is a nationally significant refugia for the protection and conservation of the single striped delma

Plants that are disjunct from their normal distribution, or occur at the extremity of their range, include *Antidesma ghaesembilla*, *Atalaya multiflora*, *Brachychiton bidwillii*, *Fitzalania heteropetala*, *Glochidion apodogynum* and *Labichea nitida*.

Decliner species and species with atypically high abundances

A number of species that are declining in abundance across much of their range are common on Magnetic Island. These include the common death adder, the rusty monitor and the bush thick-knee or stone curlew (Burhinus grallarius). The beach stone curlew is also declining across its range, but only a small number occur on the Island.

Acknowledgement:

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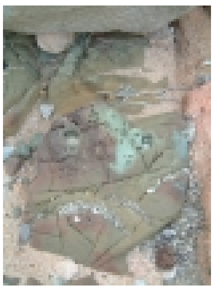

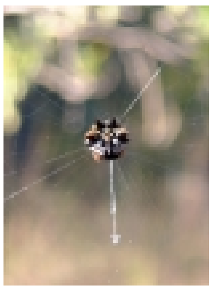

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World Heritage values of Magnetic Island: The marine system

Katharina Fabricius and Gilianne Brodie

Magnetic Island is a high continental island that lies approximately 8 kilometres north of the city of Townsville on the north-western side of Cleveland Bay. It is separated from the mainland by the shallow (<15 m) West Channel. Due to its location in Cleveland Bay, the marine habitats of Magnetic Island are diverse. They are characterised by gradients ranging from very wave-protected shallow muddy environments on the leeward sides to wave-exposed windward coastlines with clearer and deeper water. Associated with the high environmental diversity is a broad range of marine communities, ranging from those that are tolerant of muddy, low light conditions to those that are typically found in less turbid environments.

Magnetic Island's fringing reefs - spectacular species richness

In addition to its recreational and lifestyle value, the marine environment of Magnetic Island provides substantial commercial revenue to the community: with 13 of the 20 larger commercial operators who run attractions on Magnetic Island focusing on marine activities. These activities include diving, snorkelling, boating, sailing, fishing and ecotours to the coral reefs. Maintaining the health of the marine environment around the Island is therefore essential to maintain visitor attractiveness and thus a healthy economy on Magnetic Island.

The Great Barrier Reef and its immediate surrounds were declared a World Heritage Area in 1981, meeting all four of the global Natural World Heritage Criteria. Magnetic Island, together with its associated marine areas, contains a significant number of the highly valued features of the Great Barrier Reef area for which World Heritage status was awarded. These include:

- A range of well-developed nearshore fringing reefs in the bays
- Diverse coral communities around the rocky headlands
- Gorgonian assemblages at the bases of the current-exposed headlands
- Extensive mangrove habitat with associated flora and fauna on the leeward side of the Island
- Wide intertidal mud flats, with a broad range of marine organisms
- Seagrass meadows, containing a wide variety of flora plus vertebrate and invertebrate fauna
- Soft bottom nearshore habitats, forming gradients from very muddy to sandy substrate assemblages.

Marine turtles, sea snakes, several species of whales and dolphins, and the endangered dugong (*Dugong dugong*) are regularly seen in the surrounding waters. The Island's value as dugong habitat has been acknowledged by declaration of the region as a Dugong Protection Area. Several Magnetic Island beaches are also known to be regular nesting sites for the protected Green Turtle (*Chelonia mydas*). Nests of ospreys and white-breasted sea eagles are well established on several headlands and their nesting sites have been continuously used for years if not decades. In addition, many bays are also seasonally inhabited by small flocks of Torres Strait Pigeons, and regularly visited by frigate birds.

This creek mouth at Cockle Bay demonstrates the intrinsic link between Magnetic Island's marine and land systems

Marine systems are intrinsically linked with the adjacent land. Fringing reefs around high continental islands, like Magnetic Island, are quite different to off-shore platform or ribbon reefs (Veron, 1986). This is because of their relative youth in geological terms, and their exposure to natural freshwater, nutrient and sediment runoff from high continental islands onto the surrounding fringing reef. The coral reefs of Magnetic Island are shaped by high water turbidity and relatively storm-sheltered conditions from Cleveland Bay, conditions that are not found on the other high continental islands further north in the same bioregion (eg., reefs of the Palm Islands group have clearer water and greater storm exposure on their windward sides).

The coral reefs of Magnetic Island greatly vary in character and species composition between the windward and leeward sides. On the leeward sides, coral communities are composed of a number of species that are tolerant of high turbidity and sediment deposition (e.g., producing one of the most extensive colony stands of *Montipora digitata* ever recorded on the GBR), whereas on the windward sides, communities are more diverse, and contain several massive coral colonies that are hundreds of years old. Magnetic Island reefs also show more pronounced depth gradients compared with most other reefs of the GBR due to the high water turbidity. For example, the rare soft coral *Nephthyigorgia* sp, that normally only occurs in deep and dark places (Fabricius & Alderslade, 2001), has been recorded at depth of just 8 metres near Florence Bay (and so far nowhere else in the GBRWHA).

A vast stand of Montipora digitata *in Geoffrey Bay*

Cockle Bay's mangroves…

… and immense reef

Cockle Bay, located on the leeward side of Magnetic Island, has received more attention by marine scientists than the other bays, and is presented here in greater detail to illustrate the outstanding biodiversity of marine resources found on Magnetic Island fringing reefs. Like all south-west oriented shores of Magnetic Island, Cockle Bay possesses a fringing coral reef. However, the fringing reef at Cockle Bay differs from the other Magnetic Island reefs in several respects. The Cockle Bay fringing reef is very large (estimated at 265 hectares), including the main and isolated reefs (Collins 1986). By virtue of its topography and leeward aspect, this area includes an extensive intertidal reef flat, seagrass covered mudflats and significant mangrove habitat. Although a large proportion of the biodiversity of Cockle Bay remains undocumented, detailed studies of several groups of the marine flora and fauna in the area have been undertaken [e.g. corals (Mapstone *et al*., 1992), seagrass (Birch & Birch, 1984), fish and crustaceans (Kwak & Klumpp, 2003), squid (Jackson, 1986 & 1991), nematodes (Fisher, 2003a&b)]. In addition, studies of a wide variety of less obvious species groups are published in various forms, with some information more accessible than others (e.g. Mitchell, 1989; Reid, 1996; Brodie *et al*., 1997; Klussmann-Kolb & Brodie, 1999; Steer, 1999; Davies, 2003; Clarke & Brodie, 2003; McKillup & McKillup, 2004). Overall, these studies show that, although Cockle Bay has a history of human disturbance along its extensive intertidal reef flat (as a spoil ground for dredge material from the Townsville harbour shipping channel, substrate removal for a freshwater pipeline, and dumping of the wreck *City of Adelaide*), the biodiversity of some species groups living in the large intertidal reef flat area remains high.

Magnetic Island's marine environment offers a rich diversity of reefal environments along a gradient of exposure to marine and coastal influences

The World Heritage criteria, against which the Great Barrier Reef area is listed, are summarised in a Values Table (Appendix 1). Many of the World Heritage values of the Great Barrier Reef World Heritage Area (Environment Australia, 1981) apply specifically to Magnetic Island. Only a few of the many examples are listed below:

Criterion (i) an outstanding example representing a major stage of the earth's evolutionary history

The World Heritage values of Magnetic Island are reflected in and represented by the following examples:

1. Nine coral reefs reflecting a gradient of exposure to marine and coastal influences and differences in oceanographic processes in their community composition

2. A rugged, rocky shoreline with many small embayments and headlands that represent a complex array of small-scale environmental niches for marine organisms that are relatively inaccessible

Massive colonies of Porites *sp are hundreds of years old*

3. Climate history, environmental conditions and processes extending back over several hundred years are recorded and have been scientifically described from its old massive corals

4. A number of characteristic formations, such as lagoons and dune systems above high tide mark, a number of intertidal and subtidal sediment and mangrove systems, and a range of types of coral reefs and coral communities.

Criterion (ii) an outstanding example representing significant ongoing geological processes, biological evolution and man's interaction with his natural environment

As outlined above, Magnetic Island supports a diverse marine and terrestrial ecosystem, represented by:

1. Heterogeneous and interconnected near-shore fringing reef assemblages
2. Great morphological diversity from small to medium local scales, encompassing the fullest possible representation of marine environmental processes
3. Ongoing processes of accretion and erosion of coral reefs, erosion and deposition processes along the coastline
4. Living coral colonies (including some of the world's oldest)
5. Many representatives of the diverse flora and fauna characterising the Great Barrier Reef.

Criterion (iii) contain unique, rare and superlative natural phenomena, formations and features and areas of exceptional natural beauty

The Great Barrier Reef provides some of the most spectacular scenery on earth and is of exceptional natural beauty. The related World Heritage values of Magnetic Island include:

1. Coastal island systems with mangrove ecosystems of exceptional beauty
2. A rich variety of landscapes and seascapes, including rugged mountains with dense and diverse vegetation and adjacent fringing reefs
3. The abundance and diversity of shape, size and colour of marine fauna and flora in the coral reefs
4. Breeding seabirds
5. Migrating whales, dolphins, dugong, sea turtles, seabirds and concentrations of large fish.

Examples of the exceptional natural beauty afforded by marine environments of Magnetic Island

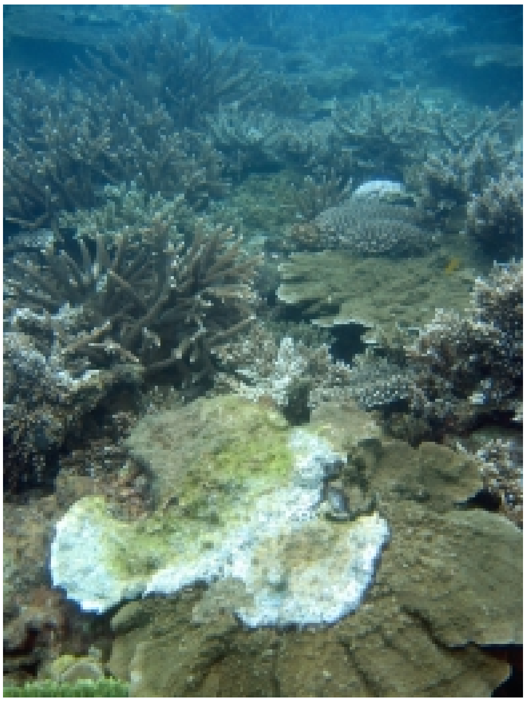
Criterion (iv) provide habitats where populations of rare and endangered species of plants and animals still survive

The Great Barrier Reef contains many outstanding examples of important and significant natural habitats for *in situ* conservation of species of conservation significance, particularly resulting from the latitudinal and cross-shelf completeness of the region. The World Heritage values of Magnetic Island include habitats for species of conservation significance, including:

1. Coral reefs that are structurally and ecologically complex
2. Seabird and sea turtle rookeries, including breeding populations of green sea turtles
3. Seagrass beds
4. Mangroves
5. Inter-reefal and lagoonal benthos.

Threats to the marine World Heritage values of Magnetic Island

Increased runoff of nutrients and sediments has been shown to have detrimental effects on marine systems in many parts of the world. Such effects have been clearly demonstrated at the local scale, eg., in areas where coral reefs and human settlement are in direct or close contact. The soils in the bays of Magnetic Island are sandy, with little storage capacity, and creeks are short. These creeks, and a "leaky" groundwater system are likely to discharge a proportion of the effluents from the Island's numerous septic sewage systems and from its sewage treatment plants. Furthermore, a proportion of the fertilisers and pesticides applied to gardens will be discharged through the creeks, or diffusely through the groundwater system, and are likely to impinge on the fringing reefs. The clearing of native lowland and riparian vegetation for residential and industrial developments, and the straightening or canalisation of some of the creeks additionally increase the discharge of water and pollutants. Scientific studies have shown that higher nutrient availability or enhanced sedimentation along inshore reefs of the GBR lead to: (a) local loss of biodiversity, (b) reduced (or failed) coral recruitment and (c) the replacement of framework-building hard corals by macroalgae or other space occupiers (van Woesik *et al*., 1999, Fabricius & De'ath, 2004). Potential secondary influences of pollution, such as diseases, enhanced survival of crown-of-thorns larvae, and increased growth of reef-eroding organisms, are less understood. However, these processes have profound downstream effects on the wider ecosystem.



Magnetic Island corals are susceptible to diseases when stressed by environmental conditions. This diseased Montipora colony is bound to die within a few weeks

A large number of activities associated with a growing human population further affect the marine system. This includes: enhanced boat traffic, greater recreational fishing pressure, increased reef-walking, snorkelling and diving-related coral damage, and more propeller strikes of marine mammals and turtles through intensifying boat traffic. Thus, the human population on Magnetic Island (both residents and visitors) not only alters the terrestrial system, but also affects the World Heritage values of the marine system surrounding the Island. Unless activities are very carefully managed and further expansion is controlled, irreparable damage may result. For example, the Island supports an active diving industry, which has been successfully capitalising on the fringing reef habitats and biodiversity. Therefore, the long-term preservation of ecological integrity and World Heritage values, by carefully controlled development, is essential to ensure ongoing economic returns to the local community.

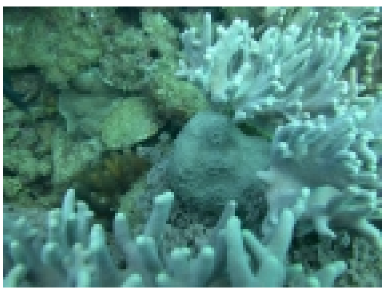
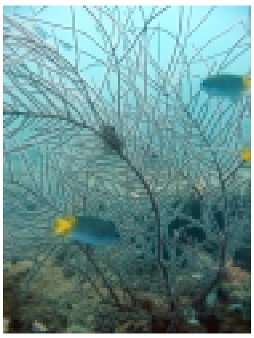
Increasing human population: The direct and indirect effects of a projected increase in the number of people from 2,100 residents and 350,000 visitors per year in 2002 to a projected 12,000 beds for residents and >1 million day visitors per year are manyfold. Unless properly managed, many of the previously mentioned pressures will increase proportionally with the population size. The following table lists the main types of pressures that will increasingly affect the World Heritage values of the marines systems around Magnetic Island.

Pressure	**Effects on marine WH values**
1) Loss of native and riparian vegetation and lowland wetlands	• Increased runoff of nutrients from septic systems and garden fertilizers through the small creeks, and diffusely through the porous sandy soils via groundwater seepage. In Picnic, Nelly, and Geoffrey Bays, the creeks discharge directly onto the coral reefs. • Increasing stormwater runoff due to increasing proportions of sealed surfaces (roads, driveways and houses), compacted soils, straightened creeks and removal of water-retaining vegetation. • Increased industrial development along the south-western coast of the Island eg., Cockle Bay, which is known to have Magnetic Island's largest reef flat, extensive seagrass meadows and mangrove habitat, and is arguably the most diverse of the Island's fringing reef ecosystems.
2) Sewage	• Runoff of nutrients from septic systems and sewage treatment plants directly affect coral reefs and seagrass meadows.
3) Fishing	• Fishing from headlands and from small boats for reef fish and pelagic fish will further reduce fish densities. • Increased use of crab pots in limited mangrove habitats.
4) Boat traffic:	• Small boats: turtle and dugong strikes, anchor damage, discharge of sewage from over-nighting vessels. • Ferries and barges: noise, dugong and turtle strikes (barge: sediment resuspension during unloading and loading in Geoffrey Bay).
5) Road traffic, beach visitation	• Disturbance of female turtles coming ashore, disturbance of turtle nests and hatchling orientation.
6) Solid waste	• Runoff of pollutants from the dump through the small creek and groundwater directly into Picnic Bay,

	possibly transported around the Cockle Bay headland towards the intertidal mudflats and coral reefs on the western side of the Island. • Litter on beaches from both terrestrial and boating activities.
7) Diving, snorkelling, reef walking	• Some breakage of corals, crushing of reef flat organisms.

Deteriorating water quality through activities in adjacent areas: The location of Magnetic Island in the shelter of Cape Cleveland makes this part of the GBRWHA particularly vulnerable to deteriorating water quality, which may be cumulative and may become a chronic pressure if not carefully managed. Although carefully monitored and managed, water quality has been under pressure during the Nelly Bay Harbour construction, as the dredging of the Harbour channel mobilized the fine material washed down from Gustav Creek and deposited it in Nelly Bay and increased the amount of sedimentation discharged onto the coral reefs in Nelly and Geoffrey Bay. Changes in the hydrodynamics in Nelly Bay due to the Harbour are also presently noticeable in Nelly Bay, resulting in large volumes of sediments deposited along the eastern intertidal shores of the bay. The periodical dredging of the Platypus shipping channel also mobilizes sea floor sediments, with unknown longer-term consequences for the eastern coral reefs of Magnetic Island. More chronic exposure arises from Burdekin river plumes, and, potentially, through resuspension from upstream dredge spoil grounds, accidental spills from heavy metal industries within Cleveland Bay, and activities of the Townsville Port.

The coral reefs of Magnetic Island were severely stressed by coral bleaching in 1998 and 2002 and lost a proportion of their coral cover. Macroalgal cover is high, and a dominant feature of the reefs in summer (Vuki & Price,1994). Unless the growing Island population is carefully managed, chronic pressures, such as ongoing exposure to nutrients and sedimentation, which stress corals (Philipp & Fabricius 2003), reduce coral fertilization (Harrison & Ward 2001) and coral recruitment success (Babcock & Smith 2002) and foster algal growth (Schaffelke & Klumpp 1999, Schaffelke 1999), may prevent coral reefs from recovering from acute stresses such as coral bleaching. Consideration of a population cap, monitoring of marine dredging, and appropriate well-managed landuse in the upstream located river catchments will prevent further deterioration of the water quality on and around Magnetic Island.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Statement of Aboriginal Values on Magnetic Island

- The Need for Consideration of Cultural Values in World Heritage Areas

Peter Veth and Melissa George

Although one of the criterion by which the Great Barrier Reef (GBR) was inscribed on the World Heritage List in 1981 notes that human interactions with the natural environment are a consideration, these interactions have only been minimally voiced throughout the history of the listing and management of the GBR.

The need to incorporate broader approaches to the identification and management of World Heritage properties has arisen in the context of the ongoing review of the World Heritage Convention, one aim of which is to provide a single (combined) set of criteria for the assessment of both natural and cultural heritage properties. It is significant that this review follows (1) the report from the Expert Meeting held in Amsterdam in March 1998 to address the specific issue of the relationship between natural and cultural values, and (2) the 1992 amendment to the Convention to allow the inclusion of cultural landscapes as World Heritage properties.

These initiatives at the World Heritage level reflect a series of advances in cultural heritage management practice, including:

1. The recognition of the need to address community/social value
2. The understanding that cultural heritage values can be attached to both tangible and intangible aspects; i.e. practice and tradition also form part of a community's heritage
3. The recognition that natural and cultural heritage values form part of a continuum and are closely linked
4. The recognition that the heritage significance of places is best understood and interpreted through a landscape approach.

The Australia ICOMOS Burra Charter states in Article 1.2 that cultural significance is defined as the 'aesthetic, historic, scientific, social or spiritual value for past present or future generations'. The Article further notes that "Cultural significance is embodied in the place itself, its setting, use, associations, meanings, records, related places and related objects".

More generally, recent interviews by heritage consultants with representatives of Magnetic Island community and a number of relevant government agencies and NGOs reveal that there is a definite concern that the heritage values of the Island will be (further) compromised without a detailed and well-documented approach to protection. For the most part, these concerns arise out of a belief that the values of the Island remain largely unidentified, and consequently are threatened. This submission aims to identify and give voice to significant indigenous values. It firstly considers historic material evidence for Aboriginal occupation and then the contemporary values of the Island for Wulgurukaba. The Wulgurukaba are currently in mediation for the determination of native title on the Island.

Archaeological Historic Values

Magnetic Island has a wide variety of cultural material evidence for past and continuing Aboriginal use of both terrestrial and marine landscapes and resources. It is likely that the groups occupying the Island also had access to the mainland. The different catchments of the generally precipitous and well-wooded Island front onto lower energy mangrove and sandy embayments as well as higher energy rocky foreshores and reef platforms. These resource catchments appear to have been used in a systematic and structured fashion, displaying elements of a tropical hunter-gatherer maritime economy. Interior portions of the Island were also occupied and exploited in a systematic fashion. Importantly, there is evidence of Aboriginal occupation continuing through the time of first contact with Europeans in the latter half of the 19th century. A number of categories of sites and features have been documented during previous archaeological, ethnobotanical, anthropological and community-based studies on the Island. These sites and places are known to, and actively maintained by, Wulgurukaba. They include the following:

- Shell middens. Stratified shell middens likely dating from the mid- to late Holocene are located within all catchments of the Island. Where these mounded and linear middens are relatively undisturbed features such as cooking hearths, stone arrangements, artefact knapping horizons and terrestrial faunal dietary remains can be seen. Middens typically reflect dominant species from different habitats, including mudwhelks and mangrove bivalves from the western low energy embayments, oysters and nerites from the northern and eastern catchments and sand bivalves from the south. Other 'dinner-time' species-specific middens are common throughout most coastal margins, although often in a more disturbed state. Where the largest freshwater sources occur, particularly on the western littoral, the middens are most extensive and take a mounded form (e.g. Ned Lees Creek and Young Bay). Both the large size, diversity of dietary components (shellfish, marine fish, marine mammal and terrestrial fauna) and presence of both flaked and ground stone artefacts (for production and maintenance of wooden implements and food processing) at these larger complexes suggests they are likely to have served more as habitation bases then as temporary camps or, indeed, one-off dinner areas. The Island has a representative sample of the different kinds of middens found along the larger North Queensland coast and the proximal islands lying within the Great Barrier Reef Province.

- Pigment art. Painted panels are known from a number of localities both from the coast and the interior of the Island. These comprise generally geometric or simple figurative monochrome and bichrome motifs, including regional themes such as shields and tracks. They have been produced through the positive application of ochres as used within the larger Cape Cleveland and Mount Elliot area. As they are in more remote locations they have not been impacted.

- Quarry sites. A number of volcanic suites have been actively quarried on the northern sections of the Island. Extensive reduction areas accompany these quarried outcrops – sometimes containing hundreds of thousands of pieces of *debitage* as well as preforms for scraper, blade and axe-production. These materials are commonly found on middens and other occupation sites around the Island. Although some walking trails pass near these sites their overall integrity is high, providing invaluable insights into the systematic procurement, reduction and preparation of stone tools for an intended range of woodworking and food procurement activities.

- Stone artefact scatters. While stone artefacts are associated with many middens, usually in low densities, there are a number of discrete localities where both small to large stone artefact scatters illustrate past habitation, food processing and implement manufacturing activities. The largest known scatters on the coast have likely deflated or been reworked from stratified contexts in dunes and sand sheets (eg. Nelly Bay reef flats) – where the organic component including shellfish may be under-represented (Paradise Beach on Cape Cleveland provides a regional comparison of deflated living floors). Collections made in the Gustav Creek area of Nelly Bay indicate a high density of cultural material representing a range of raw material types – some of which, such as clear quartz, are likely to have been sourced from mainland quarries. The presence of formal artefacts, such as edge ground axes, hatchets, edge-retouched flakes and blades, demonstrates that a range of economic activities have taken place within this embayment, and probably over a considerable period of time given the inferred stratified original context of much of this material. Other scatters are known from the interior, such as the saddles between the upper catchments of Retreat Creek and the Five Bays valleys. These interior scatters contain a range of both formal artefacts and *debitage*, again suggesting systematic occupation and use of the interior.

- Burials. There are a number of known historic Aboriginal burials on the Island. Additionally, Aboriginal skeletal remains have been unearthed during past and present earthworks on the Island (eg. Nelly Bay).

- Fish traps. The remains of a number of putative stone-walled fish traps are located around the Island. Though badly disturbed through the erection of breakwaters and walkways in the late 19th century, these are thought to occur within at least two bays on the Island. Major stone-walled fish traps are recorded from adjacent Hinchenbrook Island.

- Rockshelters with cultural deposits. A considerable number of small rockshelters containing cultural deposits are known from a number of bays and also the upper portions of catchments (eg. Arcadia suburb). Where exposed through natural erosion or human disturbance, these deposits contain the remains of economic shellfish, charcoal from hearths and flaked stone artefacts (including quartz). In several cases the shelters also display pigment art on their walls. Some rockshelter deposits have the ability to provide long-term cultural sequences for Aboriginal occupation of the Island.

- Contact sites. A number of major midden complexes around the Island contain European materials in their upper levels that date to the last half of the 19th century. These materials have been modified in ways consistent with their use as Aboriginal artefacts. The most common category includes glass artefacts made on clear and dark olive bottle glass. These implements have clearly been flaked and in some cases retouched (with signs of utilisation) and are assumed to have been used as a replacement for previous stone and shell artefacts. There is, therefore, evidence for Aboriginal occupation continuing throughout the first period of contact with, and settlement of the Island by, Europeans. Previous habitation sites continue to be occupied throughout the historic period.

- Historic camping and fishing locations. Many coastal sites around the periphery of the Island with evidence of the past extraction, use and consumption of marine resources continued to be used by Aboriginal people during the historic period and are still used in the present.

Magnetic Island hosts a range of cultural landscapes containing a plethora of material evidence for both past and present use of both coastal and interior habitats and resources. These landscapes contain places and sites known to and still visited by members of the Wulgurukaba Community. The full range of social and economic activities are reflected in the suite of large through to task-specific habitation sites and camping areas, the systematic extraction and production of artefacts, the production of pigment art and the trade and exchange of commodities. The Island is therefore highly representative of long-term Aboriginal occupation of a major near-shore island within the Great Barrier Reef Province.

Acknowledgements

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Appendix 1: Environmental Australia: Great Barrier Reef World Heritage Values http://www.ea.gov.au/heritage/awh/worldheritage/sites/gbr/gbr.html

The World Heritage criteria against which the Great Barrier Reef was listed remain the formal criteria for this property. These criteria have been included in the Values Table below. The World Heritage criteria are periodically revised and the criteria against which the property was listed in 1981 are not necessarily identical with the current criteria. Examples of the World Heritage values for which the Great Barrier Reef was listed are included in the Values Table for each criterion. These examples are illustrative of the World Heritage values of the property, and they do not necessarily constitute a comprehensive list of these values.

Natural criteria against which the Great Barrier Reef was inscribed on the WH List in 1981.	Examples of World Heritage values of the Great Barrier Reef for which the property was inscribed on the World Heritage List in 1981.
Criterion (i) an outstanding example representing a major stage of the earth's evolutionary history.	The Great Barrier Reef is by far the largest single collection of coral reefs in the world. The World Heritage values of the property include: • 2904 coral reefs covering approximately 20 055km^2; • 300 coral cays and 600 continental islands; • reef morphologies reflecting historical and on-going geomorphic and oceanographic processes; • processes of geological evolution linking islands, cays, reefs and changing sea levels, together with sand barriers, deltaic and associated sand dunes; • record of sea level changes and the complete history of the reef's evolution are recorded in the reef structure; • record of climate history, environmental conditions and processes extending back over several hundred years within old massive corals; • formations such as serpentine rocks of South Percy island, intact and active dune systems, undisturbed tidal sediments and "blue holes"; • and record of sea level changes reflected in distribution of continental island flora and fauna.
Criterion (ii) an outstanding example representing significant ongoing geological processes, biological evolution and man's interaction with his natural environment. Criterion (ii) an outstanding example representing significant ongoing geological processes, biological evolution and man's interaction with his natural environment.	Biologically the Great Barrier Reef supports the most diverse ecosystem known to man and its enormous diversity is thought to reflect the maturity of an ecosystem, which has evolved over millions of years on the northeast Continental Shelf of Australia. The World Heritage values include: • the heterogeneity and interconnectivity of the reef assemblage; • size and morphological diversity (elevation ranging from the sea bed to 1142m at Mt. Bowen and a large cross-shelf extent encompass the fullest possible representation of marine environmental processes); • ongoing processes of accretion and erosion of coral reefs, sand banks and coral cays, erosion and deposition processes along the coastline, river deltas and estuaries and continental islands; • extensive *Halimeda* beds representing active calcification and sediment accretion for over 10 000 years; • evidence of the dispersion and evolution of hard corals and associated flora and fauna from the "Indo-West Pacific centre of diversity" along the north-south extent of the reef; • inter-connections with the Wet Tropics via the coastal interface and Lord Howe Island via the East Australia current; • indigenous temperate species derived from tropical species;

	• living coral colonies (including some of the world's oldest);
	• inshore coral communities of southern reefs;
	• five floristic regions identified for continental islands and two for coral cays;
	• the diversity of flora and fauna, including:
	• Macroalgae (estimated 400-500 species);
	• Porifera (estimated 1500 species, some endemic, mostly undescribed);
	• Cnidaria: Corals - part of the global centre of coral diversity and including:
	    • hexacorals (70 genera and 350 species, including 10 endemic species);
	    • octocorals (80 genera, number of species not yet estimated);
	• Tunicata: Ascidians (at least 330 species);
	• Bryozoa (an estimated 300-500 species, many undescribed);
	• Crustacea (at least 1330 species from 3 subclasses);
	• Worms:
	    • Polychaetes (estimated 500 species);
	    • Platyhelminthes: include free-living Tubelleria (number of species not yet estimated), polyclad Tubelleria (up to 300 species) and parasitic helminthes (estimated 1000's of species, most undescribed);
	• Phytoplankton (a diverse group existing in two broad communities);
	• Mollusca (between 5000-8000 species);
	• Echinodermata (estimated 800 extant species, including many rare taxa and type specimens);
	• fishes (between 1200 and 2000 species from 130 families, with high species diversity and heterogeneity; includes the Whale Shark *Rhynchodon typus*);
	• seabirds (between 1.4 and 1.7 million seabirds breeding on islands);
	• marine reptiles (including 6 sea turtle species, 17 sea snake species, and 1 species of crocodile);
	• marine mammals (including 1 species of dugong (*Dugong dugon*), and 26 species of whales and dolphins);
	• terrestrial flora: see "Habitats: Islands" and;
	• terrestrial fauna, including:
	    • invertebrates (pseudoscorpions, mites, ticks, spiders, centipedes, isopods, phalangids, millipedes, collembolans and 109 families of insects from 20 orders, and large over-wintering aggregations of butterflies); and
	    • vertebrates (including seabirds (see above), reptiles: crocodiles and turtles, 9 snakes and 31 lizards, mammals);
	• the integrity of the inter-connections between reef and island networks in terms of dispersion, recruitment, and the subsequent gene flow of many taxa;
	• processes of dispersal, colonisation and establishment of plant communities within the context of island biogeography (e.g. dispersal of seeds by air, sea and vectors such as birds are examples of dispersion, colonisation and succession);
	• the isolation of certain island populations (e.g. recent speciation evident in two subspecies of the butterfly *Tirumala hamata* and the evolution of distinct races of the bird *Zosterops spp);*

	• remnant vegetation types (hoop pines) and relic species (sponges) on islands. • evidence of morphological and genetic changes in mangrove and seagrass flora across regional scales; and • feeding and/or breeding grounds for international migratory seabirds, cetaceans and sea turtles.
Criterion (iii) contain unique, rare and superlative natural phenomena, formations and features and areas of exceptional natural beauty.	The Great Barrier Reef provides some of the most spectacular scenery on earth and is of exceptional natural beauty. The World Heritage values include: • the vast extent of the reef and island systems which produces an unparalleled aerial vista; • islands ranging from towering forested continental islands complete with freshwater streams, to small coral cays with rainforest and unvegetated sand cays; • coastal and adjacent islands with mangrove systems of exceptional beauty; • the rich variety of landscapes and seascapes including rugged mountains with dense and diverse vegetation and adjacent fringing reefs; • the abundance and diversity of shape, size and colour of marine fauna and flora in the coral reefs; • spectacular breeding colonies of seabirds and great aggregations of over-wintering butterflies; and • migrating whales, dolphins, dugong, whale sharks, sea turtles, seabirds and concentrations of large fish.

Criterion (iv) provide habitats where populations of rare and endangered species of plants and animals still survive.
Criterion (iv) provide habitats where populations of rare and endangered species of plants and animals still survive.
	The Great Barrier Reef contains many outstanding examples of important and significant natural habitats for *in situ* conservation of species of conservation significance, particularly resulting from the latitudinal and cross-shelf completeness of the region.
	The World Heritage values include:
	• habitats for species of conservation significance within the 77 broadscale bioregional associations that have been identified for the property and which include:
	• over 2900 coral reefs (covering 20 055km^2) which are structurally and ecologically complex;
	• large numbers of islands, including:
	    • 600 continental islands supporting 2195 plant species in 5 distinct floristic regions;
	    • 300 coral cays and sand cays;
	    • seabird and sea turtle rookeries, including breeding populations of green sea turtles and Hawksbill turtles; and
	    • coral cays with 300-350 plant species in 2 distinct floristic regions;
	• seagrass beds (over 5000km^2) comprising 15 species, 2 endemic;
	• mangroves (over 2070km^2) including 37 species;
	• *Halimeda* banks in the northern region and the unique deep water bed in the central region; and
	• large areas of ecologically complex inter-reefal and lagoonal benthos; and
	• species of plants and animals of conservation significance.

Further information relevant to the World Heritage values of the Great Barrier Reef may be found in Great Barrier Reef Marine Park Authority (1981), Lucas *et al*., 1997 and Wachenfeld *et al*., 1998.

June 2004