



Australian Government
Director of National Parks



Pulu Keeling National Park



MANAGEMENT PLAN 2015-2025



Pulu Keeling National Park



M A N A G E M E N T P L A N 2 0 1 5 - 2 0 2 5

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This management plan sets out how the park will be managed for the next 10 years under the *Environment Protection and Biodiversity Conservation Act 1999*.

A copy of the plan is available online at:
environment.gov.au/topics/national-parks/parks-australia/publications

Foreword

Pulu Keeling National Park is one of the Australian Government's smallest national parks; nevertheless, it is a place of considerable international conservation significance. As an isolated coral atoll in an almost natural state, its relatively pristine environment is a valuable biological asset and an increasingly scarce feature in the tropics.

The park was established on 12 December 1995 and comprises North Keeling Island and its surrounding marine waters within a roughly rectangular boundary, framing 2,602 hectares of land and sea. The park is a Commonwealth reserve under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and is managed in accordance with the Act and the regulations made under it.

Pulu Keeling National Park is an internationally recognised seabird rookery and is listed as a Wetland of International Importance under the Ramsar Convention. It supports one of the world's largest populations of the red-footed booby, *Sula sula*. It is also home to the endemic Cocos buff-banded rail, *Gallirallus philippensis andrewsi*, which is listed as endangered under the EPBC Act, and the Cocos angelfish, *Centropyge jocularis*, which is endemic to both Christmas and Cocos (Keeling) Islands. The park supports at least 26 species of crabs, including several species of hermit crabs (terrestrial and aquatic), the red spider crab (*Schizophrys aspera*), swimmer crabs (*Thalamitoides quadridens*) and the coconut or robber crab (*Birgus latro*), which was formerly abundant on the southern atoll but is now rare or absent (Bunce 1988). Green turtles (*Chelonia mydas*), listed as vulnerable under the EPBC Act, nest on North Keeling Island and hawksbill turtles (*Eretmochelys imbricata*) occur in the waters of the park. Three other of the world's seven marine turtle species visit from time to time. Two species of dolphin are regularly seen in the park, which has a healthy fish fauna with substantial populations of butterfly fish and sharks.

Pulu Keeling's forests and other native flora are examples of the original vegetation of the region and include a number of species no longer found elsewhere in the Cocos (Keeling) Islands.

This third management plan for Pulu Keeling National Park has been prepared in accordance with the EPBC Act and through the engagement of and consultation with the local community, as well as off-island stakeholders (including scientists and researchers) and the broader Australian public. This includes two publicly advertised opportunities to provide written comments towards the development of the plan.

The plan takes into account the comments arising from these consultation activities and will guide the conservation and management of this small, unique and significant national park for the next 10 years. Pulu Keeling National Park will be managed to preserve its flora, fauna and marine environment, ensuring that the park's ecological condition is maintained, while providing some opportunities for limited and controlled visitor access.

Sally Barnes
Director of National Parks

Acknowledgments

The Director of National Parks is grateful to the individuals and organisations who contributed to this management plan, in particular the Pulu Keeling National Park Community Management Committee, those who responded to the call to 'Have Your Say' and those who provided comments on the draft management plan for the park.

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Executive summary

Introduction

Pulu Keeling National Park protects the natural and cultural values of North Keeling Island, an uninhabited low-lying tropical oceanic coral atoll, and its surrounding marine waters within a roughly rectangular boundary framing 2,602 hectares of land and sea. The coastal waters of the island are home to a unique array of fish and coral species. North Keeling Island forms part of the Cocos (Keeling) Islands, located approximately 2,900 kilometres north-west of Perth.

The park is one of the few remaining relatively pristine tropical islands in the Indian Ocean region. It contains rare ecosystems, as it is the only largely undisturbed island in the Cocos (Keeling) Islands group that retains its original ecosystems and their species. Because of its isolation, evolution and relatively minimal human impacts on its condition, the park is significant to studies of the distribution of oceanic island species and atoll formation.

North Keeling Island's forests and other native flora are examples of the original vegetation of the region and include a number of species no longer found elsewhere in the Cocos (Keeling) Islands.

The park performs an important role preserving examples of the natural features of the Cocos (Keeling) Islands as they would have occurred prior to human disturbance. These features include:

- relatively pristine ecosystems and habitat of high significance for Indian Ocean seabirds, playing a vital part in the stability of the Indian Ocean seabird biota
- one of the largest known nesting habitats for the red-footed booby in the world
- unusual closed canopy forests comprising species generally found as stunted shrubs in successional forests on the shoreline of tropical islands elsewhere in the region
- habitat for 10 species listed as threatened under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) including:
 - the buff-banded rail (*Gallirallus philippensis andrews*), listed as endangered under the EPBC Act and restricted to this island
 - the green turtle (*Chelonia mydas*), listed as vulnerable under the EPBC Act, nests on the island's beaches
- habitat for the robber crab (*Birgus latro*), recognised for its conservation significance on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species.

The island is significant to studies of island biogeography because of its evolution in isolation. The Cocos (Keeling) Islands were the only coral atolls visited by Charles Darwin in the 1830s. The assemblage of flora and fauna observed by Darwin on the Cocos (Keeling) Islands is now found only on North Keeling Island.

Management of the park

Pulu Keeling National Park was proclaimed on 12 December 1995. The park is a Commonwealth reserve under the EPBC Act and is managed by the Director of National Parks in accordance with the Act, the regulations made under it, and this management plan.

This plan sets out how the park and its natural and cultural values will be managed, protected and conserved for the next 10 years.

Natural heritage management

Natural heritage management within the park is primarily focused on biodiversity monitoring and management of invasive species, with some limited opportunities for research. Limitations in accessing the park during the year make comprehensive on-ground management difficult to achieve, but also reduce the likelihood and impacts of threats.

The park is home to thousands of migratory birds and is listed as a Wetland of International Importance under the Ramsar Convention. Monitoring of bird populations in the park is ongoing, with particular attention given to the red-footed booby population.

Recent studies of fish species observed in the park provided a baseline list of 201 species of fish from 41 families. This list is likely to significantly lengthen in future surveys. Monitoring of the health of coral within the park will also continue.

During the life of the previous plan, the central lagoon closed to the sea due to natural deposition of sediment. This natural change in ecological character has impacted on the biodiversity of the park, removing habitats for some species (particularly marine species within the lagoon) and providing new opportunities for others. As a result, ongoing change in the distribution, abundance and health of species within the park will need careful monitoring.

Six exotic or naturalised plant species occur on North Keeling Island. A survey program (the Island Wide Survey) which includes a weed-mapping component was initiated in late 2009 and repeated in 2012; this will guide future weed management programs.

The invasive yellow crazy ant (*Anoplolepis gracilipes*) is found across the island and is a possible threat to the *Pisonia grandis* forest – as yellow crazy ants are associated with large populations of scale insects, particularly *Pulvinaria urbicola*, that are also implicated in the canopy dieback of pisonia. While such scale has not been detected in the park, careful biosecurity measures and monitoring need to be undertaken to ensure accidental introduction of scale insects and other foreign and invasive species, such as rats and weeds, does not occur.

Cultural heritage management

The park is listed for its natural and cultural heritage significance as a place on the Commonwealth Heritage List under the EPBC Act because of the park's:

- importance in the course, or pattern, of Australia's natural or cultural history
- possession of uncommon, rare or endangered aspects of Australia's natural or cultural history
- potential to yield information that will contribute to an understanding of Australia's natural or cultural history
- importance in demonstrating the principal characteristics of:
 - a class of Australia's natural or cultural places; or
 - a class of Australia's natural or cultural environments.

Three Malay graves from the late 19th century are located near the southern shore of the island. In addition, the park contains evidence of simple base camps inhabited during early coconut and wildlife collecting trips.

The remains of the World War I German raider SMS *Emden* lie on the reef off the southern end of the island. The *Emden* is a historic shipwreck under the *Historic Shipwrecks Act 1976*, and a protected zone has been declared around it under that Act. An abandoned and inoperable small-gauge railway, once used by salvage teams to transport material from the wreck across the island, remains on the island.

These and other less tangible cultural sites will be monitored and maintained during the life of the plan.

Use and appreciation of the park

Due to the sensitivity of North Keeling Island's wildlife, the foremost management objective of this plan will be the protection and conservation of the island and its wildlife. The island's remoteness, difficulty to access and dependency on favourable weather conditions also constrains the number and type of people who can visit the park. Any visitation may be done in accordance with a permit, and this management plan also allows for commercial tours to be conducted in the park under a permit issued by the Director.

Ongoing effective communication of the conservation values of the park is essential to maintain community awareness of relevant conservation issues, including the fragility of the island's natural ecosystems and its vulnerability to human impacts and invasive species threats.

Stakeholders and partnerships

The Director of National Parks is assisted in the management of the park by Parks Australia, a division of the Australian Government Department of the Environment. Parks Australia will work with relevant stakeholders and organisations to develop partnerships and whole-of-government approaches for implementing this plan, addressing regional conservation issues and other issues of mutual interest.

Community and stakeholder contributions to the management of the park will continue to be facilitated under this plan, particularly through the continuation of the Pulu Keeling National Park Community Management Committee, providing and supporting educational activities, employment of island residents and appropriate volunteer activities.

Compliance with relevant legislation

The EPBC Act prohibits certain activities being undertaken in the park except in accordance with a management plan. New activities not described or foreseen in this plan need to be assessed to determine whether they will impact on the park. Provision is made in this plan to enable the Director to take or authorise action in response to proposed new activities and issues not currently specified in the plan.

Review of this plan

Before the fourth management plan for the park is prepared, this plan will be evaluated to determine how effective and efficient it was in achieving its intended objectives and contributing to managing the values of the park.

Executive summary in Cocos-Malay

Ringkasan Penting Pengurusan

Pendahuluan

Taman Negara Pulu Keeling melindungi nilai-nilai semulajadi dan kebudayaan Pulu Keeling. Ia adalah satu pulu yang tidak ada orang tinggal, pulu karang laut tropika yang rendah. Watasan laut dan tanah taman adalah sebesar 2,602 hekta. Laut dibagian pingiran Pulu Keeling adalah rumah untuk banyak jenis ikan-ikan dan batu karang. Pulu Keeling terpisah dari kumpulan pulu-pulu Cocos dan berada 2,900 kilomita disebelah utara-barat Perth.

Taman Negara Pulu Keeling adalah satu dari pulu-pulu yang asli yang masih tertinggal disebelah Lautan Hindia. Ia ada ekosistem yang istimewa sebab ia adalah pulu yang tidak banyak terubah dikumpulan pulu-pulu Cocos. Pulu ini masih ada ekosistem asli dan spesis-spesisnya. Ini terjadi kerana pulu ini terpisah, evolusi dan kesan manusia yang sedikit yang tidak banyak merubah keadaanya, taman amat penting untuk pembelajaran dalam bagaian persebaran spesis pulu lautan dan bagaimana pulu-pulu terjadi.

Hutan dan tumbuhan (pokok-pokok) diPulu Keeling adalah contoh tumbuhan asli diwatanan sebelah sini dan termasuk spesis-spesis yang tidak ada lagi diwatanan lain pulu-pulu Cocos.

Taman Negara jalankan tugas yang penting dalam memelihara contoh-contoh sifat semula jadi dikepulauan Cocos yang pernah ada sebelum manusia datang dan merubahnya. Sifat-sifat ini termasuk:

- ekosistem yang hampir sempurna dan habitat (tempat tinggal spesis) yang penting untuk burung-burung laut dilautan Hindia, juga ada tugas penting untuk kestabilan ini.
- salah satu tempat burung besarang terbesar burung Booby Berkaki Merah (Burung Putih) didunia.
- hutan yang atasnya tertutup yang jarang ada dan spesis-spesis yang biasanya ditemui dipokok pokok rendah dipingir laut tempat tempat dilautan Hindia
- habitat untuk 10 spesis yang ada didaftar spesis yang terancam di bawah (Undang-undang *Pemuliharaan Biodiversiti dan Perlindungan Alam Sekitar 1999* (Undang-undang EPBC) termasuk:
 - Ayam Hutan (*Gallirallus philippensis andrews*), diliskan sebagai terancam dibawah (Undang-undang EPBC and hanya ada dipulu ini
 - Penyu Betul (*Chelonia mydas*) diliskan sebagai spesies mudah diserang
- habitat untuk Udang Darat (*Birgus latro*), perlu untuk pemuliharaanya yang disokong oleh IUCN (Kesatuan Pemuliharaan Dunia)

Pulu adalah penting untuk kajian kajian pasal biogeography pulu-pulu disebabkan evolusinya yang bejalan secara terpisah. Pulu Cocos Keeling adalah satu satunya pulu karang yang dilawat of Charles Darwin ditahun 1830an. Kumpulan binatang dan pokok pokok yang pernah ditengok oleh Darwin sekarang hanya ada diPulu Keeling.

Pengurusan taman negara

Taman Negara Pulu Keeling telah diisytiharkan pada 12 December 1995. Taman adalah perbatasan penjagaan alam Komonwel dibawah Undang-undang EPBC dan djaga oleh Direktur Taman-Taman Negara mengikut undang-undang dan juga pelaturannya dan renchana pengurusan.

Renchana kasi tahu bagaimana taman dan nilai-nilai semulajadi dan kebudyanya dijaga untuk selama 10 tahun.

Pengurusan warisan semulajadi

Pengurusan warisan semulajadi didalam taman banyak ditujukan kepada pengawasan biodiversiti dan pengurusan spesis-spesis yang mengganggu, dengan kesempatan sedikit untuk pembelajaran. Akses yang agak susah atau tidak tentu untuk pergi ditaman dalam beberapa masa dalam setahun membuat pengurusan yang lebih luas susah untuk dibuat, tapi ini membantu mengurangkan gangguan-gangguan.

Taman adalah rumah buat ribuan burung yang berpinda-pinda (migratory) dan ia juga didaftarkan sebagai tanah-tanah basah (wetland) penting antarabangsa diPerjanjian RAMSAR. Pengawasan hidupan burung ditaman adalah berterusan, dan perhatian diberi kepada burung Booby Berkaki Merah.

Kajian yang baru dijalankan berkenaan spesis-spesis ikan ditaman menunjukkan yang 201 jenis ikan dari 41 Keluarga (Family) ada dan didaftarkan dibagian Pulu Keeling. Daftar ini akan bertambah panjang bila kajian dibuat dimasa hadapan. Pengawasan pasal kesihatan karang-karang laut juga terus dijalankan.

Dilalam masa Renchana yang lepas, teluk (lagoon) tertutup di bagian laut disebabkan proses semulajadi pasir-pasir (sediment). Pertukaran sifat-sifat ekologi secara semulajadi ada kesan terhadap biodiversiti ditaman. Contohnya kurangnya habitat buat beberapa spesis (seperti spesis lautan dalam teluk) tapi kasi kesempatan buat spesis lain. Jadi pertukaraan yang berterusan dari segi persiaran, banyaknya dan kesihatan spesis dalam taman perlukan pengawasan yang rapi.

Ada enam spesis tumbuhan luar yang sudah ada diPulu Keeling. Program Survey Pulu yang ada membuat map tumbuhan mula dibuat ditahun 2009 dan dibuat lagi ditahun 2012. Survey ini akan kasi haluan buat program kurangkan pokok-pokok mengganggu untuk masa hadapan.

Semut Gila Kuning (*Anoplolepis gracillipes*) yang mengganggu ada diseluruh taman dan ia boleh merusakkan hutan pokok ampol, Semut Gila Kuning biasa berkumpul dengan kutu-kutu pokok (scale insect) seperti spesis *Pulvinaria urbicola* yang bertanggung jawab merusakkan daun-daun pokok ampol. Biar pun spesis kutu belum ada ditaman, penjagaan dan pengawasan biosecurity rapi diperlukan untuk memastikan spesis ini dan juga spesis mengganggu lain seperti tikus dan pokok pokok tidak datang secara tidak sengajak.

Pengurusan warisan kebudayaan

Taman didaftarkan kerana kepentingan warisan semulajadi dan kebudayaannya sebagai satu tempat diDaftar Warisan Kommonwel dibawah Undang-undang EPBC sebab:

- Kepentingan dalam haluan dan macamnya (pattern) buat sejarah semulajadi dan kebudayaan Australia
- Adanya bagian/sifat sejarah semulajadi dan kebudayaan Australia yang jarang dan dalam kesusahan
- Mungkin boleh kasi keterangan yang boleh membantu untuk mengerti sejarah semulajadi dan kebudayaan Australia
- Penting dalam menunjukkan ciri-ciri asas bagi:
 - satu klas buat tempat semulajadi dan kebudayaan Australia
 - satu klas buat alam sekitar semulajadi dan kebudayaan Australia

Tiga kuburan Melayu dari abad kesembilanbelas ada dekat piggir laut sebelah selatan. Dan lagi taman ada bekas-bekas pondok yang dipakek untuk ambik kelapa dan binatang dimasa yang dulu.

Bekas kapal SMS *Emden* German waktu Perang Dunia yangg Pertama ada dibaria karang bagaian selatan. Kapal *Emden* adalah bekas kapal laut bersejarah dibawah *Historic Shipwrecks Act 1976* dan watasanya (zone) juga dilindungi. Satu jalan rel kecil yang ditinggalkan dan tak boleh dipakak lagi masih ada dipulu. Jalan rel ini dulu dipakek untuk bawak barang barang dari kapal.

Ini semua dan peninggalan tempat kebudayaan yang lain akan diawasi dan dijaga waktu Renchana ini dijalankan.

Kegunaan dan penghargaan taman

Disebabkan hidupan liar sensitif Pulu Keeling, tujuan pengurusan yang paling penting adalah pemuliharaan dan perlindungan pulu dan hiduppannya. Pulu yang jauh dan susah akses dan berharap pada cuaca yang baik membuat susah untuk banyaknya dan macam orang yang boleh melawat ditaman. Setiap pelawatan mesti mengikut pelaturan permit, dan renchana ini juga kasi kebenaran untuk perlanccungan secara kommersel dijalankan ditaman gunakan permit yang disahkan dari Direktur.

Pengomongan baik yang selalu dijalankan pasal nilai-nilai pemuliharaan taman adalah amat penting untuk pastikan supaya masyarakat tahu pasal pasal pemuliharaan, termasuk ekosistem semulajadi pulu yang senang rusak dan boleh terganggu disebabkan oleh perbuatan manusia dan anchaman dari spesis-spesi yang mengganggu.

Stakeholders dan kerja sama

Direktur Taman-taman Negara dalam tugas pengurusan pulau dibantu oleh Parks Australia, satu divisi dari Departmen Alam Sekitar Australia. Parks Australia akan berkerja sama dengan stakeholders dan organisasi- organisasi untuk membuat kerjasama untuk menjalankan renchana ini, bekerja untuk selesaikan isu-isu pemuliharaan watasan dan pekara-pekerja yang kenak menganak dengan semua.

Bantuan masyarakat dan stakeholders akan terus dijalankan dalam renchana ini, terutamanya dengan bekerja dengan PKNPCMC, kasi dan bantu buat aktiviti-aktiviti pembelajaran, kasi penduduk pekerjaan dan aktiviti-aktiviti sukarela yang yang kenak.

Pengikutan dengan undang undang

Undang-undang EPBC melarang seberapa aktiviti dari dijalankan ditaman kecuali kalok mengikut pelaturan renchana pengurusan. Aktiviti-aktiviti baru yang tidak disebut atau dilihat didalam renchana akan diperiksa untuk pastikan apa ia boleh mengganggu taman atau tadak. Ada bagian renchana ini yang benarkan Direktur merekenkan jawapan untuk aktiviti-aktiviti dan isu-isu yang tidak disebutkan dalam renchana.

Pemeriksaan renchana

Sebelum renchana pengurusan yang nomor empat dibuat, renchana ini diperkisa untuk pastikan berapa effective dan bagus ia dapatkan tujuan yang ditetapkan dan cara ia membantu mengurus nilai-nilai taman.



Vision and values of Pulu Keeling National Park

Vision and values of Pulu Keeling National Park

Park vision

Pulu Keeling National Park continues to be recognised for its natural, cultural and scientific values, as an isolated atoll with largely intact marine, terrestrial and wetland ecosystems, with minimal human impact upon its natural condition.

Park values

Pulu Keeling National Park is an uninhabited low-lying tropical oceanic coral atoll, mostly covered by sand and fragments of coral and pumice, on top of an old volcanic seamount that rises from a depth of 5,000 metres.

The park includes all of North Keeling Island, a land area of 1.2 square kilometres and a central lagoon wetland, and surrounding marine waters extending 1.5 kilometres from the island's shore.

The park was proclaimed in December 1995 for the purposes of:

- The preservation of the area in its natural condition
- The encouragement and regulation of the appropriate use, appreciation and enjoyment of the area by the public.

The land area of the park falls within the Indian Ocean Tropical Islands bioregion under the Interim Biogeographic Regionalisation for Australia. The marine waters of the park fall within the Christmas Island Province marine bioregion.

Natural values

- ***The park contains internationally significant habitats and biodiversity.***
 - The park is in a relatively pristine state and supports rare and original ecosystems and their species; it includes terrestrial, wetland and marine habitats.
 - The park preserves terrestrial plant communities that are the last intact remnants of the original Cocos (Keeling) Islands plant communities.
 - The park supports the most diverse seabird populations in the Indian Ocean and is the only seabird rookery within a radius of 900 kilometres.
 - The park supports coconut trees that are considered to be the most primitive form of the species.
 - The park supports globally threatened species (green and hawksbill turtles) and two endemic subspecies (Cocos buff-banded rail and Cocos subspecies of pandanus).
 - The park supports a diverse fish fauna including hybrid fish, with substantial populations of butterfly fish and sharks.

Cultural values

- *The park contains relics and remains from human activities undertaken early last century, and an internationally significant shipwreck: the SMS Emden.*
 - The park contains sites of social and historical significance, including the wreck of a German raider, the SMS *Emden*, sunk by the HMAS *Sydney* in 1914, the first naval engagement for the Royal Australian Navy.

Objectives of the plan

Based on the park's values the objectives for management of the park are:

- The park's natural values are protected and conserved
- There is a greater understanding of marine and terrestrial ecosystem diversity, processes, values and threats to inform conservation management decisions
- The park's cultural values are protected and conserved
- A limited range of opportunities are available during the life of the plan for rare, unique, educational and safe natural and cultural-focused experiences without disturbing park values
- Cooperative and productive partnerships with stakeholders help address the prescriptions of this plan and issues of mutual interest
- Appropriate management actions are implemented to support the administration, management and protection of the park.

The park's values provide the basis and rationale for the management of the park and underpin this plan's objectives, policies and actions.

The management prescriptions in this plan contribute to achieving the objectives for the management of the park. These objectives support the purpose for which the park was declared and conservation of the park's values and ensure the park is managed consistently with the assigned International Union for the Conservation of Nature (IUCN) categories. The conditions of the Lease for the park (to the Commonwealth) require this plan to take into account and incorporate world-class park management practices. For further information on the lease arrangements for the park, see Section 6.1, Community, stakeholder and partnerships.



Each year thousands of red-footed boobies gather to nest on North Keeling Island



Management plan for Pulu Keeling National Park

1. Introductory provisions

1.1 Short title

This management plan may be cited as the Pulu Keeling National Park Management Plan.

1.2 Commencement and termination

This management plan will come into operation following approval by the Minister under s.370 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), on a date specified by the Minister or the day after it is registered under the *Legislative Instruments Act 2003*, whichever is later, and will cease to have effect 10 years after commencement, unless revoked sooner or replaced with a new plan.

1.3 Interpretation

Definitions of terms, concepts, legislation and acronyms used in this plan are provided in Appendix A.

1.4 Planning process and legislative context

A summary of the legislative context under which this management plan was prepared is provided at Appendix B, including a description of the legislative basis for the establishment of the park and a description of international conservation agreements applicable to the management of the park.

2. IUCN category

The International Union for the Conservation of Nature (IUCN) categorisation and zoning scheme for the park takes into account the requirements of the EPBC Act and the Environment Protection and Biodiversity Conservation Regulations 2000 (EPBC Regulations), including relevant reserve management principles; and regional conservation strategies aimed at conserving biodiversity through such things as protection of threatened species and habitat and conservation of the marine environment.

2.1 IUCN category and zoning

Background

The IUCN defines a protected area as 'an area of land and/or sea specifically dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means'.

The EPBC Act requires this management plan to assign the park to one of the Australian IUCN categories prescribed in the EPBC Regulations (which correspond to the IUCN categories). The EPBC Act also allows a management plan to divide a reserve into zones and to assign the zones to an IUCN category, which may differ from the overall category of the reserve. The EPBC Regulations (Schedule 8) prescribe the Australian IUCN reserve management principles for each of the seven Australian IUCN categories.

Issues

- The EPBC Act requires that the park and any zones into which it is divided are assigned to an appropriate IUCN category.
- The terrestrial and marine areas of the park have different management requirements and vulnerabilities. An appropriate IUCN management category needs to be assigned to each zone.

What we are going to do

Policies

2.1.1 The park is assigned to Australian IUCN category Ia (strict nature reserve).

2.1.2 The park is divided into two zones:

1. Strict Nature Reserve Zone:

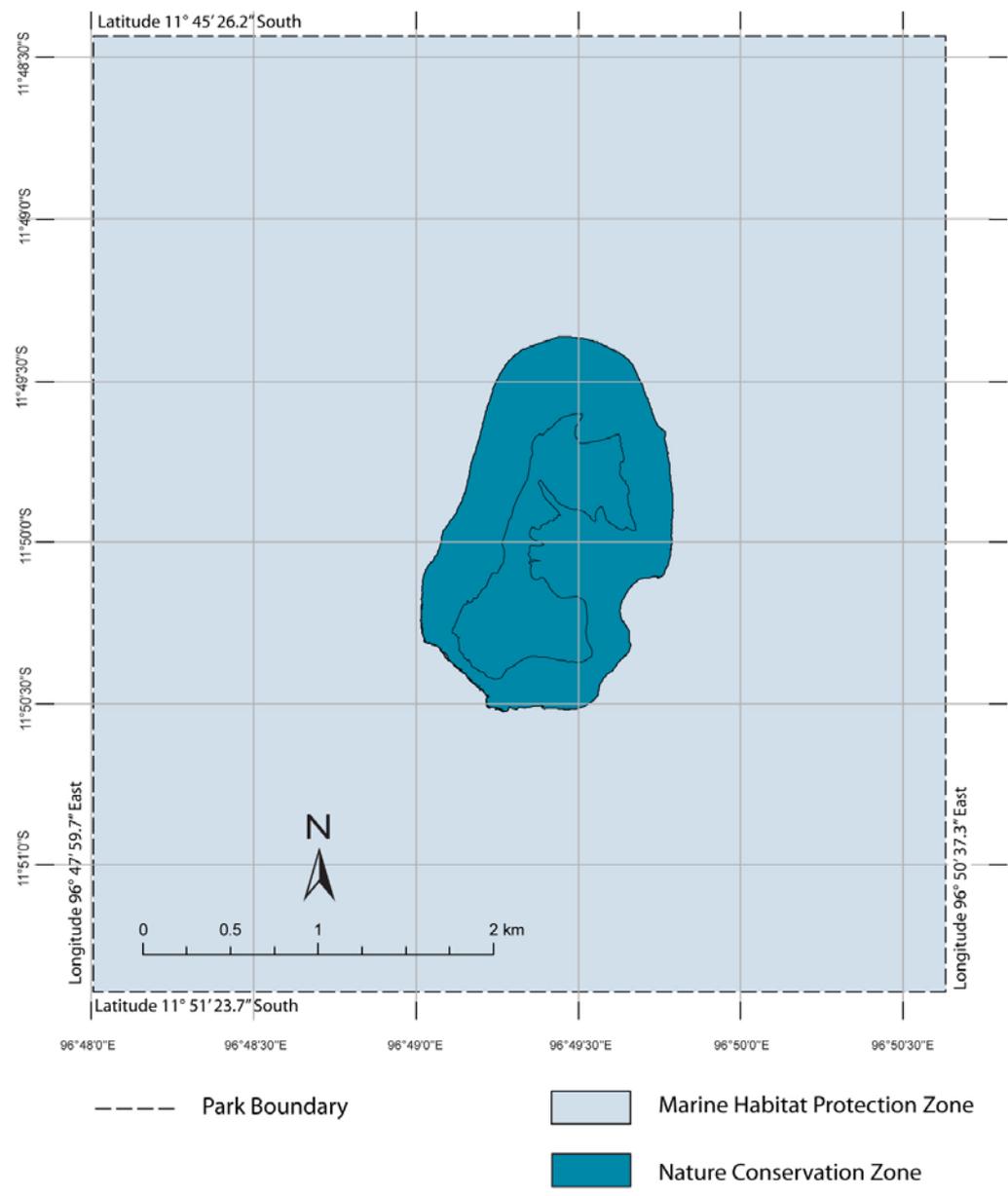
- (a) assigned IUCN category Ia (strict nature reserve)
- (b) consisting of the terrestrial area of the park to the low water mark, including the lagoon area

2. Marine Reserve Zone

- (a) - assigned IUCN category II (national park)
- (b) - consisting of the marine component of the park from the low water mark.

Map 1 indicates the areas covered by each zone. A description of the features of each zone and a summary of activities appropriate for each management zone appears as Appendix C.

Map 1: Management zones at Pulu Keeling National Park



3. Natural heritage management

Objectives

- The park's natural values are protected and conserved
- There is a greater understanding of marine and terrestrial ecosystem diversity, processes, values and threats to inform conservation management decisions.

Performance indicators

The following indicators will be used under this plan to measure performance in natural heritage management:

- Area of *Pisonia grandis* is maintained
- Abundance of red-footed booby and the Cocos buff-banded rail is maintained
- Yellow crazy ant and coral berry distribution is reduced
- No new invasive species establish
- Cover of healthy coral reef habitat in the park is maintained
- Extent to which management plan research and monitoring priorities are implemented.

3.1 Terrestrial ecosystems and species

Background

Values

Given the extensive modification of the vegetation of the southern atoll for coconut plantations and settlements, the vegetation of North Keeling Island is now particularly significant as the last intact remnant of the original Cocos (Keeling) Islands flora.

The forest vegetation is dominated by tall pisonia (*Pisonia grandis*) and coconut (*Cocos nucifera*) with small amounts of ironwood (*Cordia subcordata*) and other species. The forest is fringed on the lagoon shore by tea shrub, *Pemphis acidula*, and on the exposed ocean shores by octopus bush (*Argusia argentea*) shrubland. Each of these vegetation communities supports breeding colonies of seabirds. See also Map 4.

The island is a key breeding site for red-footed boobies, a listed migratory species under the EPBC Act, and listed under international migratory bird agreements including JAMBA and CAMBA. The environmental assessment and approval provisions of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) apply to any actions affecting listed species.

The island is also the main refuge of the Cocos buff-banded rail, *Gallirallus philippensis andrewsi*, an endemic subspecies which was listed as endangered in 1998. Monitoring of buff-banded rail populations indicated they are stable.

The key objectives of the National Recovery Plan for the Buff-banded Rail (Commonwealth of Australia. (2006)) are the establishment of a suitable habitat for a second viable population in the southern atoll and the reduction of threats to the species across the island group. In 2013 the reintroduction of the buff-banded rail to the southern atoll was initiated (see page 58 for details).

North Keeling Island supports several species of land crabs, including the robber crab (*Birgus latro*). Like the seabird colonies, this species requires careful management consideration.

The whole of Pulu Keeling National Park was listed as a Ramsar Wetland of International Importance in 1996. As a consequence, the content of this management plan also provides for the management of the Ramsar site, monitoring, protecting and conserving the ecological character of the site. The prescriptions within this management plan are consistent with Australian Ramsar management principles and other relevant obligations under the EPBC Act for maintaining the values and ecological character for which the park has been listed.

Threats

North Keeling Island is one of the few seabird colonies in the Indian Ocean as yet unaffected by vertebrate pests, such as cats and rats. The vulnerability of seabird colonies to introduced animals is well documented (Director of National Parks 2014). The protection of the island against the accidental introduction of exotic animals or diseases is paramount.

Six exotic or naturalised plant species are known to occur on North Keeling Island: Indian copperleaf (*Acalypha lanceolata*), limeberry (*Triphasia trifolia*), wild gooseberry (*Physalis minima*), pigweed (*Portulaca oleracea*), pawpaw (*Carica papaya*), and coral berry (*Rivina humilis*). None of these plants are considered to be a severe environmental problem, or to have the potential to become one in the foreseeable future (Claussen and Slip 2002). However, the distribution and abundance of some introduced plants, particularly coral berry, appeared to increase during the life of the last management plan.

Surveys show that numbers of the yellow crazy ant (*Anoplolepis gracilipes*) were high in some patches of pisonia forest on North Keeling Island, reaching abundances seen in supercolonies on Christmas Island. This is an important conservation concern, since on other oceanic islands yellow crazy ants are associated with large populations of scale insects, particularly *Pulvinaria urbicola*, that are also implicated in canopy dieback of pisonia (Hill et al. 2003, Smith et al. 2004; Kay et al. 2003; Handler et al. 2007). Surveys to examine the occurrence of scale insects on the island undertaken in May 2011 did not detect the presence of *Pulvinaria urbicola* scale insects on pisonia, however a mealybug was found on coconut palm.

Winds from cyclones have destroyed substantial amounts of vegetation in the past and have had a detrimental effect on the breeding seabird populations. In January 1989 Cyclone John devastated the red-footed booby population on North Keeling Island.

Under the previous plan, permits could be issued for the collection of plant propagules. No requests for such permits were received during the life of the previous plan.

To enable the Cocos-Malay community to continue traditional crafts, permits were available under the previous management plan for the collection of small amounts of ironwood from North Keeling Island and will continue to be available under this plan. At the time of preparing this plan, no permits had been requested or issued for the collection of ironwood since the park was proclaimed.

Note: Under ss.354 and 354A of the EPBC Act a person (including the Director) may not kill, injure, take, trade, keep or move a member of a native species except in accordance with a management plan. The Environment Protection and Biodiversity Conservation Regulations 2000 (EPBC Regulations) (r.12.20) also prohibit taking animals and plants into the park.

Mining operations are prohibited in Pulu Keeling National Park by the EPBC Act (ss.355 and 355A) except where authorised under a management plan.

Under regulation 12.15 a person must not use or introduce a pesticide, herbicide or other poisonous substance in the park, unless it is provided for by, and carried out in accordance with, a management plan in force for the park, or is authorised by a permit, or under certain other conditions (r.12.06).

Research and monitoring will be undertaken in accordance with Section 3.3, Research and monitoring.

Issues

- Reducing threats to vegetation and significant habitats, particularly existing invasive species and the likelihood of additional invasive species entering and establishing.
- Managing the park's biodiversity, especially threatened species, in a bioregional context. This may include the need to facilitate and/or assist with off-park conservation actions such as the reintroduction and/or monitoring of native species to the southern atoll, which requires significant resources and effective stakeholder collaboration.
- Access to North Keeling Island is difficult or limited, restricting the amount of research and monitoring activities that can be undertaken.

What we are going to do

Policies

- 3.1.1 The park will be managed to maintain its values and ecological character in accordance with the Australian International Union for the Conservation of Nature (IUCN) management principles and the Ramsar Ecological Character Description.
- 3.1.2 The park will work collaboratively with stakeholders, particularly the Territory Administration, the Cocos (Keeling) Islands Shire Council and relevant natural heritage researchers and managers, in regard to regional approaches to the conservation and management of terrestrial and marine habitats and biodiversity within the Cocos (Keeling) Islands Province bioregion.
- 3.1.3 The Director may take actions concerning native species within the park, including species listed under Part 13 of the EPBC Act, that are otherwise prohibited by the EPBC Act where they are necessary to implement this plan, or where they are otherwise necessary for preserving or protecting the park, protecting or conserving biodiversity, or protecting persons or property in the Park.
- 3.1.4 Plant propagules may be taken and removed from the park by park staff or in accordance with a permit issued by the Director under the EPBC Regulations for the revegetation of the southern atoll. Plant propagules may only be taken after assessment of the potential impact of the activity on park vegetation and dependent communities, and subject to conditions that minimise such impact.
- 3.1.5 Permits may be issued for the collection and removal of ironwood from the park for the purpose of building model boats and other craftwork within the Cocos community. A permit may be issued only if the environmental impacts would be minimal and after a thorough assessment of alternative sources has been completed by the proponent.
- 3.1.6 Subject to invasive species/biosecurity and toxin risk assessments, hardwood and softwood timber may be brought into the park and used for management purposes. See also Action 3.1.11.
- 3.1.7 Exotic weeds, animals and pathogens may be controlled or eradicated using chemicals, physical methods, but care will be taken to minimise the effects on non-target species (using minimum-residue chemicals wherever practicable, subject to Section 7.1, Assessment of proposals).

- 3.1.8 Subject to risk assessments and required approvals, the Director may introduce, or issue a permit for the introduction of, non-native species into the park for conservation purposes – for example, for use in the biological control of one or more invasive species.
- 3.1.9 Mining operations are prohibited in the park.

Actions

- 3.1.10 In accordance with relevant sections of this plan, monitor and maintain the ecological character of the Ramsar listed wetland known as Pulu Keeling National Park. This will include monitoring characteristic biodiversity and changes to the lagoon and ecosystems, as well as monitoring and, as needed, mitigating the impacts of threats.
- 3.1.11 Continue to implement targeted invasive weed and fauna management programs. This may include control programs for yellow crazy ants (subject to 3.3.6.d)
- 3.1.12 Develop and implement strict biosecurity measures to assess and minimise the risk of the introduction and establishment of new invasive species and pathogens. This will include:
- (a) assessing the likelihood of particular species entering, as well as entry pathways
 - (b) reducing the likelihood of introducing species and pathogens when staff and visitors enter the park
 - (c) monitoring for the early detection of species and pathogens that may enter the park, in particular scale insects, rats and siam weed
 - (d) rapidly controlling and, where feasible, eradicating any new invasive species detected in the park. Target species include but are not limited to rats, mice and Siam weed
 - (e) reducing and/or assessing risks of rehabilitated and returned seabirds introducing invasive species (especially diseases and pathogens) into wild seabird populations and/or the park.
- 3.1.13 So far as is practicable, implement or support the implementation of relevant EPBC recovery plans and relevant threat abatement plans for listed threatened species and key threatening processes.
- 3.1.14 Support and/or facilitate the establishment of ex situ populations of selected native species, particularly the buff-banded rail and flora species for rehabilitation purposes.
- 3.1.15 If EPBC Act listed species or other significant species are in decline to a level that may threaten their conservation status, the Director will:
- a) evaluate existing and potential threats and implement appropriate mitigation measures
 - b) if threats are not known or are unlikely to be mitigated for some time, assess the feasibility and effectiveness of implementing interventionist measures, such as ex-situ conservation and species reintroduction, that have the long-term aim of conserving the species in their natural environment.

- 3.1.16 Undertake risk and impact assessments of the potential and any actual impacts of unauthorised arrivals and use of the park, and implement appropriate risk and impact mitigation measures (See also Section 6, Stakeholders and partnerships).

3.2 Marine ecosystems and species

Background

Values

The park contains marine habitats that were once common to other parts of the Indo-Pacific region. The park is unaffected by development pressures now seen on similar coral atolls in many other parts of the region and the world generally.

In 2009 the Department commissioned a study titled *Conservation values in Commonwealth waters of the Christmas and Cocos (Keeling) Island remote territories*. The study indicated that the marine environment is highly unique with many potential deep-ocean ecological systems that we have very little understanding of, particularly deep-water and other systems below scuba diving depth.

Scientific surveys have shown that the Cocos (Keeling) Islands fall within a marine suture zone where interbreeding may occur between Indian and Pacific Ocean fish species. This has resulted in a high degree of fish hybridisation around the Cocos (Keeling) Islands, which could ultimately lead to the evolution of new species (Hobbs et al. 2008).

At the time of preparing this plan, 201 species of fish had been recorded in the park (Hobbs 2010). This number may increase with additional surveys, given that approximately 550 species have been recorded from the southern atoll (Allen and Smith-Vaniz 1994). Research and monitoring in the park will be undertaken in accordance with Section 3.3 of this plan, Research and monitoring.

Threats

Coral reefs worldwide are under threat, with remote reefs in the Indian Ocean being among the worst affected. In 1998, a mass coral bleaching event resulted in 90 to 99 per cent mortality of corals on many Indian Ocean reefs, and remote locations have proved particularly vulnerable to these disturbances because isolation has limited their recovery (Hobbs 2006). Coral bleaching, crown-of-thorns starfish and coral disease have also affected reefs in the Cocos-Christmas region.

More recently, an outbreak of white syndrome coral disease resulted in widespread mortality of *Acropora* plate corals at Christmas Island in 2008 (Hobbs and Frisch 2010). White syndrome disease was also present in 2008 on a small number of plate corals at the southern atoll, but no disease was recorded on plate corals at North Keeling Island (Hobbs and Frisch 2010). During a recent survey of North Keeling Island no occurrences of white syndrome or crown-of-thorns starfish were detected (Hobbs 2010).

Some of the stocks of fish and invertebrates in the region are highly vulnerable and isolated; they have very little resilience to overfishing and, once depleted, have almost no capacity to recover. Evidence for the fragility of the stocks is demonstrated by the regional extinctions at the Cocos (Keeling) Islands of threadfin salmon (*Polynemus indicus*) within the past 50 years or so, and the drastic depletions of species such as the giant clam (*Tridacna gigas*) within only the last 10 years (Hourston 2010).

Large quantities of plastic items from south-east Asia, where there is a high human population density in contact with an extensive coastline, end up in the surrounding seas. The

accumulation of durable rubbish reaching Christmas Island and the Cocos (Keeling) Islands was considered to be the highest recorded within the Indian Ocean region in a survey of natural and plastic flotsam conducted by the British Natural Environmental Research Council in 2004. During the survey, 23.5% of debris investigated on the shores of the Cocos (Keeling) Islands was found to be colonised by living organisms. The vast amount of waterborne debris in the Indian Ocean is providing increased opportunities for marine organisms to travel and thus for exotic invaders to spread (Barnes 2004).

Marine debris also causes the death and debilitation of marine turtles and other marine wildlife (Balazs 1985, Cawthorn 1985). The ingestion of plastic marine debris and the threat of being tangled in fibrous material, such as netting and plastic strapping, is of concern for the health of marine biodiversity including sea turtles and seabirds. Responding to stranding events and quantifying mortality caused by marine debris are identified as actions to monitor and manage in the *Recovery Plan for Marine Turtles in Australia* (Commonwealth of Australia 2003). The recovery plan further suggests that some assessment of the impact of ingested debris should be determined through post-mortem examinations of stranded animals.

In 2005, the lagoon entrance closed as a result of natural forces of deposition and is no longer flushed with seawater, leading to significant changes within this habitat (Hobbs 2009). As a consequence, the lagoon no longer supports large numbers of fish and invertebrates and it is considered that mud crab (*Scylla* sp.) and bonefish (*Albula glossodonta*) have become locally extinct (Hobbs 2009).

Research and monitoring will be undertaken in accordance with Section 3.3, Research and monitoring.

Note: Under ss.354 and 354A of the EPBC Act a person may not kill, injure, take, trade, keep or move a member of a native species except in accordance with a management plan. The EPBC Regulations (r.12.20) also prohibit taking animals and plants into the park. See also Policy 3.1.2 with regard to actions undertaken by the Director and actions undertaken by persons authorised by the Director.

Issues

- More knowledge is needed about marine ecosystems and species, including threats, interactions between marine and terrestrial ecosystems and species, and the distribution and abundance of significant and 'at risk' species.
- Preventing, monitoring and mitigating threats is a priority. Threats may include recreational or illegal fishing, changing ocean conditions and temperatures, coral disease and bleaching, pollution and introduced species.
- Access to the waters of North Keeling Island is limited, restricting the amount of research, monitoring, compliance and enforcement activities that can be undertaken.

What we are going to do

Policies

Policies 3.1.1 and 3.1.2 apply to the Marine Reserve Zone.

Actions

- 3.2.1 So far as is practicable, support the implementation of relevant species recovery plans, particularly for marine turtles, and threat abatement plans. This may include contributing to off and on park recovery actions.

- 3.2.2 Assess and monitor threats to marine ecosystems and species (including biosecurity threats and marine debris) and work with stakeholders to implement threat mitigation measures (see also Action 3.1.11).

3.3 Research and monitoring

Background

Research and monitoring provides baseline and updated information about the resources of the park, visitor use and impacts. Monitoring is an essential management tool for keeping track of changes to the environment and for measuring the success of management actions.

During the life of the previous plan a number of studies were undertaken including investigations into the status of the Cocos buff-banded rail population, coral reefs and marine resources. In addition, a risk assessment was undertaken on the impact of climate change on the Indian Ocean Territories, and monitoring of crazy ants, weeds, seabirds and marine turtles was undertaken. Vegetation mapping also progressed, with the use of high-resolution aerial imagery, followed by ground-truthing of data.

A primary ecological value of North Keeling Island is its role as a seabird colony and as critical habitat for the endangered and endemic Cocos buff-banded rail. To increase knowledge and the capacity to manage these seabird species successfully, research and monitoring should be directed towards the breeding success, habitat utilisation and factors affecting adult and juvenile mortality of seabirds and Cocos buff-banded rail.

The vegetation of North Keeling Island is also particularly significant as the last intact remnant of the original Cocos (Keeling) Islands flora. Before being visited by people, colonisation of North Keeling Island by plants and animals occurred only by wind, pelagic drift, flight or animal carriage. The origins and development of the flora and fauna of the island provide biologists with unique research opportunities into the origin of species and access to uniquely primitive species forms. Developing in isolation and with minimal human impact, *Cordia subcordata*, which generally occurs as a stunted shrub elsewhere, reaches the size of a large tree; the *Pisonia grandis* trees of the island are exceptionally taller than usual; and the coconut trees of the island are a rare source of one of the earliest forms of the species.

A strong focus of research and monitoring on North Keeling Island has been surveys and assessment of data associated with the red-footed booby population. These surveys have been conducted regularly since 1986. This ongoing program has become significant for monitoring one of the park's key values and the ecological character of the Ramsar site.

Following the relocation of 39 Cocos buff-banded rails to Horsburgh Island in April 2013, monitoring of the translocated population will be paramount to determine the viability of establishing and maintaining a second population of this endemic threatened species. Efforts to establish a second viable population of the buff-banded rail, and associated research and monitoring, are key actions of the National Recovery Plan for the Buff-banded Rail. This has included monitoring of the park's population, which is stable with an estimated population in 2013 of around 1,000.

The Round Island petrel (*Pterodroma arminjoniana*) was recorded on North Keeling in 1986 by Stokes and Goh (1987). There have been no sightings in Pulu Keeling National Park since the 1986 record and there is insufficient evidence to show that the Round Island petrel is a frequent visitor to or breeding on the island. Extensive searches undertaken in the years following its initial discovery failed to detect any presence of the petrel.

Other research and survey projects have included:

- repeat analysis of red-footed booby survey methodology and data
- turtle monitoring, with a focus in the southern Cocos Keeling Islands, with only irregular surveys occurring in the park.
- Cocos (Keeling) Islands quantitative baseline surveys for core marine reserves and a biosphere reserve on the southern atoll lagoon.

In 2009 the Island Wide Survey was first conducted, to establish baseline data on the presence of yellow crazy ants, weeds and other biodiversity data; it was repeated in 2012 to monitor changes and trends. Satellite imagery was also used to map vegetation on the island, supported by ground-truthing. The collection of this data has assisted in the weed control program and will be invaluable for future monitoring.

The park provides opportunities for broader research projects that consider the regional and global context of the park and its biota. For example, ecological research on reefs and North Keeling Island, where human activity is controlled and minimal, provides good research opportunities to study largely intact reef systems. Monitoring to assess the status of and detect any changes to the marine environment, particularly those associated with human activity, is a high priority to facilitate proper management of the marine area of the park. Monitoring of marine habitats needs to be long term so that effects of natural disturbances such as cyclones, outbreaks of crown-of-thorns starfish or El Niño events, may be accurately recorded, and to help assess the impacts of fishing in the Cocos (Keeling) Islands region.

Although the research priorities identified in the previous plan were largely achieved and helped to assess the status of island biodiversity, securing funding and in-kind support for continued monitoring and research and implementing research recommendations remain relevant issues.

The *Ecological Character Description for the Pulu Keeling National Park Ramsar Site* (Hale 2010) recommended a number of actions necessary to identify indicator species for monitoring, and specific monitoring recommendations in relation to vegetation, invasive species, invertebrates, birds and marine species (see Table 1).

Table 1: Ramsar monitoring needs for Pulu Keeling National Park

Component/process	Purpose	Indicator	Locations	Frequency	Priority
Vegetation – extent	Identified knowledge gap. Although there is no Limit of Acceptable Change for vegetation, survey data can inform on condition and extent of major vegetation types. This could be used as an indicator for seabird habitat in management planning.	Extent of broad vegetation types (pisonia, coconut, ironwood, octopus bush) by remote sensing	Entire Ramsar site	Every 5 years	Medium
Weeds	Determination of impact	Identifying and determining extent of weeds by land survey	Entire Ramsar site	Annual	Low
Yellow crazy ants	Determination of impact	Abundance; presence of scale insects	Pisonia forest	Every 2 years	High
Marine invertebrates – coral	Assessment against Limit of Acceptable Change	Coral extent and health	Existing Bunya coral site	Annual	High
Fish	Establishment of indicator species, and baseline on which a Limit of Acceptable	Abundance and community composition	Reef	Every 2–5 years	Moderate

	Change can be developed.				
Waterbirds	Assessment against Limit of Acceptable Change	Counts and species identifications; breeding observations	Atoll	Annual	High
Marine turtles	Assessment against Limit of Acceptable Change	Nesting surveys	Northern and southern beaches	Annual	Moderate

Source: Hale 2010 Ecological Character Description for Pulu Keeling National Park: Note: These priorities do not represent or detail all monitoring requirements for the park.

Efforts during the life of the previous plan significantly contributed to filling some of these gaps, and extension of current ongoing monitoring may need to be considered to satisfy some additional requirements. Research proposals for the park will be guided towards these areas of priority, where feasible.

Under the EPBC Regulations (r.12.10) research may not be undertaken in the park unless it is provided for by, and carried out in accordance with, this plan. Research that involves killing, injuring, taking, trading, keeping or moving native species or is undertaken for commercial purposes is prohibited by ss.354 and 354A of the EPBC Act except in accordance with this plan.

Research that affects listed threatened species or ecological communities, listed migratory species, cetaceans or listed marine species must comply with Part 13 of the Act unless done in accordance with this plan. Any research must also address the relevant EPBC Act requirements relating to listed heritage places, including places on the Commonwealth Heritage List.

See also policy 3.1.2 with regard to actions undertaken by the Director and actions undertaken by persons authorised by the Director and Section 3.3, Research and monitoring.

Access to biological resources

Research or other approved activities may involve access to biological resources of native species. Access to biological resources (also known as biodiscovery) is the taking of biological resources of native species for research and development of any genetic resources, or biochemical compounds, comprising or contained in samples or specimens of these species.

Access to biological resources in Commonwealth areas such as the park is regulated under Section 301 of the EPBC Act and Part 8A of the EPBC Regulations. Key features of Part 8A in relation to Pulu Keeling National Park are set out in Table 2.

Biological resources are defined by the EPBC Act (s.528) as including genetic resources, organisms, parts of organisms, populations and any other biotic component of an ecosystem with actual or potential use or value for humanity. Genetic resources are defined as any material of plant, animal, microbial or other origin that contains functional units of heredity and that has actual or potential value for humanity. Part 8A of the EPBC Regulations (made under s.301 of the Act) controls access to biological resources in Commonwealth areas including Pulu Keeling National Park. Access to biological resources is also covered by ss.354 and 354A of the EPBC Act if the resources are members of a native species and/or if access is for commercial purposes. Any access to biological resources from the park must be in accordance with this plan.

This section should be read in conjunction with Sections 3.1 and 3.2.

Table 2: Key relevant features of the EPBC Regulations on access to biological resources as they concern the park

1. Any person who wants to access biological resources must obtain a permit from the Minister or authorised delegate.
2. Written permission for the taking of biological resources must be obtained from the Director of National Parks, the 'access provider' for Pulu Keeling National Park.
3. Where access is sought for commercial purposes or potential commercial purposes: <ul style="list-style-type: none"> - there must be a benefit-sharing agreement with the Director of National Parks - the benefit-sharing agreement must provide for reasonable benefit-sharing arrangements
4. Where access is sought for non-commercial purposes: <ul style="list-style-type: none"> - a statutory declaration must be given to the Director of National Parks declaring, among other things, that any biological resources taken are not intended to be used for commercial purposes, that a written report will be given to the Commonwealth on the results of any research into the biological resources, that samples will not be given to other people (other than voucher specimens to a specified research institution) without permission of the Commonwealth and that the person(s) given access will not carry out, or allow others to carry out, commercial research or development unless a benefit-sharing arrangement is in place with the Director of National Parks.
5. There must be an environmental impact assessment of the proposed access if it is likely to have more than negligible environmental impact.

Issues

- There is a need to monitor and maintain the ecological character of the listed Ramsar site.
- Scientifically robust evidence and information is needed for making conservation management decisions and to improve knowledge and understanding of the marine environment of the park.
- Research on North Keeling Island requires good collaboration and can be logistically challenging due to the park's isolation and access difficulties, lack of freshwater and basic facilities.
- Effective methods are needed for storing and accessing research and monitoring data and results.

What we are going to do

Policies

- 3.3.1 Permits authorising research will be managed so as to:
- (a) address priorities identified in this plan
 - (b) ensure minimal disturbance to the park and park operations
 - (c) avoid potential adverse impacts to park values.
- 3.3.2 Permits may be issued for undertaking research where the proposed research:
- (a) cannot reasonably be done outside the park

- (b) is consistent with the management principles for the IUCN category of the zone of the park where the research is proposed to be carried out
 - (c) is conducted by a researcher with appropriate credentials and experience
 - (d) will not adversely affect natural and cultural heritage values of the park
 - (e) will not threaten the conservation status of any species of flora or fauna
 - (f) complies with the provisions of this management plan.
- 3.3.3 Researchers should provide the Director with reports and findings arising from research activities in the park, including rights to use and share the work where appropriate.
- 3.3.4 Research and monitoring that involves access to biological resources within the meaning of Part 8A of the EPBC Regulations must comply with those Regulations, in addition to the requirements of this section of the plan.
- 3.3.5 Research and monitoring priorities shall be regularly reviewed during the life of this plan to address key threats to the values of the park (also see 3.1.5).

Actions

- 3.3.6 Subject to available resources, collaborate with the scientific community, research organisations and other relevant agencies to undertake an effective research and monitoring program for the park to address the following priorities:
- (a) ecological and population surveys of red-footed boobies
 - (b) ecological and population studies of the endemic Cocos buff-banded rail, including studies related to their relocation to the southern atoll
 - (c) monitoring of land crab diversity, population and ecology
 - (d) monitoring of the yellow crazy ant and scale insects, including assessment of the impacts of yellow crazy ants to, if required, inform control strategies
 - (e) monitoring and mapping of island vegetation, including weed species
 - (f) monitoring and mapping of the structure and morphology of the island and the central lagoon
 - (g) monitoring of the population of marine turtles in the waters of the park and surrounding area, including nesting activity
 - (h) monitoring of coral reefs and significant fish species, including marine species diversity and hybrid fauna, and to detect changes in coral reef ecosystem health
 - (i) establishing and implementing a monitoring program of the ecological character of the Ramsar site to inform management activities
 - (j) undertaking studies to assist with addressing emerging park management issues, such as monitoring methodology and strategies for controlling any newly introduced invasive species. This may include off-park studies.
- 3.3.7 Maintain a registry of scientific and research reports and articles relevant to the park.
- 3.3.8 Establish and maintain an effective and accessible system to store and manage research data using relevant computerised databases and a geographic information system (GIS).

4. Cultural heritage management

Objective

The park's cultural values are protected and conserved.

Performance indicators

The following indicators will be used under this plan to measure performance in cultural heritage management:

- The condition of significant cultural heritage sites is inspected and maintained.

4.1 Cultural heritage site management

Background

The park is a listed place on the Commonwealth Heritage List under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) for its natural and cultural heritage significance (see Appendix D for the basis of listing).

Previous human activity in the park has included visits by Cocos-Malay workers and actions associated with the two world wars. These activities have left various relics of value and interest.

The graves of a Malay woman and girl who died from beri-beri, a dietary deficiency, in the late 19th century are located near the southern shore. There is a third grave on the island, that of a man who died in an accident (Bunce 1988).

There is evidence of several wells close to the lagoon edge created by Malay workers using basic tools in an attempt to source underground water.

There is also evidence of two base camp sites that were inhabited during coconut and wildlife collecting trips. One is in vegetation situated within metres of the landing site and the second is at the western side of the lagoon edge where the railway ends. Wooden stumps that would have supported large huts are still in place. Scattered around them are old bottles, equipment and timber debris. The railway track that joined these base camps was a section of small-gauge track that used a trolley cart; its east-west traverse assisted workers shifting bags of husked coconuts to the landing site.

The resting place of the World War I German raider SMS *Emden* is located on the reef off the southern end of the island. The *Emden* is a historic shipwreck under the *Historic Shipwrecks Act 1976* and a protected zone has been declared around it under that Act.

During the operation to salvage the SMS *Emden*, the small-gauge railway track on the island was extended as far south as possible to access the wreck site.

A World War II De Havilland Mosquito aircraft, A52-606, from 87 Squadron, failed to reach West Island airstrip and crash-landed on the east coast of North Keeling Island in June 1945. A section of the engine is still visible at the crash site.

Issues

- A number of historic and cultural sites in the park, including portable artefacts of heritage significance, are difficult to locate, may be fragile and require appropriate protection from the impacts of visitors.
- The cultural heritage artefacts are to remain in situ and will be exposed to extreme weather events, salt air and saltwater. Natural deterioration will continue to degrade the condition of artefacts, particularly those constructed of timber and metal; this is an acceptable natural process.

What we are going to do

Policies

- 4.1.1 The heritage values of the park will be managed in accordance with relevant Commonwealth Heritage management principles (Appendix D) and the *Historic Shipwrecks Act 1976*.
- 4.1.2 Disturbance to cultural sites and artefacts of heritage significance in the park should be avoided so far as is practicable, or minimised.
- 4.1.3 Only essential protection and conservation activities will be carried out for cultural sites and artefacts of heritage significance in the park; these may include activities necessary to stabilise, maintain or restore condition.
- 4.1.4 The Cocos-Malay community, through the Pulu Keeling National Park Community Management Committee, will be consulted regarding the care of the Malay graves on North Keeling Island.

Actions

- 4.1.5 Work with relevant experts and stakeholders, including the Territory Administration, the Cocos (Keeling) Islands Shire Council and the Cocos-Malay community, to identify, document, assess and protect the values of cultural and historic sites within the park.
- 4.1.6 Develop and maintain a register of heritage sites and artefacts for the park which includes an inspection and maintenance schedule.

5. Visitor management and park use

Objective

A limited range of opportunities are available during the life of the plan for rare, unique, educational and safe natural and cultural focused experiences without disturbing park values.

5.1 Visitor access and use

Background

The majority of visits to the island are by park staff undertaking park management activities. Periodically, tourists also visit the island, either guided by tour operators under a valid permit, or accompanying park staff. Access onto North Keeling Island can be hazardous as it normally involves a swim from a boat across the reef to the shore. There are no roads or tracks on the island and boats are not allowed to approach the shore or land on the island. When walking on the island, park staff and visitors follow either the lagoon edge or the coastline to avoid impacts on vegetation and habitat.

It is not feasible to install and maintain facilities to improve the ease of access to the island, and such development could significantly impact the values of the park and would not be compatible with its strict nature reserve zoning.

Human disturbance of seabird colonies has the potential to decrease the recruitment of juvenile birds into the population or to increase adult mortality (WBM Oceanics Australia 1995). Four strategies were developed to guide the Director in managing visitor access and use under the previous management plan, and to inform the public. The strategies prescribe conditions for visitor access, boating, recreational fishing and scuba diving, and represent codes of conduct for minimising impacts on the values of the park. These strategies will continue to apply during this life of this plan and may be reviewed. Permit conditions require observance of the strategies.

Cocos-Malay people have relied on marine wildlife for a major part of their food supply since settlement in the 1820s. The cultural tradition of catching a large number of fish to provide as gifts remains strong. On the southern atoll, there has been a steady rise in fishing since the 1980s. However, due to the difficulties of access, the fishing, harvesting and collecting of North Keeling Island's marine resources by the local community and visitors has been limited. Prior to the declaration of the park, fishing was allowed to within 100 metres of the shoreline.

The previous management plans for the park restricted fishing to trolling only, to minimise impacts of fishing on reef fish species. This policy will continue under this management plan in order to protect and conserve marine species within the park.

As noted in Section 4.1 of this plan, the SMS *Emden* is an historic shipwreck under the *Historic Shipwrecks Act 1976* and a protected zone has been declared around it under the Act (see also Map 4). The power to grant permits to access the protected zone surrounding the *Emden* under the *Historic Shipwrecks Act 1976* lies with the Commonwealth Historic Shipwrecks Delegate, who at the time of writing this plan was the Commonwealth Shipwrecks Officer within the Department.

The Environment Protection and Biodiversity Conservation Regulations 2000 (EPBC Regulations) prohibit a person who is fishing to use underwater breathing apparatus or fishing equipment other than lines, hooks and lures. The Regulations also prohibit the use of live bait or native species as bait (other than a species of fish), and cleaning or filleting fish within a marine area. Under r.12.35, the Director may prohibit fishing in the park or determine restrictions on fishing.

The EPBC Regulations (rr.12.23 and 12.23A) enable the Director to restrict entry to areas in the park on a temporary or permanent basis, and to prohibit or restrict activities or classes of activities within all or part of a Commonwealth reserve. In addition, the Director may implement temporary or long-term closures of areas in the park if an activity or access has the potential to impact on park values or poses a risk to public safety, or if required for management purposes. In these circumstances every effort is made to inform visitors and tour operators as soon as possible.

The EPBC Regulations also include provisions that prohibit or regulate other visitor and recreation activities in the park, including, but not limited to, public gatherings of more than 15 people and the use of vessels.

Issues

- The natural and cultural values of the park are vulnerable to visitor impacts, including through the accidental introduction of invasive species and pathogens to the park.
- Access to the park is difficult and can present a number of hazards to visitors.
- Some visitors to the Cocos (Keeling) Islands may have an expectation that unrestricted access will be available to the park for recreational and cultural purposes.

What we are going to do

Policies

General – Access

- 5.1.1 Disturbance to wildlife, particularly the seabird colonies, Cocos buff-banded rail and robber crab, by park visitors will be minimised by maintaining and enforcing strict controls on visitor access and behaviour.
- 5.1.2 Subject to the provisions of this section, access to the park by the public is limited to persons:
 - (a) in the company of park staff; or
 - (b) authorised by a permit issued by the Director under the EPBC Regulations
 - (c) carrying on or taking part in authorised commercial activities for which a permit has been issued (see Section 5.2, Commercial tourism and other commercial activities).
- 5.1.3 Decisions about permits to access the park will be subject to consideration of the carrying capacity of the park, the risk associated with the activity and the potential impact on park values. Limits may be placed on the numbers of visitors and the frequency of visitation, and approval may not be given to large groups (see also Section 7.1, Assessment of proposals).

- 5.1.4 Persons accessing North Keeling Island for recreational purposes will be required to walk only on beaches and designated access routes.
- 5.1.5 Other than for research purposes, permits for entry to North Keeling Island will only be issued for observation, study and quiet enjoyment of the island's natural and cultural values.
- 5.1.6 If the frequency of visitation to the park increases significantly, or if a long-term research or management program requires visitors to stay overnight for long periods, actions to monitor, assess and, where required, minimise impacts of park visitors will be undertaken.
- 5.1.7 Persons holding a permit for scuba diving, snorkelling, surfing or recreational fishing in the park are prohibited from accessing North Keeling Island or the lagoon unless specifically provided for in their permit conditions.
- 5.1.8 Permits authorising access to the park for the purpose of carrying on activities within the protected zone declared around the wreck of the SMS Emden under the *Historic Shipwrecks Act 1976* will be subject to possession of any permit required for the proposed activities under that Act.

Commercial activities

See section 5.2.

Camping

- 5.1.9 Camping is not allowed on North Keeling Island except by persons participating in research or park management activities.

Recreational fishing

- 5.1.10 Recreational fishing may be carried out in the marine reserve zone of the park only if it is considered to be sustainable, does not impact on the park's values and is in accordance with the conditions of a permit issued by the Director, subject to any determinations issued by the Director under r.12.35 of the Regulations, and subject to the following limitations:
 - (a) fishing must not be undertaken within 100 metres of the shoreline
 - (b) only fin-fish may be taken
 - (c) only pelagic fish may be taken
 - (d) fishing must only be carried out by trolling or deep-water fishing and not by bottom fishing.
- 5.1.11 Where consistent with this plan and the conservation of marine species, fishing permit conditions may be aligned to the number, size and type of fish described in the fishing regulations applicable to surrounding territorial waters, under the *Fish Resource Management Act 1994 (WA)*, subject to additional restrictions made to protect the marine biodiversity of the park.
- 5.1.12 Permits authorising recreational fishing in the marine zone may include conditions regarding the submission of catch returns, and observance of the recreational fishing strategy and boating strategy for the park (see Section 5.1, Visitor access and use).

- 5.1.13 Permits authorising recreational fishing will discourage anchoring of vessels due to the potential impact on the marine environment.
- 5.1.14 Recreational fishing is not allowed on or from North Keeling Island.
- 5.1.15 Spear fishing is not allowed in the park.

Scuba diving, snorkelling, and other marine activities

- 5.1.16 Permits authorising access to the park for the purposes of scuba diving, snorkelling and surfing may be issued to:
 - (a) persons taking part in an authorised commercial tour
 - (b) persons snorkelling and diving as part of a research activity.
- 5.1.17 Vessels associated with scuba diving, snorkelling and surfing must be manned at all times when in the park to avoid the need to anchor vessels and to ensure the safety and recovery of the participants of these activities.
- 5.1.18 Where a visitor intends to enter the protected zone associated with the wreck of the Emden, this must be clearly indicated in any permit application.
- 5.1.19 Permits may be issued to individuals and groups not covered by 5.1.16 that authorise access to the marine zone of the park for the purposes of scuba diving, snorkelling and surfing only if the Director is satisfied that issues of supervision, safety, environmental protection and liability are adequately addressed.
- 5.1.20 Waterskiing and jetskiing are not allowed in the park.

Actions

- 5.1.21 Review and implement procedures for visitor access, boating, recreational fishing and scuba diving to ensure that they minimise the risk of visitor impacts on the values of the park and are consistent with the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), EPBC Regulations and this management plan.
- 5.1.22 Continue to monitor recreational fishing effort and catch, to contribute to evaluating the effects of recreational fishing and to determine whether additional controls are required.
- 5.1.23 Monitor the effects of any anchoring in the marine reserve zone and, if necessary, put formal restrictions in place if any impacts are considered unacceptable.

5.2 Tourism and other visitor activities

Background

Tourism is considered an avenue for significant future economic growth for the southern atoll of the Cocos (Keeling) Islands. Many visitors to the Cocos (Keeling) Islands will seek a nature-based experience, which may mean that during the life of this management plan the demand for visits to the park will increase.

The only available access to the park is via a 32 kilometre boat journey, hampered by frequent rough seas and a requirement to swim the last leg of the journey across an area of reef to the shore. Access is also limited by boat availability, cost and the need to provide for visitor safety. Given these constraints, well-managed, limited, low-intensity visitor access providing opportunities for unique high-quality visitor experiences to the park is considered appropriate, under strict conditions.

Due to the sensitivity of North Keeling Island's wildlife the foremost management objective of this plan will be the protection and conservation of the island and its wildlife. Visitor access and commercial use of the park must be carefully managed to help protect the unique values of the island (restricted to prevent conflict with that objective).

The fragile and evolving ecosystems of the park are suitable subjects for filmmakers, photographers and journalists who wish to document the natural values of an isolated atoll undergoing change. Such activities can greatly contribute to increasing understanding and promoting the park's natural values. Any such activity will require close supervision and management.

Regulation 12.38 of the EPBC Regulations prohibits deriving commercial gain from images captured in the park, unless enabled by a permit issued by the Director.

Commercial activities, including commercial tours and commercial image capture, are not allowed in the park by ss.354 and 354A of the EPBC Act unless carried out in accordance with a management plan.

Issues

- Due to the fragility of the values of the park and the island's IUCN classification as a strict nature reserve, only small-scale, low-impact tourism experiences, conducted by appropriately trained and experienced operators, that maximise visitor safety and appreciation of the park and minimise impacts on park values should be supported.

What we are going to do

Policies

- 5.2.1 Commercial tourism activities may be undertaken in the park in accordance with a permit issued by the Director subject to:
- (a) the activity assisting in the promotion, understanding and appreciation of the park's natural and cultural values
 - (b) the activity having minimal impact on the park's natural and cultural values
 - (c) the Director being satisfied that safety and public liability issues are adequately addressed
 - (d) each other person (employee or contractor) who will be engaged in conducting tours being suitably qualified, experienced and insured to conduct the tours.
- 5.2.2 The following commercial activities may be carried on in the park in accordance with a permit issued by the Director:
- (a) small-scale, low-impact day tours, including land tours of North Keeling Island and scenic boat charters (other than fishing tours), which enable the observation, study and quiet enjoyment of the island's natural and cultural resources
 - (b) organised, scuba diving, snorkelling and surfing tours within the marine waters of the park
 - (c) capture of images (record by artistic representation, or on film, videotape or electronic medium) or sound recording.
- No other commercial activities may be carried on in the park.
- 5.2.3 Commercial fishing or the taking of any marine species for sale is not allowed in the park but commercial fishing boats (including associated equipment) may transit through the park.

Actions

- 5.2.4 Monitor tour operations for compliance with permit conditions and respond accordingly (see Section 7.3, Compliance and enforcement).
- 5.2.5 In consultation with commercial operators, collect visitor survey information to assess visitor satisfaction and other information associated with their experience travelling to and visiting the park.

5.3 Communicating park values

Background

The provision of interpretive information has the capacity to improve public and community understanding of the natural and cultural values of Pulu Keeling National Park, and assist in developing support for protecting park values and implementing management actions. It also informs those who visit the park on how to minimise damage to the park environment and have a safe and informative visit.

Because the number of visitors to North Keeling Island is limited, there has not been a requirement for major public education and interpretive initiatives. However, interpretive material relating to the park is available at Parks Australia offices on West Island and Home Island, the museum on Home Island and the Tourist Centre on West Island.

During the life of the last plan, a video documentary of the park was produced to increase awareness of the natural, cultural and historical values of the island, especially for those who are unable to visit the park. A coffee table book on the park was also produced concurrently with the video, promoting the values of the park. These products continue to assist with promoting the natural values and special qualities of the park.

Park staff also work closely with the Cocos (Keeling) Islands school and the broader community, raising awareness of the unique natural values of the park and of regional conservation issues, such as invasive species threats. Part of the aim of these programs is focused on raising awareness of park regulations and compliance issues.

Issues

- Given the low levels of visitation, there is not a great demand or need for extensive interpretive materials. However, any materials and information developed needs to improve understanding and appreciation of park values and, for visitors to the park, maximise visitor safety and compliance with park regulations.
- It is important that when promoting the park's values accurate and practical information about the park is made available, to ensure visitors do not have unrealistic expectations in relation to the likelihood of visiting the park.

What we are going to do

Policies

- 5.3.1 Information on the natural, cultural and historical values of the park will be included in community education and interpretive material.
- 5.3.2 Clear advice on the risks, difficulties and limitations in accessing the park will be included in community education and interpretive material, so as not to promote unrealistic public expectations of being able to easily access the park as an adventure tourism destination.
- 5.3.3 Information on priority issues will be produced in English and Malay.

Actions

- 5.3.4 Continue to provide interpretive information for visitors and tour operators about the park's natural and historical values and their protection, including through the internet, local information networks and the installation of essential appropriate signage within the park.
- 5.3.5 Promote the values of the park and its management through community education programs, particularly school education programs.
- 5.3.6 Prepare and, as needed, provide information for visitors about low-impact behaviour, consistent with this plan's policies and actions (also see 3.1.11).

6. Stakeholders and partnerships

Objective

Cooperative and productive partnerships with stakeholders help address the prescriptions of this plan and issues of mutual interest.

Performance indicators

The following indicators will be used under this plan to measure performance with regard to stakeholders and partnerships:

- Mutual benefits resulting from stakeholder and community engagement.

6.1 Community, stakeholders and partnerships

Background

North Keeling Island is leased to the Director by the Cocos (Keeling) Islands Shire Council. The lease agreement provides for a Community Management Committee (the Pulu Keeling National Park Community Management Committee, or PKNPCMC) to advise the Director in relation to the preparation of management plans for the park, and matters that arise in relation to management plans.

The *Cocos (Keeling) Islands Act 1995* provides the basis for much of the territory's administrative, legislative and judicial systems. An Administrator, appointed by the Governor-General, is responsible for the administration of the territory on behalf of the Commonwealth.

Partnerships are an important means of achieving on- and off-park conservation outcomes and also promote regional conservation issues. Conservation partnerships have included regional marine turtle and reef surveys. Off-park conservation programs, particularly the possible reintroduction of the Cocos buff-banded rail, will require continued partnerships with Territories Administration, the Cocos (Keeling) Islands Shire Council, the Cocos community and other stakeholders, including research partners.

The park works with the local community on an educational approach to compliance activities, providing information on the values of the park, particularly natural values, and engaging volunteers and locally engaged staff to assist in management activities. This continues to build a stronger relationship with the community and recognition of the values of the park that are protected through legislation for future generations.

It is possible that the Cocos (Keeling) Islands, including Pulu Keeling National Park, may continue to be a site where unauthorised boat arrivals land during the period of operation of this plan. The Department of Immigration and Border Protection has primary responsibility for managing unauthorised boat arrivals to Australia and its territories, and works with agencies such as the Australian Federal Police to undertake tasks associated with the arrival of unauthorised vessels at Cocos (Keeling) Islands (including North Keeling Island) and processing of asylum seekers. Parks Australia works with these agencies to provide coordinated responses to such incidents in the park.

The Commonwealth is primarily responsible for the delivery of state government type services in the territory, including under the applied laws of Western Australia. Agencies of the Western Australian government provide services under applied laws, under service delivery agreements with the Commonwealth. Functions and powers under the applied laws have been delegated to Western Australian government officials.

Issues

- Some park management, conservation and tourism issues relevant to the Cocos (Keeling) Islands can only be effectively addressed through cooperative approaches.

What we are going to do

Policies

- 6.1.1 Members of the PKNPCMC (or their nominated representatives) will be given the opportunity to visit the park at least once per year in the company of park staff.
- 6.1.2 In relation to significant park management issues, the Director will consult, as appropriate, with relevant stakeholders including, but not limited to, the Territory Administration, the Cocos (Keeling) Islands Shire Council, the PKNPCMC, and local community and tourism groups.
- 6.1.3 The program of rescue and care of injured and orphaned juvenile birds in the community may be continued to heighten awareness of environmental protection.

Actions

- 6.1.4 Maintain the PKNPCMC as the primary liaison mechanism with the local community for significant issues relating to park management.
- 6.1.5 Share information and work with the community and other stakeholders in relation to park conservation issues relevant across the Cocos (Keeling) Islands and other issues of mutual interest. This may include:
 - (a) participating in consultative and advisory groups or forums
 - (b) establishing or participating in awareness-raising and information-sharing forums
 - (c) consulting the community and other stakeholders in relation to specific issues.
- 6.1.6 Work with relevant stakeholders and organisations to develop partnerships and whole-of-government approaches for implementing this plan and addressing regional conservation issues and other issues of mutual interest.
- 6.1.7 Implement strategies to increase community and stakeholder involvement in contributing to the management of the park. This may include employing and training island residents and supporting appropriate volunteer activities, including eco-tourism related volunteer activities.
- 6.1.8 In cooperation with relevant government agencies, as needed, develop and implement procedures for detecting, minimising and rectifying the impacts of any unauthorised boat arrivals (see also Section 5.1, Visitor access and use).

7. Business management

Objective

- Appropriate actions are implemented to support the effective and efficient management and protection of the park.

Actions

7.1 Assessment of proposals

Background

Activities proposed to be undertaken in the park by the Director and/or external proponents need to be assessed for their potential impacts before a decision can be made on whether the proposal should be approved. Considerations include impacts on the park's natural environment and risks associated with the activity or proposal.

Some proposed actions may be 'controlled actions' under the *Environment Protection and Biodiversity Conservation Act* (EPBC Act). Controlled actions require assessment and approval by the Minister because they are likely to have a significant impact on a matter of national environmental significance (such as EPBC Act listed species or Ramsar wetlands) or on the environment generally. The EPBC Act defines the environment as including:

- (a) ecosystems and their constituent parts, including people and communities
- (b) natural and physical resources
- (c) the qualities and characteristics of locations, places and areas
- (d) heritage values of places
- (e) social, economic and cultural aspects of a thing mentioned in paragraph (a), (b), (c) or (d).

Proposed actions that do not trigger the EPBC Act assessment and approval provisions may still have impacts that require assessment before a decision can be made on whether the action should proceed.

The Director makes decisions on whether proposals should be approved using the park's impact assessment procedures.

Issues

- If proposed actions are not properly assessed, actions may cause significant impacts on the park's environmental values.
- Transparent, clear and consistent impact assessment procedures are required for consideration of proposals.
- Assessment of proposals may be resource intensive.

What we are going to do

Policies

- 7.1.1 The potential impacts of all proposed actions will be considered, and where necessary assessed, in accordance with Table 3, the assessment matters and considerations outlined in Table 4, and the following prescriptions.
- 7.1.2 Public/stakeholder consultation may be conducted when proposals are assessed (see Action 9.1.5).
- 7.1.3 Assessment of proposed activities that are not controlled actions may be carried out by park staff, or by independent experts where specialist advice is required.
- 7.1.4 Subject to the EPBC Act, where applicable the Director may recover from proponents or require proponents to pay the costs associated with administering, assessing, managing and monitoring proposals.

Action

- 7.1.5 Develop, implement and, as needed, review impact assessment procedures in accordance with tables 3 and 4.

Table 3: Decision-making processes and impact assessment procedures

Category	Examples	Decision-making process and impact assessment requirements
<i>Category 1</i>		
Actions considered likely to have no impact, or no more than a negligible impact, on the park's environment and values (see Table 4)	<p>Minor capital works (e.g. new minor infrastructure, maintenance, replacement, repairing or improving existing infrastructure in its present form)</p> <p>Regular/routine ongoing operations to implement prescriptions in this plan (e.g. weed control, environmental monitoring, overnight camping)</p> <p>Issuing permits for activities outlined in and in accordance with this plan (e.g. tour operator, research)</p>	<p>If the Director or their delegate considers that the proposed action is consistent with this plan:</p> <ul style="list-style-type: none"> • if needed, consult with relevant/affected stakeholders • formal impact assessment not usually required • decisions are made by an appropriate officer <p>If the proposed action is not considered consistent with this plan the action will not generally be allowed or may be assessed as a Category 2 proposal</p>
<i>Category 2</i>		
Actions considered likely to have more than a negligible impact, but not a significant impact, on the park's environment and values (see Table 4)	<p>Moderate capital works (e.g. new park infrastructure such as accommodation for management activities or moderate expansion/upgrade of existing infrastructure)</p> <p>Forest rehabilitation including plantings using propagules and seedlings from North Keeling that have been raised on the Southern Atoll</p> <p>Management/research programs for listed species requiring active intervention (e.g. capture, moving, tagging)</p> <p>Expansion of existing tourism activities that do not require major works</p> <p>New activities to implement policies and actions in this plan that are likely to have more than a negligible impact, but not a significant impact, on park values</p>	<p>If the Director or their delegate considers that the proposed action is consistent with this plan:</p> <ul style="list-style-type: none"> • consistent with the Lease for the park, seek written consent of the lessor for any building or works, or any other use of the land that may be inconsistent with the purpose of the Lease for the park • if needed, consult with relevant/affected stakeholders • initiate impact assessment by park staff or an external expert using impact assessment procedures in Table 4 • decisions are made by an appropriate officer <p>If the proposed action is not considered consistent with this plan the action will not generally be allowed or may be assessed as a Category 3 proposal</p>
<i>Category 3</i>		
Actions considered likely to have a significant impact on the park's environment and values	<p>Major capital works would not be permitted (e.g. new infrastructure not associated with park management activities.)</p> <p>Major new activities to implement this plan that have potential to significantly impact on park values.</p> <p>Major rehabilitation of eroded areas of the island, improvement of facilities for access to the island or actions taken to return seawater flows to the lagoon</p> <p>New types of activities or developments not otherwise specified under this plan</p>	<p>If the Director or their delegate considers that the proposed action may or may not be consistent with this plan:</p> <ul style="list-style-type: none"> • consistent with the Lease for the park, seek written consent of the lessor for any building or works, or any other use of the land that may be inconsistent with the purpose of the Lease • the Director will consider whether the action should be referred for consideration as a 'controlled action' under the EPBC Act • If the action is referred and Minister decides it is a controlled action, the action is assessed under the EPBC Act • If the action is not referred, or if it is referred and Minister decides it is not a controlled action, proceed with assessment as for Category 2

Note: Non-controlled activities related to EPBC Act listed species may also require approval under the EPBC Act.

Table 4: Impact assessment procedures: matters and considerations

Matters for assessment	Considerations include (but are not limited to)
1. IUCN category	
(a) IUCN category II, national park (marine area) (b) IUCN category Ia, strict nature reserve (terrestrial area)	<ul style="list-style-type: none"> • Consistency with IUCN management principles
2. Environmental context	
(a) Components or features of the environment in the area where the action will take place (b) Components or features of the environment likely to be impacted (c) Is the environment that is likely to be impacted, or are elements of it, sensitive or vulnerable to impacts? (d) The history, current use and condition of the environment that is likely to be impacted	<ul style="list-style-type: none"> • Matters of National Environmental Significance under the EPBC Act • The environment, as defined under the EPBC Act, including listed Commonwealth Heritage and Register of the National Estate values • Terrestrial and marine ecosystems, communities, habitats and species and their uniqueness in the park, island and region • Ground and surface water values • Cultural features and values • Socio-economic and community values • Tourism, recreational and visitor experience values • Aesthetic/landscape features and values • Scientific values • Infrastructure
3. Potential impacts	
(a) Describe the proposal or action (b) What are the predicted adverse impacts associated with the action? (c) How severe are the potential impacts? (d) What is the extent of uncertainty about potential impacts?	<ul style="list-style-type: none"> • Impacts on considerations above including short-term, long-term, off-site, cumulative, indirect and compounding impacts • Describe action components, activities, stages, scale, intensity and any associated infrastructure • Human health and safety • Biosecurity considerations
4. Impact avoidance and mitigation	
(a) Will any measures to avoid or mitigate impacts ensure, with a high degree of certainty, that impacts are not significant?	<ul style="list-style-type: none"> • Consider timing, duration and frequency of actions/activities • Include any alternative sites for actions • Design factors and considerations • Are there any acceptable impact offset actions?
5. Significance of impacts	
(a) Considering all the matters above, is the action likely to have a significant impact on the environment?	<ul style="list-style-type: none"> • If yes, the Director will consider whether the action should be referred for Ministerial consideration under the EPBC Act

7.2 Capital works and infrastructure

Background

While this management plan is in operation, s.354(1) of the EPBC Act prohibits the Director and other persons carrying on an excavation, erecting a building or other structure, or carrying out works in the park except in accordance with this plan.

At the time of preparing this plan, Parks Australia occupies an office on Home Island and West Island and has staff housing facilities. As this infrastructure is not located within the park, it is not subject to this section of the management plan.

North Keeling Island currently has three small structures for storage of equipment and overnight accommodation used by staff or other persons engaged by the Director. The structures are constructed from steel with a fibreglass hull, built by staff on site from small components carried by staff onto the island from the landing site. Other management structures are a small storage shed at the landing site and some visitor interpretive signs. Current facilities are in need of maintenance due to exposure to saltwater, tropical weather conditions and interference by unauthorised visitors to the park.

If research and monitoring on North Keeling Island increases, camping (tent) structures will need to be temporarily erected and/or more robust temporary structures may need to be installed.

Issues

- Any infrastructure in the park would need to be secure and able to withstand strong winds and severe weather and being unattended and unmaintained over long periods.
- There are no freshwater sources on North Keeling Island.

What we are going to do

Policies

7.2.1 The Director (including persons acting on behalf of the Director, such as park staff and contractors) may carry on an excavation, erect, move or remove a building or other structure, or carry out works in the park, which may include:

- (a) additional low-impact shelters for staff, contractors and equipment
- (b) desalination equipment and/or a rainwater capture and filtration system
- (c) infrastructure for emergency situations
- (d) upgrading, repairing, removing or adding signage
- (e) replacement or relocation of existing assets
- (f) communications infrastructure
- (g) other facilities for the purpose of park management operations.

7.2.2 No buildings or other structures for public use will be erected in the park.

Actions

- 7.2.3 Assess capital works and infrastructure proposals in accordance with Section 7.1.
- 7.2.4 Ensure that construction and maintenance of new and existing infrastructure is undertaken to reasonable and safe standards and to achieve the objectives of this plan.
- 7.2.5 Identify and, where practicable, implement actions to reduce the carbon footprint of park operations.

7.3 Compliance and enforcement

Background

Encouraging and monitoring compliance with relevant legislation is important for protecting park values, infrastructure and people's safety. In particular, the Director is required to comply with the provisions of the EPBC Act, this management plan and other relevant government legislation and policies.

Park or department staff may be appointed by the Minister under the EPBC Act as rangers or wardens and exercise the powers and functions conferred on them by the EPBC Act and the Environment Protection and Conservation Biodiversity Regulations 2000 (EPBC regulations). In addition, all members and special members of the Australian Federal Police and officers of the Department of Immigration and Border Protection are ex officio wardens; and officers of other Australian, state or territory government agencies may be appointed by the Minister as rangers or wardens.

The Australian Government requires that investigating officers be trained to standards set by the Commonwealth Fraud Control Guidelines and the Australian Government Investigation Standards. Park or department staff not appointed as wardens and rangers cannot exercise these powers but can encourage compliance with park regulations using educational approaches. The Director's Compliance and Enforcement Manual sets out the broad guidelines and procedures for managing compliance issues in Commonwealth reserves.

Assessing and monitoring compliance with the EPBC Act in relation to off-park actions and proposals is not the Director's responsibility. However, the Director may assist other agencies to assess and monitor compliance with the EPBC Act and Regulations in relation to actions and proposals outside the park.

The laws of the Cocos (Keeling) Islands, including applied Western Australian laws, apply in the park to the extent that they can operate concurrently with the Act and Regulations and this plan.

Foreign fishermen occasionally fish illegally in the park and have landed on North Keeling Island and stolen or vandalised park equipment. Such theft and damage has led to interference with long-term park monitoring programs. Illegal landings by foreign fishermen also have the potential to introduce weeds, pests and diseases.

Large numbers of seabirds, especially red-footed boobies, have been harvested by Cocos-Malay people over the last century. Protection of the population on North Keeling Island in more recent years has resulted in a much larger and more stable population.

Protection of migratory species under the EPBC Act has made it an offence to kill many of the birds that the Cocos-Malay community has traditionally harvested with illegal poaching of seabirds both in the park and around the southern atoll an ongoing problem. In 1998 the Australian Federal Police implemented a gun control program under the *National Firearms Program Implementation Act 1998* for registered firearms in the territory. This is likely to assist in reducing the level of poaching.

Since 2002, the Western Australian Department of Fisheries has undertaken management responsibilities for the Territorial waters surrounding the park and the southern atoll under a service delivery agreement with the Territory Administration. The territorial waters (to 12 nautical miles) are managed in accordance with any applied Western Australian fisheries laws.

During the life of the previous plan, compliance activities were refocused from a law enforcement approach to an educational approach which helped build better relations with the community. The results of this approach in relation to reducing illegal activities are yet to be determined.

Issues

- The remoteness of and difficulties accessing the park can make the conduct of on-site compliance activities challenging
- Compliance with the EPBC Act and Regulations and the provisions of this management plan needs to be monitored and enforced.
- Enforcement activities by park staff and relevant agencies must comply with Australian Government legislation, policies and guidelines.

What we are going to do

Policies

- 7.3.1 Compliance and enforcement activities in the park will be carried out in accordance with the Director's compliance and law enforcement policies and strategies.
- 7.3.2 Compliance and enforcement priorities will reflect assessed risks and will be regularly reviewed.

Actions

- 7.3.3 Assess permit applications, provide briefings to applicants and issue permits where appropriate having regard to Section 7.1, Assessment of proposals.
- 7.3.4 Further develop, implement, monitor and review compliance and law enforcement strategies.
- 7.3.5 Carry out surveillance, compliance and, as needed, law enforcement activities, including educational activities and patrols of the park.
- 7.3.6 Liaise and, where appropriate, seek to work collaboratively with relevant stakeholders, particularly the Australian Federal Police, the Department of Immigration and Border Protection and the Western Australian Department of Fisheries, in relation to compliance and enforcement issues.

7.4 Incident management

Background

Incidents in the park and on the southern atoll may potentially affect park values, property or people's safety. Incidents may include vehicle or boating accidents; missing or injured people; and damage to Parks Australia's infrastructure or the park's natural environment from natural causes like cyclones or accidents such as chemical spills. Incidents that result in the destruction of, or damage to, park property or any part of the park environment from deliberate human activity, as prescribed by the EPBC Regulations, are managed in accordance with Section 7.3.

The Director has the function under the EPBC Act of administering, managing and controlling the park. This gives the Director responsibility in relation to emergencies in the park. Also, the Director has a duty of care for park visitors and staff, and a duty under the *Work Health and Safety Act 2011* to take reasonably practicable steps to protect employees and park visitors from risks to their health and safety.

Staff and visitors to the park are normally required to swim between a landing vessel and the island shore when landing on, and being picked up from, North Keeling Island. Similarly, any equipment for the visit to the island must be transferred by hand between a landing vessel and the shore. Difficult weather conditions can increase the severity of wave heights and ocean conditions. Management of this risk is through briefing and education for all visitors to the park and ensuring that all visitors are proficient and able-bodied swimmers, and through assessment of conditions prior to travelling to the island and when considering the transfer operation. Travel to the island and transfer of personnel from boat to shore and vice versa are frequently cancelled due to weather conditions.

In the late 1980s, military personnel disposed of live World War II ammunition found on the southern end of the western beach. Waves had eroded sections of the beach and exposed the ammunition, which had been previously undetected. Reports suggest that Japanese armed forces stored them together with submarine fuel. The fuel and some ammunition was found and destroyed some time after World War II. Unexploded ammunition remains a potential risk to staff and visitors accessing the island.

The Cocos (Keeling) Islands are subject to high winds and storm events requiring disaster management procedures that apply across the islands. Participation of staff in managing these risks is essential. Difficulties accessing North Keeling Island often results in the need to draw on partnerships and commercial vessels to assist in transport to and from the island. Assistance is also required for evacuation and/or recovery operations in the case of injury or emergency on North Keeling Island. Similarly, as a member of the Cocos (Keeling) Islands Emergency Management Committee, Parks Australia would, as requested and within its capacity to do so, assist the Territory Controller in the event of an off-park emergency on the Cocos (Keeling) Islands.

Pulu Keeling National Park will continue to be a site where unauthorised boat arrivals land during the period of operation of this plan. The Department of Immigration and Border Protection has primary responsibility for managing unauthorised boat arrivals to Australia and its territories, and works with agencies such as the Australian Federal Police to undertake tasks associated with the arrival of unauthorised vessels at Cocos (Keeling) Islands (including North Keeling Island) and processing of asylum seekers.

The Australian Federal Police (AFP) is generally responsible for coordinating land and marine search and rescue operations on Cocos (Keeling) Islands. In complex emergencies the Officer in Charge of the AFP performs the role of Territory Controller and coordinates the emergency response in liaison with representatives from relevant agencies, including (if and as needed) the Director. The Territory Controller has powers to draw on available resources wherever they are and whoever controls them.

Issues

- Responding to incidents to address the Director's duty of care obligations can be difficult due to limited response capacity.
- Cocos (Keeling) Islands are subject to severe weather events, particularly cyclone activity.

What we are going to do

Policies

- 7.4.1 Incidents will be responded to in accordance with legal obligations and relevant policies and procedures, including procedures agreed to between the Director and emergency response agencies.
- 7.4.2 Subject to legal requirements, the Director may seek reimbursement of, or contributions to, the cost of responding to incidents.

Actions

- 7.4.3 Develop and update incident management procedures for managing incidents that may affect people's safety, the environment and property that:
- (a) are consistent with territory-wide emergency response procedures
 - (b) outline the roles and responsibilities of the Director and other agencies
 - (c) identify training, recording/reporting and debriefing requirements
 - (d) use evidence (from data, debriefs etc.) to improve procedures and responses.
- 7.4.4 Participate in emergency management activities, exercises and responses as requested by the Territory Controller.

7.5 New activities not otherwise specified in this plan

Background

This plan sets out how the park will be managed for a period of 10 years. During that time, circumstances or proposals may arise that were not known or anticipated at the time of preparing this plan. This may require the Director to take actions that are not covered by specific policies and actions in this plan.

As noted earlier in this plan, under ss.354 and 354A of the EPBC Act certain types of actions can only be taken if they are authorised by this plan (including actions in relation to native species, works, and commercial purposes). Actions affecting species protected under Part 13 of the Act may be taken in accordance with this plan. Other parts of this plan and the 'Background' section of the plan note additional requirements relating to the EPBC Act, including to listed heritage sites.

Section 358(2) of the EPBC Act allows the Director to grant a lease, sublease, or licence relating to land in the park provided it is in accordance with a management plan. There is potential for areas of land in the park to be used or occupied by other persons or agencies for purposes such as weather stations and navigational/communications equipment.

The Director is required by the Act (s.362) to exercise the Director's powers and to perform the Director's functions so as to give effect to the plan. Under section 354 of EPBC Act the taking of actions for commercial purposes in the park must not be done unless it is in accordance with this plan. Under r12.36 of the EPBC regulations commercial activities must not be carried out unless it is in accordance with a permit issued by the Director. A licence to undertake an activity in a Commonwealth reserve includes provision to permit the activity described within the licence.

Issue

This plan needs to enable appropriate actions to be taken and authorised that are not otherwise specified because they were not foreseen at the time of the plan's preparation.

What we are going to do

Policies

- 7.5.1 The Director may take actions that are not covered by specific prescriptions in this plan, including actions covered by ss.354 and 354A of the EPBC Act.
- 7.5.2 The Director may authorise (whether by permit, contract, lease, sublease or licence) actions by other persons that are not covered by specific prescriptions in this plan, including actions covered by ss.354 and 354A of the EPBC Act or the EPBC Regulations.
- 7.5.3 Subject to assessment under Section 7.1, Assessment of proposals, and any relevant lease conditions, the Director may grant subleases and licences of land in the park.

7.6 Management plan implementation and evaluation

Background

The Director's management effectiveness framework is used to help monitor and improve the management of Commonwealth reserves. The policies and actions contained in this plan have been developed to achieve the Director's key result area outcomes, this plan's objectives and government legislative requirements (including the EPBC Act) that deal with specific attributes and issues related to the management of the park.

It is the responsibility of the Director under s.514B of the EPBC Act to administer, control, protect, conserve and manage biodiversity in Commonwealth reserves. As an authority for the purposes of the *Commonwealth Authorities and Companies Act 1997*, the Director is also subject to the requirements of that Act as well as other relevant legislative requirements and government policies. These policies include the Department's Risk Watch List, which is used to identify and help manage departmental risk management issues.

Park staff are responsible for management of the park's day-to-day operations and its budget, and manage the park in accordance with the Chief Executive Instructions and policies of the Director, including this plan.

Issues

- Monitoring, reporting on and implementing this plan must be done effectively and responsibly, consistent with relevant government policies and requirements.
- The effectiveness of the plan's implementation needs to be evaluated before the next plan is prepared.
- This plan prescribes many actions which need to be prioritised and may require additional funding.

What we are going to do

Policies

- 7.6.1 Priorities for implementing policies and actions in this plan and for budget allocations will be determined by the need to protect park values, ensure safety and cost effectiveness and any other priorities as determined by the Director.
- 7.6.2 Park management activities will be carried out in accordance with government legislative, policy and other requirements.

Actions

- 7.6.3 Develop and implement a Performance Monitoring Plan for the park to enable performance reporting on the management of the park and its values.
- 7.6.4 Develop, implement and maintain a Management Plan Implementation Schedule throughout the life of the plan to guide annual work programs and to determine management priorities, scheduling and funding allocation.
- 7.6.5 Annually monitor, review and report on the implementation of this management plan.
- 7.6.6 Audit the plan's implementation before preparing the next management plan. The audit will include, but not be limited to:
- (a) assessing whether the policies and actions were successfully adopted or implemented and if not, the reasons why
 - (b) assessing whether the policies and actions were successful in meeting the objectives outlined in the plan, the EPBC Act requirements and maintaining park values
 - (c) making recommendations for the preparation of the next plan.



A description of the Cocos (Keeling) Islands and Pulu Keeling National Park

A description of the Cocos (Keeling) Islands and Pulu Keeling National Park

Location of the Cocos (Keeling) Islands

Located in the Indian Ocean (latitude 12°12'S, longitude 96°54'E), the Cocos (Keeling) Islands are approximately 2,900 kilometres north-west of Perth, 975 kilometres west-south-west of Christmas Island and 1,000 kilometres south-west of Java Head in Indonesia. They are one of Australia's most distant and isolated territories. The Cocos (Keeling) Islands consist of 27 separate islands, the land area of which totals some 14 square kilometres (see Map 2).

The island group comprises two separate atolls: the southern, inhabited atoll of 26 islands, and the northern atoll, North Keeling Island – a single figure-eight shaped island – which is located 24 kilometres to the north of the southern group of islands. The atolls are connected by a submerged ridge at a depth of 700–800 metres. Together they comprise a single feature rising from the surrounding ocean floor.

Pulu Keeling National Park was proclaimed in December 1995 and is Australia's sixth Commonwealth national park. 'Pulu' is the Cocos-Malay word for island. The boundary of the park is rectangular in shape. The park includes 213 hectares of land on the island (including the central lagoon) and a marine area of 2,390 hectares surrounding the island (see Map 3).

Settlement of the Cocos (Keeling) Islands

Captain William Keeling of the Dutch East India Company is believed to have been the first European to sight the islands in 1609 on his return from Bantam in the Dutch East Indies, though there is no formally documented record of that sighting.

In 1805, when sailing through this region of the Indian Ocean, the British hydrographer James Horsburgh named the island group the Cocos-Keeling Islands, after the coconut (*Cocos nucifera*) which grow in profusion on the islands, and named Horsburgh Island after himself.

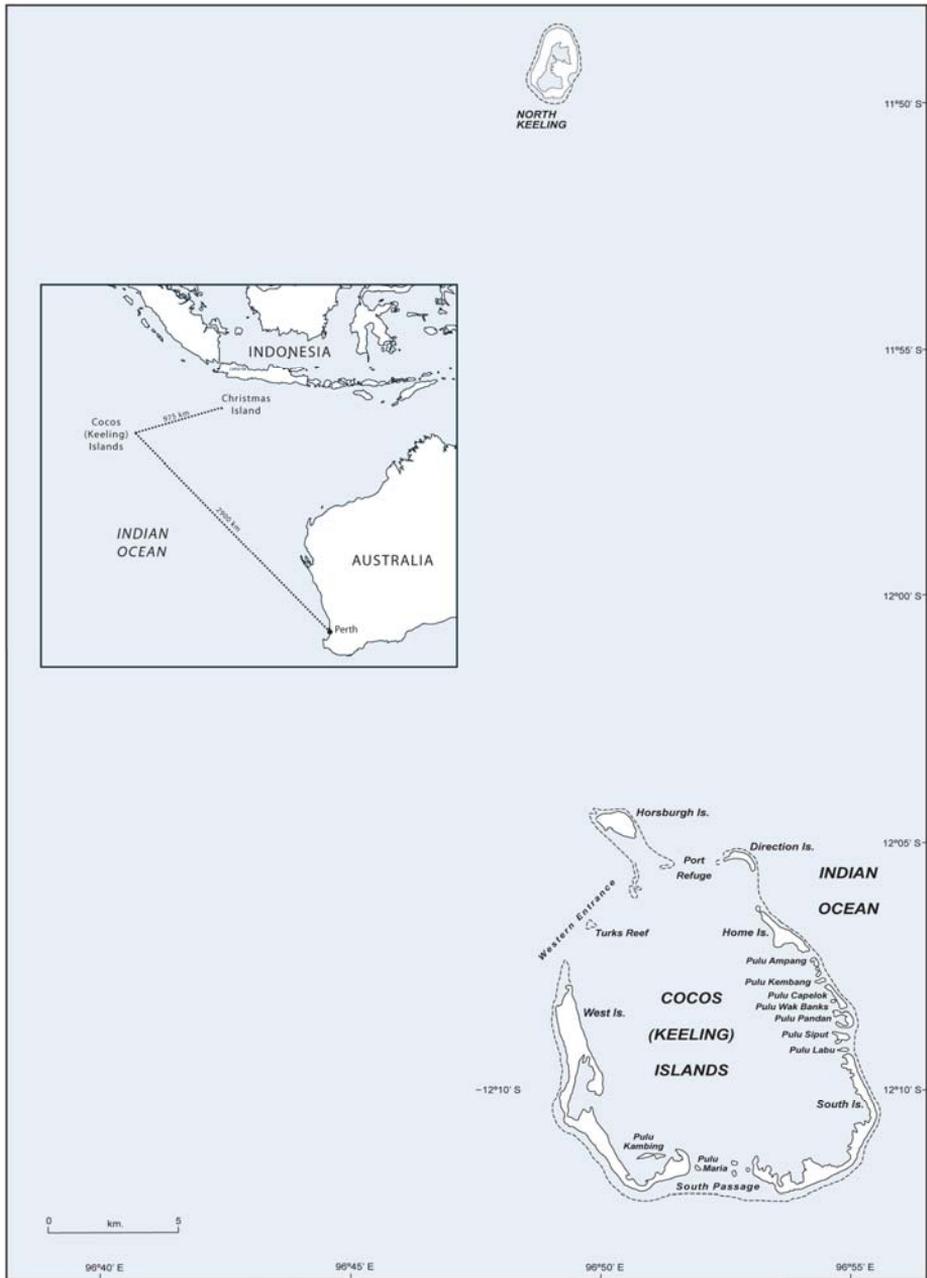
On 6 December 1825, Captain John Clunies-Ross, a Scottish merchant seaman sailing the *Borneo* made a brief landing on the uninhabited islands when searching for a possible new place to reside for English merchant Alexander Hare, who owned and operated the merchant vessel *Borneo*.

The first permanent settlement on the islands was led by Alexander Hare, arriving in 1826. Hare commenced commercial activity on the islands with the harvesting of coconuts and the production of coconut oil. A second settlement began in 1827 with the arrival of a party led by Captain John Clunies-Ross. Clunies-Ross was also keen to establish his own settlement and exploit the island's coconut supplies.

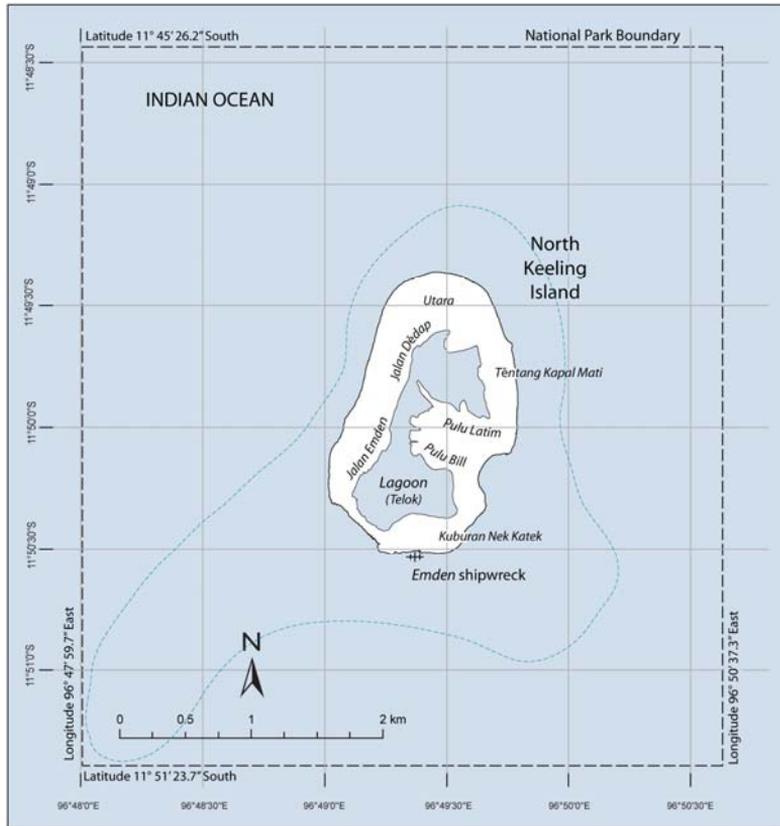
The relationship between Clunies-Ross and Hare was poor, with both claiming ownership of the islands, but in 1831 Hare eventually departed the atoll, while the Clunies-Ross family remained for more than 150 years.

In 1857 the islands were declared a part of the British Dominions by Captain Fremantle, who arrived aboard HMS *Juno* (Gibson-Hill 1947). In 1886, Queen Victoria granted all of the islands, under certain provisions, to John George Clunies-Ross (the third descendant of Captain Clunies-Ross) and his heirs in perpetuity.

Map 2: Location of the Cocos (Keeling) Islands



Map 3: Pulu Keeling National Park



Formal responsibility for supervision of the islands was transferred over the years to the Governments of Ceylon (1878), the Straits Settlements (1886), Singapore (1903) and Ceylon once again (1939–45). They became a Territory of the Commonwealth of Australia in 1955. In 1978 Australia purchased all of the land, except the family home, from the Clunies-Ross family for \$6.25 million. The Clunies-Ross family papers contain detailed information on the history and use of the islands during this time. The family home and the Clunies-Ross collection of historic books, documents, furniture and paintings were purchased by the Australian Government in 1993 for \$1.2 million.

In 1984, through a United Nations supervised Act of Self Determination (ASD), the Cocos-Malay population on the islands voted to formally integrate with Australia. The ASD process instigated a commitment by the Commonwealth to raise services and standards of living to comparable Australian levels within 10 years (Carlsen 1995).

Early inhabitants of the Cocos (Keeling) Islands called the islands the Borneo Coral Reefs after the supply vessel, the *Borneo*, earlier captained by John Clunies-Ross. The islands were also known as the Keeling-Cocos Islands until 1955, when they officially became the Cocos (Keeling) Islands.

There are about 460 Cocos-Malay people currently living in the *kampong* (settlement) on Home Island in the southern atoll. The population of Home Island predominantly descends from Malay workers brought to the Cocos (Keeling) Islands to work in the coconut plantations established by the Clunies-Ross family in the 1830s. These Cocos-Malays have developed a unique culture based on Muslim beliefs and have colourful celebrations for events such as *Hari Raya* (a significant day of celebration and reconciliation for the local Cocos-Malay community) and weddings.

About 140 people – mostly government employees, contractors and their families – live on West Island.

Governance of the Cocos (Keeling) Islands

The Cocos (Keeling) Islands have been an External Territory of the Commonwealth of Australia since 1955. The *Cocos (Keeling) Islands Act 1955* provides the basis for the territory's administrative and legislative systems. The *Territories Law Reform Act 1992* amended the *Cocos (Keeling) Islands Act 1955* to apply various Commonwealth Acts and the laws of the State of Western Australia to the territory. This introduced a contemporary body of Australian law to the territory and was a major step in extending to the residents of the territory the same rights, responsibilities and obligations as their fellow Australians.

Administration of the territory is the responsibility of the Australian Government department that administers the *Cocos (Keeling) Islands Act*. At the time of preparing the plan, this is the Australian Government Department of Infrastructure and Regional Development (Territories Administration).

Administration includes provision of state government type services. Some services are provided through service delivery arrangements between the Australian and Western Australian governments. Other on-island Australian Government agencies and departments include the Department of Immigration and Border Protection, the Department of Agriculture and the Australian Federal Police.

The Cocos (Keeling) Islands Shire Council has similar responsibilities to local governments on mainland Australia.

History of North Keeling Island

North Keeling Island was sketched by the Swedish captain Carl Gustaf Ekeberg in 1749 and appears on the 1787 chart reproduced by Alexander Dalrymple, the British hydrographer. Vice Admiral (at the time Captain) Robert Fitzroy examined and mapped it from HMS *Beagle* in 1836, but made no landing.

North Keeling Island has not been inhabited for any extended period and is in a relatively natural state. Its remoteness from the southern atoll, its difficult landing area and the absence of a reliable freshwater supply have combined to preclude any possibility of permanent settlement. Nevertheless, Cocos-Malay boats have paid occasional visits to this island almost every year since the early days of the occupation of the southern atoll. These hazardous voyages were usually made to collect coconuts, timber and seabirds (Bunce 1988).

Late in the 19th century, beri-beri sufferers lived on the island in small camps for short periods. Malay graves near the southern shore of the island mark the final resting place of a woman and a girl who succumbed to this dietary deficiency, and a man (also suffering from beri-beri), who died in an accident (Bunce 1988).

During World War I, in November 1914, Captain Karl von Müller sailed the German light cruiser SMS *Emden* to the Cocos (Keeling) Islands on a mission to destroy the Eastern Telegraph Company wireless station at Direction Island to cripple Allied communication in the Indian Ocean. The *Emden* was challenged by HMAS *Sydney* and, after an unsuccessful battle with the more powerful Australian light cruiser, the *Emden* was run aground on the windswept southern reef of North Keeling Island.

German losses were 131 dead and 65 wounded. Around 50 German crew members who landed on Direction Island to destroy the station's radio tower and equipment were able to escape to Sumatra on a commandeered sailing vessel, the *Ayasha*. Captain von Müller and the rest of his crew on the *Emden* were taken prisoner; however, not all of the ship's survivors were prepared to give themselves up, and a handful hid on North Keeling Island. In October 1915, a work gang from Home Island found a number of their skeletons, which they buried on the shore of North Keeling near the wreck (Gibson-Hill 1948).

From October 1915 to January 1916, the islanders salvaged what they could from the German ship. Anything detachable and portable was removed and transported to the landing area by trolleys that ran on narrow railway lines. The stripped hulk later slipped back off the reef into deeper water after a cyclone (Gibson-Hill 1948). In 1950, a Japanese salvage company removed as much of the hull of the *Emden* as they could and shipped it back to Japan (Bunce 1988).

What remains of the *Emden* lies approximately 100 metres off the southern end of the island in three to nine metres of water. The *Emden* is listed under the *Historic Shipwrecks Act 1976* and has marine archaeology research potential.

Between World War I and World War II, groups of Cocos-Malay workers were stationed on North Keeling Island for up to two weeks at a time, harvesting coconuts, ironwood and birds. Historically ironwood was collected in considerable quantities, mainly for boat building and firewood. Ironwood was cut from around the margins of the lagoon, where it forms a thicket with tea shrub. The small-gauge rail system used initially to transport salvage from the wreck of the *Emden* was used during this period to transport goods. The corroded and incomplete remains of these tracks still exist. The decayed remains of small rail carriages can also be seen near the island landing site.

On the western shores of the lagoon there is evidence of two *atap* (long-houses) which were briefly inhabited during this time by the Cocos-Malay workers. Once or twice a week they received a visit from an estate vessel delivering foodstuffs and water and returning to Home Island with timber, coconuts and birds (Bunce 1988).

Historically all access to North Keeling Island was under direct supervision of the Clunies-Ross family. After the death of John Sydney Clunies-Ross in 1944, the frequency of seabird hunting trips to North Keeling Island increased considerably. Groups of *jukongs* (small sailing boats) sailed to the island whenever the weather was suitable, and thousands of birds were brought down with shotguns as well as traditional flails. Barges also travelled to the island once or twice a year to gather coconuts or bring back birds for *Hari Raya* festivities (Bunce 1988). After the Australian Government purchased the islands, people were required to obtain a permit from the Cocos (Keeling) Islands Shire Council prior to visiting North Keeling.

In the late 1970s and early 1980s, the acquisition of more efficient boats and weapons by the Cocos-Malay people greatly increased the frequency and efficiency of bird-hunting, primarily of the red-footed booby, on North Keeling Island (Stokes 1994). In 1982, the Australian National Parks and Wildlife Service, now Parks Australia, investigated the situation and recommended urgent control of hunting (Stokes et al. 1984).

By July 1986, agreement had been reached with the Cocos-Malay people for a seabird hunting moratorium on North Keeling Island and the institution of a quota system of hunting for Horsburgh Island. Cyclone John devastated the red-footed booby population in 1989 and all legal hunting ceased to allow the population to recover. In October 1992, Part 3 of the National Parks and Wildlife Regulations (made under the *National Parks and Wildlife Conservation Act 1975*) came into operation and provided protection for the red-footed booby and other species in the Cocos (Keeling) Islands Territory.

In July 2000, the *National Parks and Wildlife Conservation Act 1975* was replaced by the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Red-footed boobies are listed as a migratory species under the EPBC Act and as a consequence are protected under that Act. Similarly, many other migratory species occurring in the park, listed as migratory under the EPBC Act, are protected under national legislation and international agreements (See Appendix E). The taking, trading, keeping, moving, killing or harming of a listed species requires a permit under the EPBC Act. At the commencement of this plan, no permits have been issued under the EPBC Act for the harvest of red-footed boobies in the Cocos (Keeling) Islands.

History of Pulu Keeling National Park

In 1984, the Commonwealth handed over most of the land of the Cocos (Keeling) Islands to the Cocos (Keeling) Islands Shire Council, to be held in trust for the people of the islands. This trust deed stipulated that North Keeling Island was to be managed to conserve, among other things, the unique flora and fauna of the island.

The conservation significance of North Keeling Island was clearly recognised when it was recommended to become a national park or nature reserve by House of Representative committees in 1990 and 1991.

In mid 1993, the Cocos (Keeling) Islands Shire Council decided, in principle, to lease North Keeling Island to the Commonwealth for the creation of a national park. This lease was signed by the Commonwealth and the Council in January 1995. Pulu Keeling National Park, comprising North Keeling Island and surrounding waters, was later declared by proclamation under the *National Parks and Wildlife Conservation Act 1975* on 12 December 1995. The Commonwealth's interest as lessee of North Keeling Island passed to the Director of National Parks in accordance with the *National Parks and Wildlife Conservation Act 1975*.

The entire park was listed as a Wetland of International Importance under the Ramsar Convention in 1996.

The *National Parks and Wildlife Conservation Act 1975* was replaced in July 2000 by the EPBC Act. Under the *Environmental Reform (Consequential Provisions) Act 1999* the proclamation of Pulu Keeling National Park continues as if it had been made under Section 344 of the EPBC Act.

The *Environmental Reform (Consequential Provisions) Act 1999* defines the purposes of the park as:

- (a) the preservation of the area in its natural condition
- (b) the encouragement and regulation of the appropriate use, appreciation and enjoyment of the area by the public.

Such purposes are generally consistent with Australian International Union for the Conservation of Nature (IUCN) category II (national park), which generally allows frequent but sustainable visitor access and recreational activities. The 1995 declaration of the reserve indicated that the North Keeling Island and its surrounding marine waters should be managed as a wilderness zone in recognition that the natural and cultural values of the park can easily be impacted by visitors and their activities.

The EPBC Act requires this management plan to assign the park to an Australian IUCN category. Under this plan, the terrestrial and lagoon components of the park have been assigned Australian IUCN category Ia (strict nature reserve) in keeping with the original intention of the proclamation of the park. See also Section 2, IUCN category.

As an IUCN strict nature reserve, the park's land area is primarily managed for scientific research and environmental monitoring, and to preserve its habitats, ecosystems and native species in as undisturbed a state as possible. However, the presence of a significant bird breeding area, a historic shipwreck and relatively pristine marine and terrestrial ecosystems provides unique and exclusive wilderness experience opportunities for a limited number of visitors, such as special interest groups intending to birdwatch or scuba dive, or educational groups.

The natural environment and ecology of Pulu Keeling National Park

Geology

The Cocos (Keeling) Islands consist of two separate coral atolls, 24 kilometres apart, which have formed atop an old volcanic seamount that rises from a depth of 5,000 metres in the north-eastern Indian Ocean.

Over the last 100 million years the Indo-Australian plate has moved steadily north towards the Java Trench. As it has done so, it has passed over a 'hot spot', or plume rising from deep in the mantle, producing a chain of seamounts with a south-west to north-east trend. Bathymetric research shows that the atolls' foundations are actually two of a series of undersea features known as the Vening-Meinesz Seamounts. This range of mountains also includes Christmas Island and extends in a north-easterly direction from a prominent seafloor feature of the Indian Ocean known as the Ninetyeast Ridge. The atolls of the Cocos (Keeling) Islands are two peaks in a section of the range known as the Cocos Rise (Jongsma 1976).

Sediments on the Cocos Rise are very thin (100 metres to 200 metres thick) and no mineralisation or accumulation of petroleum has occurred (Jongsma 1976). The thickness of the corals underlying Cocos is not known, but the dredging of basaltic rocks in local waters suggests that it is in the order of 500–1,000 metres (Bunce 1988).

The two atolls are connected by a narrow submarine bank at a depth of 700–800 metres (Gibson-Hill 1948). Approximately 100 kilometres south-west of the Cocos (Keeling) Islands lies the Umitaka-Mary or Muirfield Seamount, which rises to 16 metres below the surface of the ocean. Taken as a series from Umitaka-Mary in the south-west to Christmas Island in the north-east, these seamounts display a sequence in the evolution of atolls.

Geomorphology and topography

North Keeling Island is approximately 2 kilometres long and 1.3 kilometres wide, with an internal lagoon, and a terrestrial area of 1.2 square kilometres above high water mark. It is approximately shaped like a figure eight, with its long axis bearing slightly north-east. Like the southern atoll, it is a true coral island.

In form, the island is low and flat. The shore rises fairly steeply to a height of 3–5 metres, and from this peripheral ridge the ground slopes gently down to a large, shallow lagoon which occupies the greater part of the interior (see Map 3).

The composition of the island varies from sand to coral rubble. On the northern shore there is a broad, sandy beach. This continues along the western shore but with varying amounts of shingle. In profile, the sandy beach rises up to about 4 metres above mean sea level. The southern shore of the island is composed of a spectacular steep shingle beach, with a series of berms, or ridges. The entrance to the lagoon was previously located on the eastern side of the island. In 2005, the entrance to the lagoon closed as a result of natural forces of deposition. Much of the eastern shore is composed of a series of shingle berms; these are particularly well-developed along the south-eastern shore, south of the closed entrance to the lagoon, but also continue to the north.

There are also outcrops of coral conglomerate. A broad platform of conglomerate extends out over the reef flat at the eastern part of the island. Along much of the southern and eastern shore, the conglomerate outcrops occur at the foot of the beach but contain a series of parallel rubble ridges, that are dipped and stratified like beachrock.

The Cocos (Keeling) Islands were the only coral atolls that Charles Darwin visited in 1836 as he developed his well-known theory of coral atoll formation (Darwin 1842), in which he asserted

that the upgrowth of coral reefs continued long after the seamounts that supported them had subsided. While others, including Guppy (1889) and Wood-Jones (1912), presented alternative theories, Darwin's subsidence theory of coral reef development gained wide acceptance.

The location of the now closed entrance to the lagoon is unusual because it developed on the most windward side of the island, rather than in the shelter of the leeward side. Indeed, the island is the inverse of the horseshoe shape that Guppy (1889) considered the typical style of development of the main atoll. This has led a number of observers, starting with Fitzroy (1839), to suggest that the island developed from a series of formerly unconnected islands.

Some indication of the age of the island has been found through radiocarbon dating. A coral from a conglomerate on the northeast of the island dated $3,840 \pm 85$ years before present (BP). Similarly, a coral shingle sampled from a pit in the centre of the island was dated as $3,060 \pm 60$ years BP, suggesting little time difference between the formation of the beach at the margin of the reef platform and the formation of the island itself. Continual additions to the island have occurred over the past 3,000 years, including the build-up of sediments and coral blocks during cyclonic events (Woodroffe et al. 1994).

Soils

The soils of North Keeling Island are calcareous and derived from coral breakdown. They comprise a relatively thin layer of sandy loam, which in places grades into moderately and/or very stony sand comprising considerable amounts of coral clinker. They overlay a highly permeable sub-stratum which allows rapid leaching of nutrients. On the main (southern) atoll, long-term leaching has led to deficiencies in iron, potassium, copper, manganese, magnesium and other minerals (Cameron McNamara Consultants 1984). This leaching has probably also occurred on North Keeling Island. Similarly, the soils of North Keeling Island are expected to be highly alkaline, as on the southern atoll, with pH levels of between 8.0 and 8.5. Soils abutting the outer shore are subject to wave erosion during high tides and storm surges.

The lagoon shore of the island slopes gradually and deepens slowly. Its maximum depth is less than 2 metres. The bottom, and much of the beach, is a fine, greyish sandy silt, much of which is derived from decaying vegetation. Towards the eastern recesses this is greyer and darker, and in the north-east corner the beach is composed of a fine, dark, brownish mud. In a few places, particularly towards the southern end, the sand is replaced by a bare breccia slope and jagged fragments occur all down the west side.

Along the sheltered sides of the island, the shore is composed partly of coral shingle and partly of patches of white sand. However, periodic storms and changes in wave alignments alter the distribution of beach sand on an annual cycle. On the south and east coast (the windward sides) the bank is almost entirely coral shingle.

Hydrology

The non-marine water resources of the Cocos (Keeling) Islands consist essentially of groundwater and rainwater. Where conditions are favourable, fresh groundwater on coral islands occurs in the form of shallow lenses beneath the ground surface. Such lenses are found in some of the larger islands within the Cocos (Keeling) Islands. Due to the generally porous nature of the soils and underlying geology, there is no significant surface run-off. Run-off only occurs in localised areas where the ground is compacted and only for very short periods after heavy rain.

Preliminary investigations on North Keeling Island (Falkland 1988, 1992) indicate the presence of a very thin freshwater lens on at least part of the island. It is not known whether this lens is permanent.

Gibson-Hill (1948) states that the North Keeling Island wells were sunk to a depth of 3.6–4.5 metres before World War II when between 40 and 60 Cocos-Malay people lived there for up to three months at the end of each year, collecting coconuts and timber. The water in the wells was reported to be brackish, and was used for washing and cooking rather than drinking.

The broader western side of the island is an average 300–400 metres wide. This roughly equates to the minimum 400 metre width of larger islands on the southern atoll, which is necessary to sustain a freshwater lens on tidally influenced saltwater (Jacobson 1976).

The closure of the lagoon entrance in 2005 as a result of natural forces of deposition has led to significant changes within the lagoon habitat. Whilst the water level of the lagoon varies, depending on rainfall and evaporation, seawater no longer enters the lagoon and levels are not affected by tidal fluctuation. Without regular flushing of seawater, the lagoon will become further deoxygenated and brackish and is likely to support freshwater weeds in the shallower waters.

A positive impact of the lagoon closure is the colonisation of the lagoon entrance by plants and trees that provide additional habitat for breeding seabirds. Masked boobies have been observed nesting in this area since the closure of the lagoon (Hobbs 2009).

Climate

The climate of North Keeling Island corresponds closely with that of the southern atoll of the Cocos (Keeling) Islands.

The Cocos (Keeling) Islands are situated in the humid, tropical zone, at the southern edge of the equatorial low-pressure belt which moves northwards and southwards according to the season. The islands are subject to the north-west monsoons from January to May, which are moderated by oceanic conditions. Relatively strong, constant south-east trade winds blow for much of the year, both during and outside the monsoon season.

In 2010, the wettest year on record for the Cocos (Keeling) Islands, over 3 metres of rainfall was recorded.

The main climatic features of the islands are:

- Annual rainfall varying between about 855 and 3,490 mm, with an average of 1,979 mm per annum
- Annual evaporation of about 2,375 mm, with an average daily evaporation of 6.5 mm
- Relatively uniform temperatures, with an average daily maximum temperature of 29°C and average daily minimum temperature of 24.5°C
- Relative humidity ranging between about 60 per cent and 85 per cent, with a mean of about 75 per cent
- Mean daily surface pressure of approximately 1,010 hectopascals. Extremely low pressure values may, however, be recorded during the passage of tropical cyclones
- Prevailing winds from the east to south-east for all months, showing the influence of the south-east trade winds
- Varying mean daily wind speeds, with the trade winds averaging 25 to 30 kilometres per hour and a maximum gust during a cyclone recorded at 176 kilometres per hour in 1968.

In 2006, the Director commissioned a study of the potential implications of climate change for management of Commonwealth reserves, including Pulu Keeling National Park (Hyder 2008). The terrestrial and marine environments of the park are potentially exposed to a number of impacts associated with climate change.

The future climate change projections include:

- Increased seasonal air temperature ranging from 0.6°C warmer by 2030 to 1.8°C warmer by 2070
- Increased sea surface temperature by 0.6°C in 2030, which may reach 1.8°C by 2070
- Possible reduction in rainfall during the dry seasons
- An average sea level rise of 14 centimetres in 2030, 40 centimetres by 2070 and up to 1.1 metres by the end of the 21st century (worst case scenario)
- A doubling of the number of intense tropical cyclones by 2030, decreasing by 2070 (AECOM 2010).

As the island rises only four meters in elevation and lies within a cyclone prone area of the Indian Ocean, rising sea levels and more severe storm events predicted to occur as a result of climate change have the potential to severely impact the vegetation, wildlife and morphology of the island.

Hyder recommended a review of existing strategies and activities related to the management of weeds, invasive pest animals, visitor access and commercial activities (such as recreational fishing) in and around the park (Hyder 2008). The management actions and policies in this plan provide a suitable response to these recommendations, maximising protection of habitats within the park through minimising the potential impacts of human visitation, invasive species and commercial operations.

The Territory Administration commissioned a climate change risk assessment for the Indian Ocean Territories, which was finalised in 2010. Recommendations from this risk assessment will be considered during/through the implementation of this plan.

Terrestrial environment

Flora

North Keeling Island is a very remote oceanic island that has always been isolated from any large land mass. Before it was first visited by people, colonisation of the island by plants and animals could have occurred only by wind, pelagic drift, flight or animal carriage. The origins and development of the flora and fauna of the island into a unique assemblage of 'travelling' species has long fascinated biologists.

In terms of geological substrate and elevation, the Cocos (Keeling) Islands have similarities with some of the islands of the central and western Indian Ocean, for example the Maldives and the Farquhar Group. All of these low islands have evolved in isolation from a continent, through the combined forces of vulcanism, subsidence and coral growth. They all now rise less than 10 metres above sea level (Williams 1994b). The low habitat diversity of these islands leads to a flora characterised by very low endemism with indigenous taxa of pan-tropical or Indo-Pacific distribution dominating (Renvoize 1979).

The Cocos (Keeling) Islands are no exception to this general pattern, with only one endemic plant, *Pandanus tectorius* ssp. *cocosensis* (Renvoize 1979). Sixty-one plant species have been recorded on Cocos (Keeling) Islands and 40 plant species have been recorded in the park.

North Keeling Island has a number of species not found on the southern atoll, including:

- African cabbage (*Cleome gynandra*)
- maunaloa (*Canavalia cathartica*)
- Indian coral tree (*Erythrina variegata*)
- saltwater couch (*Paspalum vaginatum*)
- tit-berry (*Allophylus cobbe*)
- West Indian woodnettle (*Laportea aestuans*).

Some species are more abundant on North Keeling Island than on the islands of the southern atoll, either because there are greater areas of suitable habitat on North Keeling Island or due to clearing over the last 160 years on the southern atoll (Williams 1994a). Much of the southern atoll was cleared and planted with *Cocos nucifera* as part of the Clunies-Ross estate. The naturally occurring coconut trees of North Keeling Island, which drifted to the island over thousands of years, are considered to be the most primitive form of the species (Gunn et al. 2011).

Other species on North Keeling Island have a restricted distribution and most of these are found on the northern peninsula at the previous site of the entrance to the lagoon, on the north-west shore and adjacent habitats.

The vegetation of North Keeling Island was divided into four zones by Gibson-Hill (1948):

- pisonia (*Pisonia grandis*) and coconut (*Cocos nucifera*) forest
- octopus bush (*Heliotropium foertherianum*) shrublands
- tea shrub (*Pemphis acidula*) thickets
- open grassy areas.

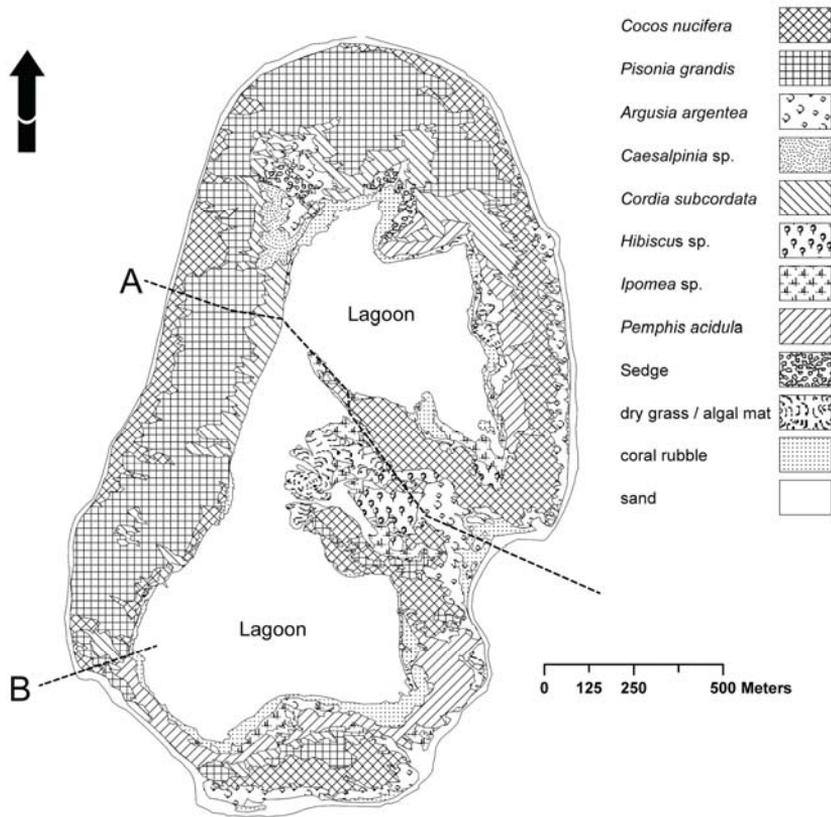
Much of North Keeling Island is dominated by the pisonia forest, fringed on the lagoon shore by tea shrub and on the exposed ocean shores by octopus bush shrubland. The island's closed canopy forests are unusual as they are composed of species generally found as stunted shrubs in successional forests on the shoreline of tropical islands elsewhere in the Indian Ocean region. *Cordia subcordata*, which generally occurs as a stunted shrub elsewhere, reaches the size of a large tree, and the pisonia trees themselves are unusually tall.

Octopus bush is common on the eastern shore, dominating the crest of the shingle or rubble ridges. In some cases it forms monospecific stands while north of the lagoon entrance it occurs with cabbage bush, *Scaevola taccada*. Around the margins of the lagoon, tea shrub forms dense thickets, replaced in some places by ironwood (*Cordia subcordata*). The open grassy areas often have a covering of sea purslane (*Sesuvium portulacastrum*) such as the clearing to the north-west of the lagoon.

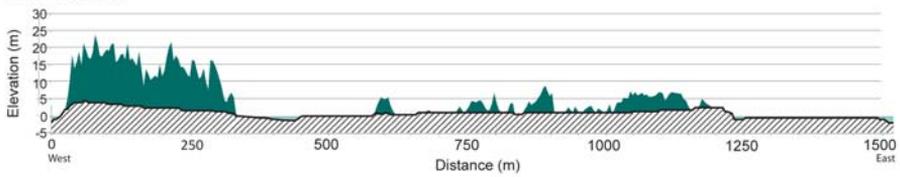
The richest diversity of plant species on the island, apart from the herblands, is found in the forest types near the closed lagoon entrance and on the north-west side of the island.

Each of these ecological communities supports breeding colonies of seabirds (see also Map 4). Appendix E lists native plants, exotic species and plant species with restricted distribution on North Keeling Island.

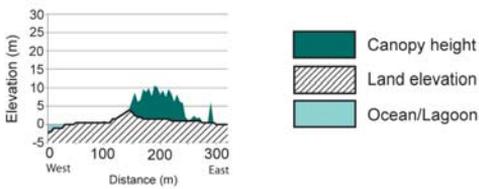
Map 4: Vegetation distribution on North Keeling Island



Cross section A



Cross section B



Fauna

Like the flora, the fauna of the Cocos (Keeling) Islands emanates from a number of locations. While no mammals exist on the island, land crabs are conspicuous on the forest floor, seabirds are prolific, with many island breeding species, and there are a host of small invertebrates present. Appendix C details species in the park that are listed under the EPBC Act and international agreements.

Terrestrial vertebrates

The only terrestrial vertebrates recorded from North Keeling Island are birds, the pantropical mourning gecko (*Lepidodactylus lugubris*), the introduced house gecko (*Hemidactylus frenatus*) and the rabbit (*Oryctolagus cuniculus*). The mourning gecko is relatively uncommon (Stokes and Cogger 1987). While the rabbit was an early introduction to the island, it had disappeared by the 1880s (Guppy 1890). At the time of preparation of this plan, the park is one of the few remaining tropical islands without introduced rats and other invasive vertebrate species like cats, significantly contributing to retention of the island's conservation values and significance.

Birds

When Charles Darwin visited the Cocos (Keeling) Islands in April 1836, the 'immense number' of marine birds recorded in 1828-29 on the southern atoll (cited in Gibson-Hill 1949) were probably somewhat diminished. Darwin does, however, refer to trees on the southern atoll being occupied by many nests of gannets [sic], frigate birds and terns, and to a smell in the air which led him to call it a 'sea rookery' (Darwin 1979). From Darwin's diary, it would appear that the forest of the southern atoll was by then well on the way to being transformed into the monoculture coconut plantation that it had become by 1885, when most birds had been eliminated from the southern atoll (Forbes 1885). The reason for this decline was almost certainly due to habitat change, intense hunting and predation by cats and rats. Today, there are still very few birds on the southern atoll.

Birds remain in large numbers on North Keeling Island due to its isolation, the difficulty of human access to the island, the absence of any feral predators (Stokes 1994) and the availability of forest nesting habitat.

Of the approximately 60 species of birds recorded from the Cocos (Keeling) Islands, 24 have been seen on North Keeling Island in the last 30 years. Of those 24, 16 breed on the island. All bird species recorded on North Keeling Island are protected by the EPBC Act, being listed threatened species (critically endangered, endangered or vulnerable), listed migratory species or listed marine species under the Act.

Thirteen species of birds in the park are listed under international migratory bird agreements between Australia and Japan, China and the Republic of Korea (JAMBA, CAMBA and ROKAMBA). These agreements require each country to take appropriate measures to preserve and enhance the environment of migratory bird species listed under each agreement.

As the only seabird breeding colony within a radius of 900 kilometres, the island is the focal bird habitat within a huge expanse of the central-eastern Indian Ocean. It is unlikely that any other Indian Ocean island rivals North Keeling's range of seabird species (Feare 1984; Stokes and Goh 1987). However, the health of many of the island's seabird species is largely unknown and careful management is required to avoid the decline in seabird populations seen on other Indian Ocean islands over the last 100 years.

By far the most numerous seabird on North Keeling Island is the red-footed booby (*Sula sula*). Based on comprehensive population surveys between 1985 and 1996, the current population is estimated at approximately 30,000 breeding pairs (Baker et al. 2007), making it one of the most important and possibly the largest colony of red-footed boobies in the world. Although the red-footed booby is the most numerous booby species in the world, most populations are threatened by habitat destruction and feral animals (Marchant and Higgins 1990).

Gibson-Hill (1948) estimated there were only 3,500–4,000 pairs of breeding red-footed boobies in July 1941. The main pisonia community on the western margin of the island, which now supports the major concentration of nesting red-footed boobies, was apparently devoid of nests at the time of Gibson-Hill's visit. Large numbers of birds of all ages have been harvested by Cocos-Malay people over the last century, and this undoubtedly had a significant impact on the population status. Protection of the population on North Keeling Island in more recent years has resulted in a much larger and more stable population, although it is still vulnerable to cyclones.

Lesser and great frigatebirds, *Fregata ariel* and *Fregata minor*, also occur on the island in large numbers. Data from surveys indicates a population size of possibly 3,000 breeding pairs of lesser frigate birds, with a smaller number of great frigate birds. North Keeling Island has the second largest population of lesser frigatebirds in Australia and probably in the Indian Ocean.

The Cocos buff-banded rail (*Gallirallus philippensis andrewsi*) is significant as the only endemic bird in the Cocos (Keeling) Islands. It is often sighted on North Keeling Island and occurs in all habitats. It frequently forages along the lagoon shore, eating crustacea, which are abundant in the seagrass deposited along the tide line. The closure of the entrance to the lagoon has significantly impacted on seagrass in the lagoon and potentially the foraging sites for the rail. Since the closure of the lagoon, rail populations appear to have remained stable, indicating that the species is capable of adapting to the changes in the lagoon and alternative suitable food resources are available.

The status of the rail in the Cocos (Keeling) Islands is of concern, as it no longer naturally occurs on the southern atoll. This is in contrast to the situation in 1906–07, when it was reported to be 'very abundant on all the islands' (Wood-Jones 1909). In the past the rail was widely hunted, and by 1941 a decline was apparent, with reduced numbers on West Island and Home Island (Gibson-Hill 1949). Buff-banded rails were not sighted on the southern atoll during the life of the previous plan.

The *National Recovery Plan for the Buff-banded Rail (Cocos (Keeling) Islands) Gallirallus philippensis andrewsi* (Commonwealth of Australia 2006) recognises the vulnerability of having only one population of this listed species, with potential for it to be impacted by catastrophic storm events, habitat modification and predation by cats and rats. The plan recommends the establishment of a second population of the buff-banded rail on the southern atoll and reduction of threats to the species across the island group.

Efforts towards the establishment of a second population on the southern atoll commenced in 2008, with 10 adult rails captured and tagged with radio transmitters. Information gathered from monitoring these adults was then used to determine preliminary estimates of the home range of the buff-banded rails.

Blood samples were also taken from 31 captured birds and DNA samples were successfully extracted to determine how individuals from various parts of the island are related. The results from this study indicate that the buff-banded rail population in the park is relatively low on genetic diversity due to a history of population fluctuation (foundation and bottleneck events) (Lux 2008). Individual rails not originating from the North Keeling population appear to have migrated to the island on one or more occasions in the past, with Australia as the likely source. The results of the study indicate that such events have increased the genetic diversity within the population and enabled recovery from a bottleneck event. Continuing divergence of the Cocos buff-banded rail into a more distinctive form is unlikely to be slowed by frequent immigrants.

The results of the study also indicate that conservation efforts should be a prime focus for this unique rail, as *Gallirallus philippensis andrewsi* is morphologically distinctive and represents the only member of *G. philippensis* to occur in the Indian Ocean. The study indicates the importance of assisting the conservation of this subspecies by the creation of a second population. The study suggests that, based on the genetic evidence collected, successful translocation of this subspecies would be an attainable goal (Lux 2008).

Thirty-nine Cocos buff-banded rails were relocated to Horsburgh Island in April 2013 consistent with the requirements of the recovery plan for the buff-banded rail (Woinarski et al. 2013). Monitoring of this population will be paramount to determine the viability of establishing and maintaining a second population of this endemic threatened species.

Establishment or enhancement of existing native vegetation at Horsburgh Island and other sites on the southern atoll may, in the long term, help support the reintroduction of the buff-banded rail and possibly hermit and robber crabs, and provide nesting habitat for sea and migratory bird species once found on the southern islands. Careful management, strict species protection and support from the Cocos community, the shire and other government agencies will be required for such a project to succeed.

The Round Island petrel, *Pterodroma armijoniana*, was listed in July 2002 as critically endangered under the EPBC Act. It breeds at fewer than five locations world-wide and was sighted in Pulu Keeling National Park in 1986. Although Parks Australia staff conducted surveys and visiting birdwatching groups have searched for the Round Island petrel during the life of the previous plan, there were no confirmed sightings of the Round Island petrel in Pulu Keeling National Park during that period.

White-tailed tropicbirds (*Phaethon lepturus*) are common, nesting in moderate numbers in hollows of mature pisonia trees.

Several species of migratory waders are occasionally seen feeding on the lagoon shoreline. The significance of the island as a staging point for migratory birds is not known.

Feral chickens (*Gallus gallus*) are reported to have existed on the island for many years from last century, but are no longer present (Guppy 1890; Gibson-Hill 1948).

During the Island Wide Survey conducted in 2009 an individual tropical shearwater (*Puffinus lherminieri*) was sighted on North Keeling Island. Photographs enabled clear identification of the individual and the sighting is being submitted to the Birdlife Australia Rarities Committee (BARC) for registration. This is the first known sighting of this species on the island.

Terrestrial reptiles

The mourning gecko (*Lepidodactylus lugubris*) has successfully colonised many oceanic islands including North Keeling Island, a success in part attributed to its ability to reproduce asexually (Cogger 1996). It is not possible to say whether the species made its own way to the Cocos (Keeling) Islands or whether it was introduced as a result of human activity (Cogger 1996).

Invertebrates

The park provides habitat for at least 26 species of crabs, the most conspicuous and probably the most numerous inhabitants of the forest floor and beach fringe. The little nipper (*Geograpsus grayi*) is common under the pisonia forest. The world's largest land crab, the robber crab (*Birgus latro*), listed as vulnerable by the IUCN, is occasionally observed within the forest but was probably more abundant prior to harvesting by Cocos-Malay people. Three species of hermit crabs are present in large numbers: the red hermit crab (*Coenobita perlata*); the purple hermit crab (*C. brevimana*); and the tawny hermit crab (*C. rugosa*). During the day the hermit crabs take refuge under logs and shrubs and at night they venture out to scavenge on the forest floor and beach.

The purple crab (*Cardisoma carnifex*) is abundant, particularly in the saltmarsh and on the fringes of the lagoon. The Christmas Island red crab (*Gecarcoidea natalis*) is commonly sighted on forest floor of the island and the yellow nipper (*Geograpsus crinipes*) also occurs in this habitat of the park. The horn-eyed ghost crab (*Ocypode ceratophthalma*) is commonly found on the north-western beaches, and *Grapsus tenuicrustatus* is common on rocky sections of the coast.

Appendix G lists the crustaceans recorded for the park and the whole of the Cocos (Keeling) Islands.

A species of cricket, *Ornebius* sp., occurs among the leaves of both cordia and pisonia, and *Nerius lineolatus*, a long-legged dipteran, and the Asian tiger mosquito (*Aedes albopictus*) are plentiful. Butterflies, ants, cockroaches, beetles and weevils are also present on North Keeling Island.

Spiders, a small wood-louse, centipedes, millipedes, termites, scorpions, various species of ectoparasitic ticks and mites, and a terrestrial mollusc (*Melampus* sp.) have been recorded on North Keeling, but as yet no earthworms have been found. Earthworms are abundant on the southern atoll.

Marine environment

North Keeling Island is entirely surrounded by a broken, irregular fringing reef, except at the north-west corner. The reef is narrower on the sheltered sides of the island (north and west), and broader on the exposed sides (south and east). On the east coast it is continuous across the now-closed mouth of the lagoon. Much of the reef is partly exposed at low tide (Gibson-Hill 1948). Along the western side of the island is a wide coral terrace which drops into deep water (Ecology Lab 1994).

Given its relatively pristine environment and isolation from the southern atoll, the park's marine waters provide a valuable reference area because there is minimal impact from human activities such as human settlement, pollution and commercial fishing.

In broad terms the park comprises three major marine habitat types:

- outer reef slope (subtidal)
- reef flats including sandy and rocky shores (predominantly intertidal)
- lagoon (predominantly subtidal) (Berry 1989).

The Cocos (Keeling) Islands represent the western limit for many species of the Western Pacific biogeographic province. Biogeographic and ecological interest in the marine biota also stems from the extreme isolation and relatively small size of the atolls, from which there are some unusual absences including benthic skates and rays.

According to Berry (1989), the extreme isolation of the islands influences their faunal composition. Species established at the Cocos (Keeling) Islands must be pelagic as adults or have long-lived pelagic larval stages to allow them to colonise the marine waters around the islands. In general, the marine fauna is relatively depauperate compared with other atolls (Berry 1989). However, the Christmas and Cocos (Keeling) Islands have recently been identified as falling within a significant marine hybrid zone, with 11 new hybrid fishes documented (Hobbs 2009). In recent times periodical large-scale natural disturbances including cyclones (Bunce 1988), deoxygenation of lagoon waters and outbreaks of crown-of-thorns starfish (*Acanthaster planci*) have also reduced the abundance of corals (Berry 1989).

Taxonomic surveys of the marine fauna of the southern atoll were undertaken by the Western Australian Museum in 1989 and the Ecology Laboratory of the Institute of Marine Ecology, University of Sydney in 1992, with little attention given to the waters surrounding North Keeling Island due to the difficulty of access. Underwater visual surveys of the fish species of North Keeling Island were undertaken by James Cook University between 2008 and 2010, which provided data on observations of fish species of North Keeling Island, observations of hybrid fish species, and an initial report on the health of the lagoon since the closure of the lagoon entrance in 2005 (Hobbs 2010).

In 2009 the Department commissioned a study conducted by CSIRO and Geoscience Australia titled *Conservation values in Commonwealth waters of the Christmas and Cocos (Keeling) Island remote territories* (Brewer et al. 2009). The objective of the study was to provide a summary of available and relevant information describing the conservation values of the marine environment under Commonwealth jurisdiction surrounding both Christmas Island and the Cocos (Keeling) Islands.

The study indicated that the marine environment is highly unique with many potential deep-ocean ecological systems that we have very little understanding of, particularly deep-water and other systems below scuba diving depth.

There appears to be an unusual lack of endemism on the Cocos (Keeling) Islands and surrounding shallow reefs due to its recent emergence and colonisation some 4,000 years ago in conjunction with periodic catastrophic events, including tropical cyclones, that have substantially impacted the viability of fauna. In comparison, Christmas Island is an uplifted limestone island, which is still being uplifted, with biota that has existed for a longer and more stable period of time (Brewer et al. 2009).

Marine mammals

Two species of dolphins are regularly seen in the park: the common dolphin (*Delphinus delphis*) and the bottlenose dolphin (*Tursiops truncatus*) (Murray 2002, pers. comm.).

Humpback whales (*Megaptera novaeangliae*) and their calves have been filmed migrating past the Cocos (Keeling) Islands and there have been several sightings of Cuviers beaked whale (*Ziphius cavirostris*) and unidentified pilot whales. A dead sperm whale (*Physeter macrocephalus*) washed up on South Island in October 2003 (Murray 2003, pers. comm.).

A dugong (*Dugong dugong*) was occasionally sighted by residents over a number of years in the lagoon of the southern atoll, eventually taking up residency in 2002. At the time of preparing this plan this individual is still sighted regularly.

A sub-adult Sub-Antarctic fur seal was recorded at West Island in September 2011 (Flores 2011).

Marine reptiles

As early as 1909, Wood-Jones observed that breeding of green turtles had virtually ceased on the islands of the southern atoll, although extensive nesting could be observed on North Keeling Island. Gibson Hill (1950a) reported a similar situation in 1941. Gibson-Hill (1950a) recorded both the hawksbill turtle and the green turtle occurring at the Cocos (Keeling) Islands. Nesting green turtles are occasionally observed on the southern atoll, and frequently on North Keeling Island, and are a globally unique genetic stock (Whiting et al 2014). Although hawksbill turtles are seen and are likely to reside around the island, nesting has not been recorded (Tranter 1997, pers. comm.). Olive ridley turtles (*Lepidochelys olivacea*) have been seen in the marine waters of the park. Loggerheads (*Caretta caretta*) and leatherbacks (*Dermochelys coriacea*) have been observed on the southern atoll (Murray 2002, pers. comm.).

Fish

About 550 species of fish have been recorded in the seas of the Cocos (Keeling) Islands (Allen and Smith-Vanis 1994). Compared with other oceanic atolls, the islands' fish fauna appears impoverished (Allen 1989). Reasons for this may include the small physical size of the islands, the relative isolation and lack of surrounding island 'stepping stones', and limited surveys of fish (Allen 1989). Most fish found around the Cocos (Keeling) Islands have distributions that cover large areas of the Indo-Pacific region (Allen 1989). However, recent genetic research has shown a number of species to be hybridising. This is believed to be the result of the Cocos (Keeling) Islands' location at the confluence of the western Pacific and eastern Indian Ocean biogeographic provinces (Choat 2003, pers. comm.). Scientific surveys by James Cook University have identified a high degree of fish hybridisation around the Cocos (Keeling) Islands, which could ultimately result in the evolution of new species (Hobbs et al. 2008).

There is no confirmed endemism in the Cocos (Keeling) Islands fish fauna, although the Cocos angelfish (*Centropyge jocularis*) is known only from the Cocos (Keeling) Islands and Christmas Island. An undescribed goby of the genus *Trimma* may have the same distribution (Allen and Smith-Vaniz 1994).

Substantial populations of both butterflyfishes and sharks of several species in the park provide a good indication of a healthy fish fauna. Whale sharks (*Rhinocodon typus*) are also occasionally seen as they migrate past the atolls. Comparisons made between the Cocos (Keeling) Islands and other Indo-Pacific atolls reinforce the notion of the Cocos (Keeling) Islands being one of the last areas with pristine reef systems in the world (Choat 2003 pers. comm.).

Underwater visual surveys of the fish species of North Keeling Island were undertaken in November 2008 and March 2010 by James Cook University, resulting in 195 fish species being positively identified (Hobbs 2010).

An additional six species were added to the species list based on previous surveys (Lincoln Smith et al 1995), photographs and communications with local people. Therefore, at the time of preparing this plan, a total of 201 species of fish from 41 families had been recorded in Pulu Keeling National Park (Appendix H). This number will certainly increase with further surveys, although it is unlikely to exceed the 550 species recorded on the southern atoll (Allen and Smith-Vanis, 1994). The majority (83.4 per cent) of fish species recorded at North Keeling Island are widely distributed throughout the world or Indo-Pacific. However, a mixture of Pacific (10.4 per cent) and Indian Ocean (6.2 per cent) species were also present. For many of these species, North Keeling Island represents the western or eastern edge (respectively) of their geographic range.

The most speciose family at North Keeling Island was Labridae (wrasses and parrotfishes), followed by Pomacentridae (damselfishes), Acanthuridae (surgeonfishes and unicornfishes) and Chaetodontidae (butterflyfishes). The North Keeling Island species list includes groups that are generally difficult to identify using visual census methods due to their cryptic or nocturnal lifestyles (e.g. Gobiidae, Apogonidae, Muraenidae, Blennidae and Holocentridae). Surprisingly, nine species observed in surveys at North Keeling Island have not been reported from the southern atoll and represent new records for the Cocos (Keeling) Islands.

Maori wrasse or green fish (*Cheilinus undulatus*) is a resident of the waters of North Keeling Island and is one of the few species known to be a predator of crown-of-thorns starfish, which could decimate the coral reefs. This fish is a prime target species for local fishers. Giving the waters of North Keeling Island special protection provides a replenishment area for Maori wrasse and other species that are prime targets for fishers (Berry 1989).

Due to its smaller size and lower range of habitats, the number of fishes at North Keeling Island is unlikely to exceed the southern atoll. Most species of fish present on the southern atoll are capable of dispersing 24 kilometres to North Keeling Island, and therefore the fish community of North Keeling Island is likely to be a subset of the southern atoll. Whether a species can successfully colonise North Keeling Island will largely be dependent on the availability of suitable habitat. With the closure of the lagoon, it may be difficult for lagoonal species to establish themselves.

Determining the effect of future impacts on North Keeling Island, and assessing the effectiveness of Pulu Keeling National Park in protecting marine biodiversity, requires the development of a more comprehensive marine species list specific to the marine waters around North Keeling Island (Hobbs 2009).

Corals

Reef-building corals of the southern atoll have received considerable attention, partly because the southern atoll was the only one ever visited by Darwin (in 1836), and partly because of the intrinsic interest in the atoll's geographic isolation. The Cocos (Keeling) Islands are located approximately 1,000 kilometres and 1,830 kilometres from the reefs of Java and Western Australia respectively, with Christmas Island being the only 'stepping stone' for westerly movement of propagules (Berry 1989). Many common and widespread Indo-Pacific taxa have not been recorded from the Cocos (Keeling) Islands and are almost certainly absent. Ninety-nine species of reef corals are recorded from the Cocos (Keeling) Islands (Veron 1990). Of these, all but 12 are also known from Western Australia. Nine species are not recorded elsewhere in the eastern Indian Ocean and two (one being taxonomically doubtful) may be endemic (Veron 1990).

Molluscs

Six hundred and ten species of molluscs are known from the Cocos (Keeling) Islands. There are 496 gastropods, 109 bivalves, one chiton and four cephalopods. The fauna is diverse and compares favourably with the total number of species known from nearby areas that have been studied, such as Christmas Island with 490 species (Berry 1989).

Crustaceans

A total of 198 species of decapod crustaceans have been recorded at the Cocos (Keeling) Islands, with the most diverse taxa being xanthoid and paguroid crabs (Morgan 1994) (see Appendix G). Three species of rock lobsters, *Panulirus penicillatus*, *P. ornatus* and *P. versicolor* are widespread in the Indo-Pacific area and have also been recorded at the Cocos (Keeling) Islands (Berry 1989). A total of 13 species of barnacles in 11 genera have also been recorded from the area (Jones 1994).

Echinoderms (starfish, sea Urchins, sea cucumbers)

Eighty-nine species of echinoderms have been recorded at the Cocos (Keeling) Islands. Most are widespread Indo-West Pacific species but there are several species with westward extensions of their range from Indonesia or Christmas Island, and one with a south-eastward extension from Sri Lanka (Marsh 1994). The Cocos (Keeling) Islands have a fairly rich fauna of holothurians, including most of the species also known as trepang or beche-de-mer.

Invasive species and other threats

Human impacts

Human impacts on North Keeling Island have been relatively minimal, with the exception of the hunting of seabirds prior to the establishment of the park, with natural processes generally determining the status of native species. Unrestricted visitor access would place additional stress on the park and interfere with its protection and preservation. The introduction of new invasive species by visitors to the park and the increase in the distribution and abundance of existing invasive species are key threats to natural ecosystems in the park.

Feral animals

North Keeling Island is one of the few seabird colonies in the Indian Ocean as yet unaffected by vertebrate pests, such as cats and rats. The vulnerability of seabird colonies to introduced animals is well documented. The protection of the island against the accidental introduction of exotic animals or diseases is paramount.

Weeds

Six exotic or naturalised plant species occur on North Keeling Island: Indian copperleaf (*Acalypha lanceolata*), limeberry (*Triphasia trifolia*), wild gooseberry (*Physalis minima*), pigweed (*Portulaca oleracea*), pawpaw (*Carica papaya*), and coral berry (*Rivina humilis*). None of these plants is considered to be a severe environmental problem, or to have the potential to become one in the foreseeable future (Claussen and Slip 2002). However, the distribution and abundance of some introduced plants, particularly coral berry, appears to have increased during the life of the last management plan. A survey program (the Island Wide Survey) that includes a weed mapping component was initiated in late 2009 (and repeated in 2012) and will be used as a baseline for guiding future weed management programs.

Yellow crazy ants

A survey of the terrestrial invertebrate fauna of selected islands of the Cocos (Keeling) Islands was undertaken during June 2005. Numbers of the yellow crazy ant (*Anoplolepis gracilipes*) were high in some patches of pisonia forest on North Keeling Island, reaching abundances seen in supercolonies on Christmas Island. This is an important conservation concern, since on other oceanic islands yellow crazy ants are associated with large populations of scale insects, particularly *Pulvinaria urbicola*, that are also implicated in canopy dieback of pisonia (Hill et al. 2003; Smith et al. 2004; Kay et al. 2003; Handler et al. 2007). Furthermore, yellow crazy ants are known to affect abundance, behaviours, and reproductive success of birds on Christmas Island and in the Seychelles (Feare 1999; Davis et al. in press).

If outbreaks of scale insects occur in the pisonia forest of the park, similar to the scale experienced on Christmas Island, this could degrade nesting sites for seabirds, including the red-footed booby.

Surveys to examine the occurrence of scale insects on the island undertaken by La Trobe University and park staff in May 2011 did not detect the presence of *Pulvinaria urbicola* scale insects on pisonia, however a mealybug was found on a coconut palm. This mealybug was also found on coconut palms on all islands surveyed on the southern atoll. The mealybug identified as *Dysmicoccus finitimus*, Asian coconut mealybug, is tended by yellow crazy ants and can support high densities of yellow crazy ants. The presence of yellow crazy ants in pisonia stands on North Keeling Island may be explained by the inclusion of coconut palms within the pisonia stands (Neuman 2015 pers. comm.).

The survey identified yellow crazy ants on terminal foliage of *Cordia subcordata* where a small, possibly lepidopteran larva was found tunnelling into the shoot tips. Ants were found to be feeding on freshly broken plant surfaces where larvae were feeding on the plant. Given the high infestation of cordia by the caterpillar, this may be a primary food source for yellow crazy ants on the island (Neumann et al. 2011).

Cyclones and sea level changes

Cyclones have the potential to have serious effects on the vegetation and wildlife of the island. A cyclone database maintained by the Bureau of Meteorology shows that a number of cyclones have affected the Cocos (Keeling) Islands. On average, the Cocos (Keeling) Islands are impacted by about one cyclone, causing damaging winds, every two years and one causing

destructive winds every 14 years. One of the most damaging cyclones in recent times was Doreen, which passed directly over the southern atoll in 1968. More recently, in April 2001, Cyclone Walter destroyed 61 per cent of the canopy and 14 per cent of the trees in the park. The fledged chicks from the previous year also disappeared as a result of Cyclone Walter (Murray pers. comm. 2001). Historically by far the most significant cyclone to affect the islands occurred in 1909 when a wind gust of 225 kilometres per hour was estimated and a pressure of 945 hectopascals was recorded.

Sea level rise predicted through climate change modeling will also present significant challenges for all of the Cocos (Keeling) Islands that have maximum elevations of 1–5 metres above sea level.

Coral bleaching, white syndrome and crown-of-thorns starfish

Coral reefs worldwide are under threat from a range of impacts, with remote reefs in the Indian Ocean being among the worst affected. In 1998, a mass coral bleaching event resulted in 90–99 per cent mortality of corals on many Indian Ocean reefs, and remote locations proved particularly vulnerable to these disturbances because isolation has limited their recovery (Hobbs 2006). Coral bleaching, crown-of-thorns starfish and coral disease have also affected reefs in the Cocos (Keeling) Islands / Christmas Island region.

More recently, an outbreak of white syndrome coral disease resulted in widespread mortality of *Acropora* plate corals at Christmas Island in 2008 (Hobbs and Frisch, 2010). White syndrome disease was also present in 2008 on five coral colonies at the southern atoll but no disease was recorded on plate corals at North Keeling Island (Hobbs and Frisch, 2010).

Colonies exhibiting white syndrome at the southern atoll were observed over a four-week period, and the white band, marking the progress of the disease across the colony, indicated that tissue death was most likely due to disease and not predation by snails or starfish. The potential loss of *Acropora* plate corals due to white syndrome will not only affect coral community structure but also other reef organisms that rely on this habitat-forming coral for shelter or food (Hobbs et al 2010a).

Underwater surveys conducted at 11 sites from 1997 to 2005 revealed that the coral reef community at Cocos (Keeling) Islands was generally healthy and in a stable period with little anthropogenic impact. Live coral cover was high and there was minimal impact from coral damage, bleaching and disease. Crown-of-thorns starfish (*Acanthaster planci*) were recorded at high densities at four sites, including one site at North Keeling; however, there did not appear to be a clear impact of the starfish on hard coral cover. Continued monitoring of crown-of-thorns abundance is necessary to understanding patterns in starfish abundance and their impact on the reef community, particularly hard corals (Hobbs et al 2005).

A more recent 2010 survey conducted at North Keeling Island found no sign of coral bleaching, white syndrome coral disease or crown-of-thorns starfish. These three stressors still pose a significant future threat to marine biodiversity within the Pulu Keeling National Park. Management of the park should continue to minimise the effect of local stressors (e.g. pollution, fishing of herbivorous fishes) to ensure the reefs within the park have the best chance of coping with global threats and maximise the recovery from any impacts (Hobbs 2010).

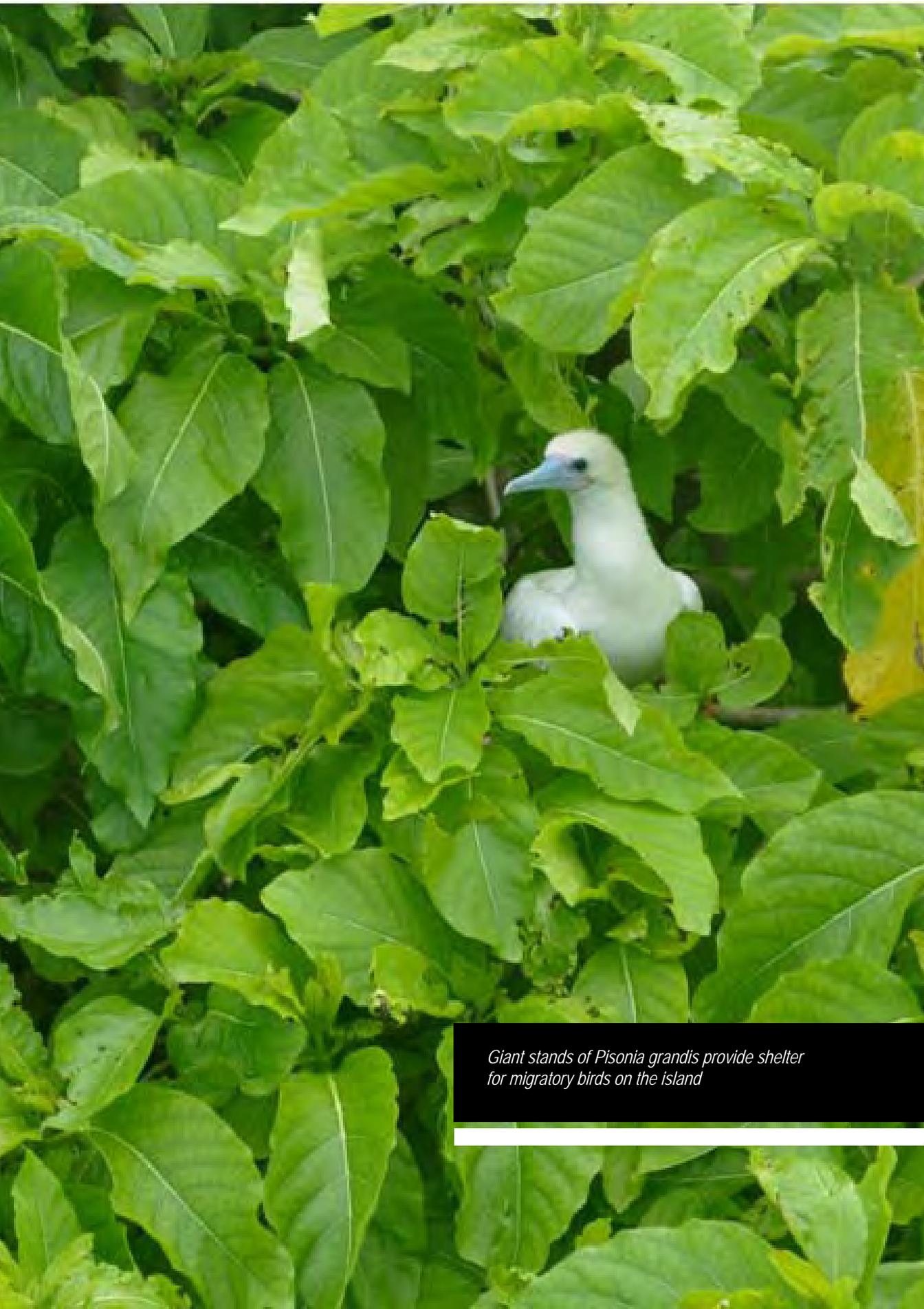
Changes in the lagoon and associated ecosystems

As noted earlier, the entrance to the lagoon from the ocean closed in 2005 as a result of natural forces of deposition. Prior to the closure of the entrance, the lagoon was largely sandy with extensive seagrass beds. Muddier areas occurred on the northern, southern and western shores of the lagoon and were inhabited by large mud crabs (*Scylla* sp.). Some small corals

lived near the lagoon entrance and green turtles often entered the lagoon to feed on seagrass. The lagoon supported at least 12 species of fish (from 10 families), including: *Albula glossodonta*, *Carcharhinus melanopterus*, *Chanos chanos*, *Crenimugil crenilabis*, *Epinephelus fuscoguttatus*, *Gerres acinaces*, *Liza vaigiensis*, *Lutjanus fulvus*, *L. monostigma* and species of trevally (Carangidae), emperor (Lethrinidae) and goatfish (Mullidae) (Hobbs 2009).

As a consequence of the closure of the lagoon entrance, the lagoon has shrunk in size and become stagnant. Underwater surveys undertaken in November 2008 revealed that there is a dense mat of cyanobacteria, varying in thickness from 1–50 centimetres, covering the bottom of the entire lagoon. Underneath the mat is a thin layer (0–2 centimetres) of black sediment that lies on top of the sand. In areas where the mat is thick, swimming and walking through the mat releases a pungent smell (like rotten eggs) that is indicative of hydrogen sulphide. Seagrass was absent throughout all the areas surveyed both inside and outside the lagoon. No animal life was observed on the surface of the sediment, but a profusion of small dead shells was found throughout the lagoon. The only animal life observed was an abundance of small shrimp (>4 centimetres in total length) hovering in the water column above the cyanobacteria mat, and 10 to 20 large milkfish (*Chanos chanos*) (Hobbs 2009).

Although the lagoon entrance has closed periodically before, natural reopening of the lagoon entrance at this time will be difficult due to the build-up of sand and rubble and colonisation by grasses and trees. Elsewhere, lagoons that have been closed for some time can be reopened by storms; however, these entrances soon close again (Allen and Robertson, 1996). It appears that the recent lagoon closure may be permanent (Hobbs 2009).



*Giant stands of *Pisonia grandis* provide shelter for migratory birds on the island*



Appendices

Appendix A

General list of definitions (including acronyms)

In this plan, unless the contrary intention appears:

AFP means the Australian Federal Police

AFMA means the Australian Fisheries Management Authority or other agency that may be responsible for administering the *Fisheries Management Act 1991* or any Act that replaces it

Australian Government means the Government of the Commonwealth of Australia

Biological diversity or **biodiversity** means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, diversity between species and diversity of ecosystems

Biological resources means genetic resources, organisms, parts of organisms, populations and any other biotic component of an ecosystem with actual or potential use or value for humanity (as per s.528 of the EPBC Act)

Bonn Convention means the Convention on the Conservation of Migratory Species of Wild Animals

CAMBA means the Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment

CITES means the Convention on International Trade in Endangered Species of Wild Fauna and Flora

Commonwealth reserve means a reserve established under Division 4 of Part 15 of the EPBC Act

CSIRO means the Commonwealth Scientific and Industrial Research Organisation

Department means the Australian Government department responsible for the administration of the EPBC Act (at the time of preparing this plan, the Department of the Environment)

Director means the Director of National Parks under s.514A of the EPBC Act, and includes Parks Australia and any person to whom the Director has delegated powers and functions under the EPBC Act in relation to Pulu Keeling National Park, and any agency that succeeds to the functions of the Director

Endemic means native plant and animal species that have a restricted geographical distribution and, for the purposes of this plan, species that are only found in Pulu Keeling National Park

Ecological community means an assemblage of interdependent plant and animal species interacting with one another in a particular area

Ecosystem means an ecological community together with the physical non-living environment interacting as a functional unit

EPBC Act or **the Act** means the *Environment Protection and Biodiversity Conservation Act 1999*, including Regulations under the Act, and includes reference to any Act amending, repealing or replacing the EPBC Act

EPBC Regulations or **the Regulations** means the Environment Protection and Biodiversity Conservation Regulations 2000 and includes reference to any Regulations amending, repealing or replacing the EPBC Regulations

Gazette means the *Commonwealth of Australia Gazette*

Island or the island means North Keeling Island or the terrestrial area of Pulu Keeling National Park

International Union for Conservation of Nature or IUCN means the global environment network of that name, a democratic membership union which brings together member states (countries), non-government organisations, United Nations agencies, companies and local communities to discuss solutions to international environment and development challenges

JAMBA means the Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment

Landscape means an area of land composed of interacting ecosystems that are repeated in a similar form throughout an area and include living and non-living natural aspects as well as human influenced or made aspects – for the purpose of this plan, the entire land and lagoon area of Pulu Keeling National Park

Lease agreement or Lease means the Memorandum of Lease between the Cocos (Keeling) Islands Shire Council and the Director, unless otherwise stated

Management plan or the plan means this management plan for Pulu Keeling National Park, unless otherwise stated

Minister means the Minister administering the EPBC Act

NPWC Act means the former *National Parks and Wildlife Conservation Act 1975* and the Regulations under that Act (repealed and replaced by the EPBC Act in 2000)

Pulu Keeling National Park or the park means the area declared as a national park by that name under the NPWC Act and continued under the EPBC Act by the *Environmental Reform (Consequential Provisions) Act 1999*

Parks Australia means the Director of National Parks and the agency that assists the Director in performing the Director's functions under the EPBC Act. At the time of preparing the plan, the agency assisting the Director is the Parks Australia Division of the Australian Government Department of the Environment

Parks Australia staff, staff or park staff means employees in Parks Australia

Park values means the values described in the Commonwealth Heritage Listing of North Keeling Island's Natural Areas and the Park Values described on page 2 and 3 of this plan

Pelagic means living or occurring in the upper waters of open sea, not near the shore

Pest or invasive species means any animal, plant or organism having, or with the potential to have, an adverse economic, environmental or social impact

PKNPCMC means the Pulu Keeling National Park Community Management Committee

Ramsar Convention means the Convention on Wetlands of International Importance

Reserve management principles means the Australian IUCN-protected area management category set out in Schedule 8 of the EPBC Regulations (see Appendix I)

ROKAMBA means the Agreement between the Government of Australia and the Government of the Republic of Korea for the Protection of Migratory Birds and their Environment

Territory Administration means the Australian Government department with responsibility for administering the *Christmas Island Act 1958*. At the time of preparing this plan that agency was the Department of Infrastructure and Regional Development

Unauthorised boat arrivals means the arrival of a vessel, vessels, passengers and/or crew of a vessel that land on North Keeling Island without prior authorisation to do so.

UNESCO means the United Nations Educational, Scientific and Cultural Organisation

Appendix B

Planning process and legislative context

Director of National Parks

The Director of National Parks is a corporation under the s.514A of the EPBC Act. The corporation is controlled by the person appointed by the Governor-General to the office that is also called the Director of National Parks (s.514F).

The functions of the Director (s.514B) include the administration, management and control of the park. The Director generally has power to do all things necessary or convenient for performing the Director's functions (s.514C). The Director has a number of specified powers under the EPBC Act and EPBC Regulations, including the power to prohibit or control some activities and to issue permits for activities that are otherwise not allowed. The Director performs functions and exercises powers in accordance with this management plan.

Establishment of the national park

The park was proclaimed under the *National Parks and Wildlife Conservation Act 1975 (NPWC Act)* on 12 December 1995 which was replaced by the EPBC Act in July 2000. The park continues as a Commonwealth reserve under the EPBC Act pursuant to the *Environmental Reform (Consequential Provisions) Act 1999*.

Lease agreement

North Keeling Island is leased to the Commonwealth of Australia by the Cocos (Keeling) Islands Shire Council and this plan is required by the EPBC Act to take account of, and be consistent with, the Lease agreement.

North Keeling Island is leased for the purposes of administration, management and control of the park in accordance with the EPBC Act. Under the Lease agreement the Director has covenanted:

- (a) that the flora, fauna and natural environment of the park will be preserved, managed and maintained according to the best comparable management practices established for national parks anywhere in the world (or if no comparable management practices exist, to the highest standards practicable); and
- (b) to take all practicable steps to ensure compliance with the Lease, the EPBC Act, the EPBC Regulations, the management plan for the park and laws applicable to the park.

The Lease agreement requires management plans for the park to establish and continue a Community Management Committee comprising the Director (or the Director's nominee), three members nominated by the Director and six members nominated by the Cocos (Keeling) Islands Shire Council to represent the Cocos (Keeling) Islands community, with the functions to:

- (a) provide the Director with its view in relation to the preparation and amendment of management plans for the park
- (b) advise the Director in relation to matters arising under or connected with the management plans.

The first management plan for the park provided for the establishment of the Pulu Keeling National Park Community Management Committee, which is continued by this management plan (See Section 6, Stakeholders and partnerships).

Management plans

The EPBC Act (ss.366 and 368) requires the Director of National Parks to prepare management plans for Commonwealth reserves and sets out the content of a plan and matters to be taken into account when preparing a management plan. When prepared, the plans are given to the Minister for approval. A management plan is a 'legislative instrument' for the purposes of the *Legislative Instruments Act 2003* and must be registered under the Act. Following registration the plan is tabled in each house of the Commonwealth Parliament and may be disallowed by either house on a motion moved within 15 sitting days of the house after tabling.

A management plan for a Commonwealth reserve has effect for 10 years, subject to its being revoked or amended earlier by another management plan for the reserve.

Planning process

This is the third management plan for Pulu Keeling National Park. The second plan came into operation on 28 April 2004 and ceased to have effect on 27 April 2011. When the second plan was prepared the EPBC Act required management plans for Commonwealth reserves to have effect for seven years. The EPBC Act now provides management plans have effect for 10 years.

Section 366 of the EPBC Act requires that the Director of National Parks prepare management plans for each Commonwealth reserve. Section 368 requires the Director to seek comments from members of the public and the relevant state or territory government.

Stakeholders were also consulted during the preparation of this plan. They included Australian and Western Australian government departments and agencies; the Pulu Keeling National Park Community Management Committee; the Cocos (Keeling) Islands Shire Council; researchers; island residents and community groups; and non-government organisations.

Prior to preparing this plan an audit was conducted to review the implementation of the previous plan and to provide recommendations to assist with the preparation of this plan. The audit (Director of National Parks 2010a) determined that 84 per cent (100) of prescriptions within the previous plan were successfully implemented, 13 per cent (15) were partially completed and 3 per cent (4) were unable to be commenced during the life of the plan.

Prescriptions under the previous plan that were not enacted include:

- (a) Advice from the Pulu Keeling National Park Community Management Committee was not specifically sought in relation to research priorities however their advice was sought on general park management issues
- (b) An interpretive training program for staff was not implemented due to resourcing issues
- (c) A diving strategy was not reviewed in cooperation with tour operators
- (d) A park-specific compliance strategy was not prepared. Enforcement activities were carried out in accordance with Parks Australia compliance procedures.

A summary of the results from the audit of the previous plan appears at Appendix J.

Purpose, content and matters to be taken into account in a management plan

The purpose of this management plan is to describe the philosophy and direction for the management of the park for the next 10 years in accordance with the EPBC Act. The plan outlines and identifies the park's values and how they are to be protected, conserved and presented. It enables management to proceed in an orderly way, helps reconcile competing interests and identifies priorities for the allocation of available resources.

Under s.367(1) of the EPBC Act, a management plan for a Commonwealth reserve must provide for the protection and conservation of the reserve. In particular, each management plan must:

- (a) assign the reserve to an IUCN category (whether or not a proclamation has assigned the reserve or a zone of the reserve to that IUCN category); and
- (b) state how the reserve, or each zone of the reserve, is to be managed; and
- (c) state how the natural features of the reserve, or of each zone of the reserve, are to be protected and conserved; and
- (d) if the Director holds land or seabed included in the reserve under Lease—be consistent with the Director's obligations under the Lease; and
- (e) specify any limitation or prohibition on the exercise of a power, or performance of a function, under the EPBC Act in or in relation to the reserve; and
- (f) specify any mining operation, major excavation or other works that may be carried on in the reserve, and the conditions under which it may be carried on; and
- (g) specify any other operation or activity that may be carried on in the reserve; and
- (h) indicate generally the activities that are to be prohibited or regulated in the reserve, and the means of prohibiting or regulating them; and
- (i) indicate how the plan takes account of Australia's obligations under each agreement with one or more other countries that is relevant to the reserve (including the Ramsar Convention); and
- (j) if the reserve includes a National Heritage place:
 - not be inconsistent with the National Heritage management principles; and
 - address the matters prescribed by regulations made for the purposes of paragraph 324S(4)(a); and
- (k) if the reserve includes a Commonwealth Heritage place:
 - not be inconsistent with the Commonwealth Heritage management principles; and
 - address the matters prescribed by regulations made for the purposes of paragraph 341S(4)(a).

In preparing a management plan the EPBC Act (s.368) also requires account to be taken of various matters. In respect to Pulu Keeling National Park these matters include:

- (a) the regulation of the use of the park for the purpose for which it was declared
- (b) the interests of any person who has a usage right relating to land, sea or seabed in the park that existed (or is derived from a usage right that existed) immediately before the park was declared

- (c) the protection of the special features of the park, including objects and sites of biological, historical, palaeontological, archaeological, geological and geographical interest
- (d) the protection, conservation and management of biodiversity and heritage within the park
- (e) the protection of the park against damage
- (f) Australia's obligations under agreements between Australia and one or more other countries relevant to the protection and conservation of biodiversity and heritage.

IUCN category and zoning

In addition to assigning a Commonwealth reserve to an IUCN category, a management plan may divide a Commonwealth reserve into zones and assign each zone to an IUCN category. The category to which a zone is assigned may differ from the category to which the reserve is assigned (s.367(2)).

The provisions of a management plan must not be inconsistent with the Australian reserve management principles prescribed in Schedule 8 to the EPBC Regulations for the IUCN category to which the reserve or a zone of the reserve is assigned (s.367(3)). See Section 2 for information on Pulu Keeling National Park's IUCN category.

Control of actions in Commonwealth reserves

The EPBC Act (ss.354 and 354A) prohibits certain actions being taken in Commonwealth reserves except in accordance with a management plan. These actions are:

- kill, injure, take, trade, keep or move a member of a native species; or
- damage heritage; or
- carry on an excavation; or
- erect a building or other structure; or
- carry out works; or
- take an action for commercial purposes.

Mining operations are prohibited in Commonwealth reserves by the EPBC Act (ss.355 and 355A) except in accordance with a management plan.

The EPBC Regulations control, or allow the Director to control, a range of activities in Commonwealth reserves, such as camping, use of vehicles and vessels, littering, commercial activities and research. The Director applies the Regulations subject to and in accordance with the EPBC Act and management plans. The Regulations do not apply to the Director or to wardens or rangers appointed under the EPBC Act. Activities that are prohibited or restricted by the EPBC Regulations may be carried on if they are authorised by a permit issued by the Director and/or they are carried on in accordance with a management plan or if another exception prescribed by r.12.06(1) of the Regulations applies.

Section 358(2) of the EPBC Act provides that the Director may grant a lease or sublease of, or a licence relating to, land in a Commonwealth reserve, but only in accordance with a management plan in operation for the reserve. A licence to undertake an activity in a Commonwealth reserve shall include provisions to permit the activity described within the licence.

Access to biological resources in Commonwealth areas is regulated under Part 8A of the EPBC Regulations. Access to biological resources is also covered by ss.354 and 354A of the EPBC Act if the resources are members of a native species and/or if access is for commercial purposes.

Environmental impact assessment

Actions that are likely to have a significant impact on matters of national environmental significance are subject to the referral, assessment and approval provisions of chapters 2 to 4 of the EPBC Act (irrespective of where the action is taken).

At the time of preparing this plan, the matters of national environmental significance identified in the EPBC Act and relevant to the park are:

- World Heritage listed properties
- Ramsar Wetlands of International Importance
- nationally listed threatened species and ecological communities
- listed migratory species
- Commonwealth marine areas.

The referral, assessment and approval provisions also apply to actions on Commonwealth land that are likely to have a significant impact on the environment and to actions taken outside Commonwealth land that are likely to have a significant impact on the environment on Commonwealth land. The park is Commonwealth land for the purposes of the EPBC Act.

Responsibility for compliance with the assessment and approval provisions of the EPBC Act lies with persons taking relevant 'controlled' actions. A person proposing to take an action that the person thinks may be or is a controlled action should refer the proposal to the Minister for the Minister's decision whether or not the action is a controlled action. The Director of National Parks may also refer proposed actions to the Minister.

Penalties

Civil and/or criminal penalties may be imposed for breaches of the Act or Regulations.

Fees and charges

Under s.356A of the EPBC Act the Director may, with the Minister's approval, set and impose charges for activities in the park.

Fees may also be prescribed by Schedule 11 of the EPBC Regulations in relation to issuing and managing permits. At the commencement of this plan there were fees in place under the EPBC Regulations for issuing permits for commercial activities in Pulu Keeling National Park. Fees may also apply for the capturing of images or audio in the park, subject to any prohibition or restriction made by the Director.

The Director may also issue subleases and licences for activities to occur in Commonwealth reserves. Under this plan, the Director may determine the fee for each sublessee or licensee and the length of any sublease or licence (Policy 7.5.3).

Wildlife protection

The EPBC Act also contains provisions (Part 13) that prohibit and regulate actions in relation to listed threatened species and ecological communities, listed migratory species, cetaceans (whales and dolphins) and listed marine species. Appendix E to this plan identifies species in the park that are listed as threatened under the EPBC Act at the time of preparing this plan. Appendix E also identifies migratory and marine species that are listed under the EPBC Act and under international conventions, treaties and agreements at the time of preparing this plan.

Actions taken in a Commonwealth reserve in accordance with a management plan in relation to members of species listed under Part 13 of the Act are exempt from prohibitions that would otherwise apply under Part 13.

Part 9 of the EPBC Regulations provides for the protection and conservation of biodiversity in the Cocos (Keeling) Island Territory outside the boundaries of the park and prohibits and/or regulates actions affecting members of native species specified in Schedule 12 to the Regulations, and their habitat.

Heritage protection

Commonwealth Heritage List

At the time of preparing this plan North Keeling Island is a listed place on the Commonwealth Heritage List under the EPBC Act. The Commonwealth Heritage values of the park are described in Appendix D.

The EPBC Act heritage protection provisions (ss.341A to 341ZH) relevantly provide:

- for establishment and maintenance of a Commonwealth Heritage List, criteria and values for inclusion of places in the list and management principles for places included in the list
- that Commonwealth agencies that own or control places must:
 - i. prepare a written heritage strategy for managing those places to protect and conserve their Commonwealth Heritage values. The strategy must address any matters required by the EPBC Regulations, and not be inconsistent with the Commonwealth Heritage management principles
 - ii. identify Commonwealth Heritage values for each place, and produce a register that sets out the Commonwealth Heritage values (if any) for each place (and do so within the timeframe set out in the place's heritage strategy)
- that Commonwealth agencies must not take an action that is likely to have an adverse impact on the heritage values of a place included in the Commonwealth Heritage list unless there is no feasible and prudent alternative to taking the action, and all measures that can reasonably be taken to mitigate the impact of the action on those values are taken.

The boundaries of the Commonwealth Heritage site comprise the whole of the island and lagoon and the surrounding ocean within 1.5 kilometres of the high water mark (see Map 4).

The prescriptions within this management plan are consistent with Commonwealth Heritage management principles (Schedule 7B of the EPBC Regulations) and obligations for protecting and conserving the heritage values for which the park was listed, as required by the EPBC Act. Appendix I of this plan indicates how the plan complies with Schedule 7B of the Regulations.

Historic Shipwrecks Act 1976

The wreck of the SMS *Emden* is a declared historic shipwreck under the *Historic Shipwrecks Act 1976*. The Act prohibits conduct that destroys or causes damage to a historic shipwreck; causes interference with a historic shipwreck; causes the disposal of a historic shipwreck; or causes a historic shipwreck to be removed from Australia.

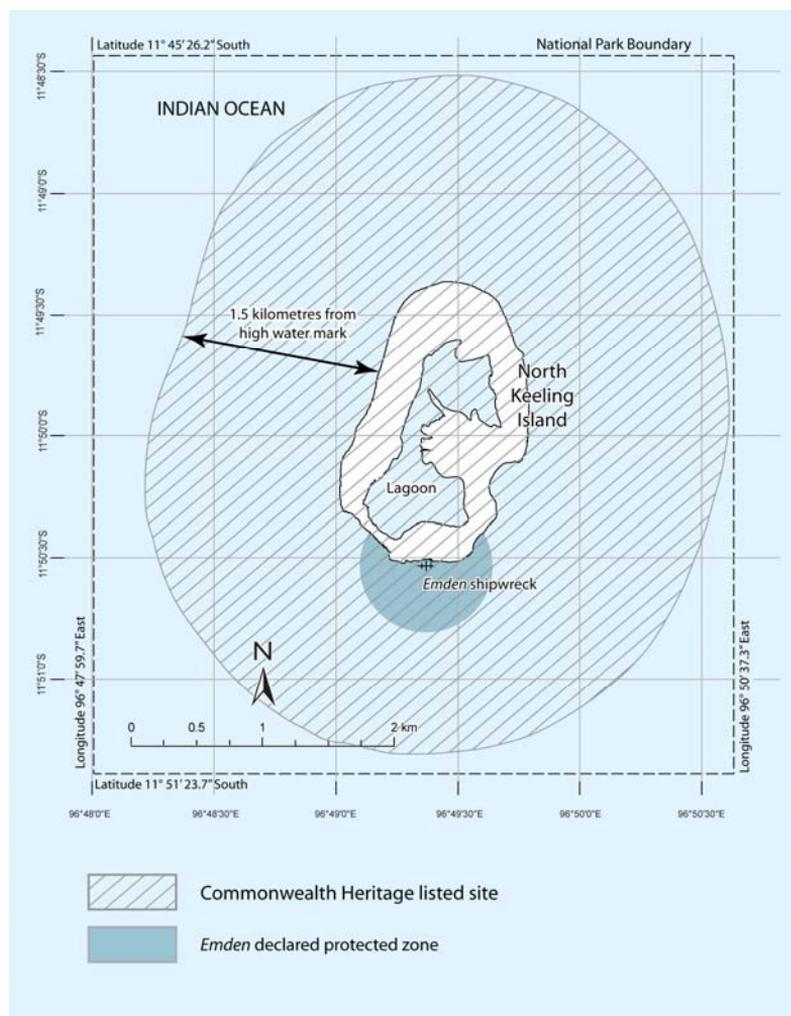
The area of sea within a 500 metre radius around the remains of the SMS *Emden* to the lowest astronomical tide is a declared protected zone under the *Historic Shipwrecks Act 1976*, (see Map 4). Relics from the *Emden* located on the beach and the island are also protected under the *Historic Shipwrecks Act 1976*. The *Historic Shipwrecks Regulations 1978* prohibit certain activities in a protected zone unless they are done in accordance with a permit under the Act.

The prohibited activities include bringing diving equipment into a protected zone; using such equipment in a protected zone; causing a ship carrying such equipment to enter, or remain within, a protected zone; diving or engaging in any other underwater activity within a protected zone; and mooring or using ships within a protected zone.

The power to grant permits to access the protected zone surrounding the *Emden* under the *Historic Shipwrecks Act 1976* lies with the Commonwealth Historic Shipwrecks Delegate, which at the time of writing this plan was the Commonwealth Shipwrecks Officer within the Department.

Map 4 indicates the boundaries of the *Emden* declared protection zone.

Map 5: Boundaries of the North Keeling Island Commonwealth Heritage site and the *Emden* historic shipwreck declared protection zone



International agreements

This plan must take account of Australia's obligations under relevant international agreements. The following agreements are relevant to the park and are taken into account in this plan. Species listed under the agreements and conventions are listed species under Part 13 of the EPBC Act. Appendix E to this management plan includes listed migratory and marine species found in the park.

Ramsar Convention

The whole of Pulu Keeling National Park was listed as a Wetland of International Importance under the Ramsar Convention on 17 March 1996. As a consequence, the content of this management plan also provides for the management of the Ramsar site, monitoring, protecting and conserving the ecological character of the site.

The Convention on Wetlands of International Importance (Ramsar Convention) is an international agreement which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.

The Ramsar Convention's mission is 'the conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world'. There are now more than 160 contracting parties to the convention throughout the world.

The prescriptions within this management plan are consistent with Australian Ramsar management principles (Schedule 6(2) of the EPBC Regulations) and obligations for monitoring and maintaining the ecological character for which the park was listed, as required by the EPBC Act. Appendix I of this plan gives reference to how this plan complies with Schedule 6(2) of the Regulations.

The *Ecological Character Description for Pulu Keeling National Park Ramsar Site* (Hale 2010) forms a baseline reference of the condition of the park at the time it was listed.

The Ramsar Information Sheet and Ecological Character Description for the Pulu Keeling National Park Ramsar site is available online at:

<http://www.environment.gov.au/cgi-bin/wetlands/ramsardetails.pl?refcode=46>

The 2010 review of the Ecological Character Description identified a small number of knowledge gaps that are required to fully describe the site's ecological character to enable rigorous and defensible limits of acceptable change. Collection of information at the site is difficult, due to the remote location of the park, and difficulty of access. The review recommended a number of actions necessary to identify indicator species for monitoring and specific monitoring recommendations in relation to vegetation, invasive species, invertebrates, birds and marine species. These are further described in Section 3.3, Research and monitoring.

The Pulu Keeling National Park Ramsar site meets the following six Ramsar listing criteria:

Criterion 1: *A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.*

North Keeling Island has never been permanently inhabited and this, coupled with the remote location of this site, has resulted in wetlands in near-natural condition. As such the park contains the best examples of coral, sandy and rocky shore wetland types in the bioregion.

Criterion 2: *A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities.*

The park supports three threatened species: Cocos buff-banded rail (*Gallirallus philippensis andrews*), listed as endangered under the EPBC Act and restricted to the Ramsar site (Parks Australia 2004); green turtle (*Chelonia mydas*); and hawksbill turtle (*Eretmochelys imbricata*), both listed as vulnerable under the EPBC Act and endangered under the IUCN Red List.

Criterion 3: *A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.*

The park supports three endemic species: the Cocos buff-banded rail (*Gallirallus philippensis andrews*); the Cocos pandanus (*Pandanus tectorius* spp. *cocosensis*); and the Cocos angelfish (*Centropyge jocolator*) which only occurs at Christmas and the Cocos (Keeling) Islands (Woodroffe and Berry 1994).

In a survey undertaken by James Cook University in March 2010 the island's gregory damselfish (*Stegastes insularis*) was sighted for the first time at North Keeling Island and at the southern atoll. The island gregory has limited distribution and may be considered endemic to the Cocos (Keeling) Islands and Christmas Island (there is also a separate population or sub-species on Marcus Island in the Pacific Ocean) (Hobbs 2010). The current Ramsar Information Sheet for the site was prepared prior to the discovery of the island gregory damselfish in park waters. This species will be incorporated into the Ramsar Information Sheet when next reviewed.

In addition, the park supports a number of plant and animal species that are not recorded in the southern atoll islands. It has been suggested that this is due to the lack of human activity in the Ramsar site (Williams 1994; Stokes 1994). Stokes et al. 1984 described North Keeling Island as one of the few remaining pristine tropical islands in the Indian Ocean. As such the park, which supports flora and fauna that no longer occurs on the southern atoll islands, is important in maintaining biodiversity within the bioregion.

Criterion 4: *A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.*

The park supports 13 species of waterbird listed as migratory under international treaties (see Appendix E) and two species of migratory turtles (green and hawksbill). In addition, the site support breeding of 15 species of waterbirds; including the red-footed booby (*Sula sula*); lesser frigatebird (*Fregata ariel*), great frigatebird (*Fregata minor*) and common noddy (*Anous stolidus*) that all breed in significant numbers within the Ramsar site (Parks Australia 2004).

Criterion 5: *A wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds.*

The park regularly supports more than 30,000 pairs of red-footed booby; up to 15,000 common noddy and 3,000 greater and lesser frigate birds (Stokes et al. 1984).

Criterion 6: *A wetland should be considered internationally important if it regularly supports one percent of the individuals in a population of one species or subspecies of waterbird.*

The park regularly supports 30,000 breeding pairs of red-footed booby (six per cent of the global population) and 3,000 breeding pairs of lesser frigatebirds (three per cent of the global population).

Since listing, there is no evidence of any significant changes in the coral reef areas of the park, or in numbers of birds. However, in 2005, the lagoon entrance closed (as a result of natural forces of deposition) which has lead to significant changes within this habitat (Hobbs 2010). The closure of the lagoon has impacted on water quality and the seagrass beds which were previously foraging habitat for green and hawksbill turtle. It is estimated that there are several thousand hawksbill turtles that forage within the Cocos (Keeling) Islands feeding on algae, seagrass and sponges (Whiting 2006). However, data are limited to monitoring from the southern atoll and the importance of the Ramsar site for this species is not known.

Hobbs (2010) speculates that the seagrass habitat of the lagoon was also an important nursery habitat for a number of fish species, including blacktip reef sharks, mullets, emperors, trevallies and cods; and these species may become locally extinct if suitable alternative nursery habitats cannot be found. The lagoon habitat was also important for species of pipefish and other small fish that may be significantly affected by the lagoon closure.

The closure of the lagoon, although due to natural rather than anthropogenic causes, is considered to represent a (natural) change in ecological character of the Ramsar site. However, this has not affected the site with respect to meeting the listing criteria.

The Ecological Character Description for the site also identifies threats to the ecological character of the site:

- Biological resource utilisation – *fishing and hunting of seabirds*
- Invasive species – *in particular, yellow crazy ants*
- Climate change and severe weather – *temperature extremes, storms, sea level rise*
- Human intrusion and disturbance – *recreational activities*.

Strategies to minimise the impact of these threats are dealt with in sections: 3.1 ~ 3.3 and 5.1.

China–Australia Migratory Bird Agreement (CAMBA)

CAMBA provides for China and Australia to cooperate in the protection of migratory birds listed in the annex to the agreement and their environment, and requires each country to take appropriate measures to preserve and enhance the environment of migratory bird species listed under this agreement. Fifteen species listed under this agreement occur in Pulu Keeling National Park.

Japan–Australia Migratory Bird Agreement (JAMBA)

JAMBA provides for Japan and Australia to cooperate in taking measures for the management and protection of migratory birds and birds in danger of extinction, and the management and protection of their environments, and requires each country to take appropriate measures to preserve and enhance the environment of birds protected under the provisions of the agreement. Fifteen species listed under this agreement occur in Pulu Keeling National Park.

Republic of Korea – Australia Migratory Bird Agreement (ROKAMBA)

ROKAMBA provides for the Republic of Korea and Australia to cooperate in taking measures for the management and protection of migratory birds and their habitat by providing a forum for the exchange of information, support for training activities and collaboration on migratory bird research and monitoring activities. Eight species listed under this agreement occur in Pulu Keeling National Park.

Bonn Convention

The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) aims to conserve terrestrial, marine and avian migratory species throughout their range. Parties to this convention work together to conserve migratory species and their habitat. Eleven species listed under this agreement occur in Pulu Keeling National Park.

Convention on Biological Diversity

The Convention's objectives are:

- the conservation of the world's biological diversity
- to promote the sustainable use of the components of biological diversity
- to provide for the fair and equitable sharing of benefits from the utilisation of genetic resources, including providing appropriate access to genetic resources and the appropriate transfer of relevant technologies taking into account all rights over those resources and technologies, and by appropriate funding (UNEP 1994).

The EPBC Act is the primary legislative instrument for implementing the Convention on Biological Diversity in Australia.

Nagoya Protocol

In October 2010 the Conference of Parties to the Convention on Biological Diversity adopted the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization. Australia signed the protocol in January 2012, and is committed to its full implementation and ratification.

The protocol establishes an internationally recognised framework for access to genetic resources and associated traditional knowledge for research activities and sharing the benefits from their use. Access to biological resources in Commonwealth areas such as the park is regulated under the EPBC Act and EPBC Regulations (see also Section 3.3, Research and monitoring).

Other relevant legislation

Fish Resource Management Act 1994 (WA)

Since 2002, the Western Australian Department of Fisheries has been responsible for the delivery of fisheries management services at the Cocos (Keeling) Islands on behalf of the Commonwealth Government, under a Service Delivery Arrangement. Fishing in the park is subject to the *Fish Resource Management Act 1994 (WA)* in so far as that Act is not inconsistent with the EPBC Act, EPBC Regulations and this management plan.

Appendix C

Description of the physical features and summary of activities appropriate for each management zone

Table 5: Description of management zones

	Strict nature reserve	Marine reserve
IUCN reserve management category	Ia (strict nature reserve)	II (national park)
Location	Terrestrial area of the park including the waters and intertidal areas of the central lagoon.	All marine waters of the park from the low water mark to the boundary of the park.
Attributes	<p>An uninhabited low-lying tropical oceanic coral atoll, mostly covered by sand and rubble on top of an old volcanic seamount that rises from a depth of 5,000 metres. North Keeling Island is one of the few remaining relatively pristine tropical islands in the Indian Ocean region. It contains rare ecosystems as it is the only largely undisturbed island in the Cocos (Keeling) Islands that retains its original ecosystems and their species. Because of its isolation, evolution and relatively pristine condition, the island is significant to studies of the distribution and evolution of island species and contains ecosystems and species observed by Charles Darwin during his visit to the Cocos (Keeling) Islands in the 1830s.</p> <p>The island is highly significant for seabirds as it supports the most diverse seabird populations in the Indian Ocean and is the only seabird rookery within a radius of 900 kilometres</p> <p>EPBC listed green turtles are frequently observed nesting on the island.</p>	<p>Marine waters surrounding North Keeling Island containing a range of habitats types including sub-tidal aquatic beds, reef slope and fringing coral reefs. The reef communities of the Cocos (Keeling) Islands, including those within the park, form part of a significant marine hybrid zone that supports 11 types of hybrid coral fish the highest known number of types of marine hybrid fish recorded at any marine location in the world.</p> <p>There are two species of internationally and EPBC listed threatened turtles, the green and hawksbill turtles are found in the park's waters. Green turtles nest on the beaches of North Keeling Island.</p>
Management purpose	<ul style="list-style-type: none"> • High level of protection of natural and cultural heritage • Scientific research and monitoring into island biodiversity and geomorphological features 	<ul style="list-style-type: none"> • Protection and appreciation of marine biodiversity • Provide for appropriate recreational and commercial activities that are consistent with the protection of natural values

Table 6: Types of activities appropriate to each management zone

	Strict Nature Reserve	Marine Reserve
IUCN reserve management category	Ia (strict nature reserve)	II (national park)
Location	Terrestrial area of the park including the waters and intertidal areas of the central lagoon.	All marine waters of the park from the low water mark to the boundary of the park.
Public access	<ul style="list-style-type: none"> • Permit required • Landing of vessels is not allowed • Strict biosecurity arrangements apply (described as conditions in access permit) • Access to some areas of the park may be restricted for maintenance or conservation reasons or in accordance with Section 5.1 • See also Sections 5.1 and 5.2 for further prescriptions 	<ul style="list-style-type: none"> • Permit required • Appropriate water-based recreational activities consistent with the protection of natural values • Anchoring of vessels is discouraged • Waterskiing, boom-riding and use of jet-skis and other personal watercraft not allowed • See also Sections 5.1 and 5.2
Motor vehicle use	<ul style="list-style-type: none"> • Not allowed 	N/A
Walking	<ul style="list-style-type: none"> • Permit required • Permit holders must ensure minimal impact on the landscape and biodiversity 	N/A
Cycling	<ul style="list-style-type: none"> • Use of bicycles in the park is not allowed 	N/A
Camping	<ul style="list-style-type: none"> • Permit required – may only be issued for management and research purposes 	N/A
Fishing	<ul style="list-style-type: none"> • Not allowed 	<ul style="list-style-type: none"> • Permit required • Recreational fishing to be undertaken in accordance with Section 5.1 • Commercial fishing not allowed • Use and possession of handspears and spearguns not allowed
Snorkelling and scuba diving	<ul style="list-style-type: none"> • Permit required. • Recreational snorkelling and scuba diving not allowed within lagoon area. 	<ul style="list-style-type: none"> • Permit required • Anchoring of vessels is discouraged
Collecting	<ul style="list-style-type: none"> • Permit required – may only be issued for management and research purposes 	<ul style="list-style-type: none"> • Permit required – may only be issued for management and research purposes
Commercial activities	<ul style="list-style-type: none"> • Permit required • Commercial fishing is not allowed 	<ul style="list-style-type: none"> • Permit required • Commercial fishing is not allowed
Research	<ul style="list-style-type: none"> • Permit required • See also Section 3.3 	<ul style="list-style-type: none"> • Permit required

Appendix D

Commonwealth Heritage values of North Keeling Island

Disclaimer: The following statements of significance and values reflect the official record on the Australian Heritage Database at the time of preparing this plan and may contain information that is no longer current or has been superseded. Further information on the Commonwealth Heritage list can be obtained from environment.gov.au/heritage/places/commonwealth/index.html

North Keeling Island

Class: Natural

Legal status: Listed place (22/06/2004)

Place ID: 105180

Summary statement of significance

North Keeling Island is significant as one of the few remaining pristine tropical islands in the Indian Ocean region. The island has rare ecosystems and a high significance for Indian Ocean seabirds, playing a vital part in the stability of the Indian Ocean seabird biota. The island is significant to studies of island biogeography because of its evolution in isolation. It contains rare ecosystems now absent from other islands of the Cocos and Keeling Group. Closed canopy forests on the island are unusual as they are composed of species generally found as stunted shrubs in successional forests on the shoreline of tropical islands elsewhere in the region. The island is of very high importance to Indian Island seabird populations, supporting the most diverse populations in this ocean. Nineteen species are found on the island, 12 of which breed here. This is significant as the island is the only rookery within 900 kilometres. The island also supports a diverse land crab population, with six species occurring here. The island is the habitat of several rare species including the robber crab, which is listed as vulnerable to extinction in the IUCN red data book. The buff-banded rail, listed as endangered by IUCN, is restricted to this island. Two species of turtle listed as endangered by IUCN, the green and hawksbill turtles, nest on the island's beaches. The island is also significant as one of the four remaining red-footed booby nesting areas in the world. The Cocos Islands were the only coral atolls visited by Charles Darwin in the 1830s. The flora and fauna observed by Darwin on Cocos Island at that time is now found only on North Keeling.

The island is of particular significance in the history of Australia in World War I, due to the sinking of the SMS *Emden* by the HMAS *Sydney* in 1914. The wreck of the *Emden* is also significant as a wrecksite of a World War I cruiser, which has research potential in marine archaeology.

Commonwealth Heritage official values

Criterion A

The place has significant heritage value because of the place's importance in the course, or pattern, of Australia's natural or cultural history

Values

- North Keeling Island is of unique importance to Indian Island seabird populations, supporting the most diverse population in the Indian Ocean. Nineteen species are found on the island, 12 of which breed here. The island is the only seabird rookery within 900 kilometres.
- The island also supports a diverse land crab population, with six species occurring here.

- It is significant in island biogeography as one of the few pristine islands in the Indian Ocean.
- It contains rare ecosystems that have evolved in isolation.
- It is the only remaining undisturbed island in the Cocos Keeling Group that retains original flora and fauna.

Criterion B

The place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history

Values

- The robber crab found on North Keeling Island is listed as vulnerable to extinction in the IUCN red data book.
- The buff-banded rail, listed as endangered by IUCN, is restricted to North Keeling Island.
- The island is one of the four remaining red-footed booby nesting areas in the world.
- Thirteen species of birds protected by migratory treaties have been recorded on the island.
- Two species of turtles listed as endangered by IUCN, the green and hawksbill, nest on the island.
- Because of its pristine condition North Keeling Island is a rarity in the Indian Ocean.

Criterion C

The place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history

Values

- Of particular significance in the history of Australia in World War I, due to the sinking of the SMS *Emden* by the HMAS *Sydney* in 1914.
- Retains the original flora and fauna observed by Charles Darwin on Cocos Island in the 1830s.

Criterion D

The place has significant heritage value because of the place's importance in demonstrating the principal characteristics of:

- i. a class of Australia's natural or cultural places; or*
- ii. a class of Australia's natural or cultural environments*

Values

- One of the few remaining unmodified tropical islands in the Indian Ocean region; its plant communities are thus significant as representative of island vegetation.
- Climax closed-canopy forests no longer found on other Cocos Islands still exist here.
- Species generally found as stunted shrubs on shorelines grow as tall trees here.

Description

The island is a typical coral atoll with a central lagoon connected to the open ocean. North Keeling is principally covered by *Pisonia grandis* and *Cocos nucifera* forest with *Cordia subcordata*, *Argusia argentia* and *Sesuvium portulacastrum* herbland. *Cordia subcordata*, which generally occurs as a stunted shrub on coral islands, reaches the size of a large tree amidst the pisonia forest. The pisonia trees themselves are unusually tall. Crabs are the most conspicuous and probably the most plentiful inhabitants of the forest floor and beach fringe of the island. Six species of land crab occur on North Keeling including the robber crab (*Bigos latro*), the largest land crab in the world, which is listed as vulnerable to extinction in the International Union for the Conservation of Nature (IUCN) red data book. North Keeling is one of the few remaining pristine tropical islands in the Indian Ocean and is undoubtedly of unique importance to Indian Ocean birds, containing perhaps the widest variety of species in that ocean. A total of nineteen species have been recorded, eleven of which breed here. The herald petrel (*Pterodroma arminjonia*) may breed on the island. By far the most dominant bird species is the red-footed booby (*Sula sula*). Comprehensive population surveys in 1985 estimated current breeding populations at 34,000 pairs making it one of the largest colonies of red-footed boobies in the world. Of the sixteen original breeding populations only four remain, including North Keeling. The only land bird is the buff-banded rail (*Rallus philippensis andrewsi*) which is listed as endangered under the Japan Australia Migratory Birds Agreement (JAMBA) and is now virtually restricted to North Keeling Island. Lesser and great frigatebirds (*Fregata arie* and *F. minor*) also occur on the island in large numbers. Data from surveys (in 1987) indicate a population size of possibly 3,000 breeding pairs of lesser frigatebirds and a lesser number of great frigatebirds making it the second largest population of lesser frigatebirds in Australia and the Indian Ocean. Thirteen species of birds recorded on the island are listed in the JAMBA or the China Australia Migratory Birds Agreement (CAMBA) and are therefore protected. Two species of turtle listed as endangered in the IUCN red data book, the green turtle (*Chelonia mydas*) and the hawksbill turtle (*Eretmochelys imbricata*), nest on the beaches of the island. The introduced pantropical gecko (*Lepidocatylys lugubris*) is the only non-avian terrestrial vertebrate reported from North Keeling. It is one of the few remaining tropical islands to have avoided so far, the scourge of introduced rats and other vermin.

A declared historic shipwreck, that of the *Emden*, a World War I German light cruiser, is found on the southern reef of the island. The ship slipped off the reef on which it was run aground and is no longer visible. The wreck lies approximately 100 metres offshore in 3 metres to 9 metres of water on the southern shore of the island. Three graves lie amongst coconut palms just off the wreck site, marked with Cocos-Malay grave markers.

Condition and integrity

The island is generally in natural condition; human occupation has been sporadic and generally of low impact. Access is currently strictly controlled, however proposals for tourist access or access by Cocos-Malays for harvesting activities are cause for concern. SMS *Emden*: the wreck was subject to two salvage operations. One in 1915 and the other in the late 1930s. This has resulted in loss of all superstructure, but guns, propellers, engines etc remain, submerged.

Location

Comprises the whole of the island and lagoon and the surrounding ocean within 1.5 kilometres of High Water Mark, 24 kilometres north of Cocos (Keeling) Islands.

Appendix E – EPBC listed species

Scientific name	Common name	EPBC status	Marine	Cetacean	Migratory	CAMBA	JAMBA	ROKAMBA	Bonn
Birds									
<i>Anous stolidus</i>	Common noddy		✓		✓		✓		
<i>Ardea ibis</i>	Cattle egret		✓		✓		✓		
<i>Arenaria interpres</i>	Ruddy turnstone		✓		✓	✓	✓	✓	✓
<i>Calidris alba a</i>	Sanderling		✓		✓	✓	✓	✓	✓
<i>Chlidonias leucopterus</i>	White-winged black tern		✓		✓		✓	✓	
<i>Egretta sacra</i>	Eastern reef egret		✓		✓				
<i>Fregata andrewsi</i>	Christmas Island frigatebird	VU	✓		✓				
<i>Fregata ariel</i>	Lesser frigatebird		✓		✓	✓	✓	✓	
<i>Fregata minor</i>	Great frigatebird		✓		✓	✓	✓		
<i>Gallinago stenura</i>	Pin-tailed snipe		✓		✓	✓	✓	✓	✓
<i>Gallirallus philippensis andrewsi</i>	Cocos buff-banded rail	EN							
<i>Gygis alba</i>	White tern		✓						
<i>Hirundo rustica</i>	Barn swallow		✓		✓		✓	✓	
<i>Nycticorax caledonicus</i>	Nankeen night heron		✓						
<i>Onychoprion anaethetus</i>	Bridled tern		✓		✓	✓	✓		
<i>Onychoprion fuscata</i>	Sooty tern		✓						
<i>Phaethon lepturus fulvus</i>	White-tailed tropicbird		✓						
<i>Phaethon rubricauda</i>	Red-tailed tropicbird		✓						
<i>Phoenicopterus ruber</i>	Greater flamingo		✓						
<i>Pterodroma arminjoniana</i>	Round Island petrel	CE	✓						
<i>Ardenna pacifica</i>	Wedge-tailed shearwater		✓		✓		✓		
<i>Sula dactylatra</i>	Masked booby		✓		✓		✓	✓	
<i>Sula leucogaster</i>	Brown booby		✓		✓	✓	✓	✓	
<i>Sula sula</i>	Red-footed booby		✓		✓	✓	✓		

Scientific name	Common name	EPBC status	Marine	Cetacean	Migratory	CAMBA	JAMBA	ROKAMBA	Bonn
Mammals									
<i>Balaenoptera musculus</i>	Blue whale	EN		✓	✓				✓
<i>Balaenoptera borealis</i>	Sei whale	VU		✓	✓				✓
<i>Delphinus delphis</i>	Common dolphin			✓					
<i>Stenella longirostris</i> (E. tropic Pacific/SE Asia populations)	Long-snouted spinner dolphin			✓	✓				✓
<i>Tursiops truncatus</i>	Bottlenosed dolphin			✓					
Reptiles									
<i>Caretta caretta</i>	Loggerhead turtle	EN	✓		✓				✓
<i>Chelonia mydas</i>	Green turtle	VU	✓		✓				✓
<i>Dermochelys coriacea</i>	Leatherback turtle	EN	✓		✓				✓
<i>Eretmochelys imbricata</i>	Hawksbill turtle	VU	✓		✓				✓
<i>Lepidochelys olivacea</i>	Olive ridley turtle	EN	✓		✓				✓

Additional Marine Species

In addition to the above, all species in the families *Hydrophiidae* (sea-snakes), *Laticaudidae* (sea-snakes), and *Syngnathidae* (seahorses, sea-dragons and pipefish) are listed as marine species under the EPBC Act

Definitions

- EPBC status:** Listed as critically endangered (CE), endangered (E) or vulnerable (V) under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwth)
- Marine:** Listed as a marine species under the EPBC Act
- Cetacean:** A member of the sub-order Mysticeti or Odontoceti of the order Cetacea protected under Division 3 of the EPBC Act. Cetaceans include whales, dolphins and related marine mammals
- Migratory:** Listed as a migratory species under the EPBC Act
- CAMBA:** Listed under the *Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment*
- JAMBA:** Listed under the *Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and their Environment*
- ROKAMBA:** Listed under the *Agreement between the Government of Australia and the Republic of Korea on the Protection of Migratory Birds*
- Bonn:** Listed under the *Convention on the Conservation of Migratory Species of Wild Animals*

Appendix F

Vascular plants of Pulu Keeling National Park

* Indicates exotic species; **bold** indicates species not recorded elsewhere in the Cocos (Keeling) Islands; taxonomy and common names from Australia Flora Online anbg.gov.au/ibis/speciesLinks.html

Family	Species	Common name
Acanthaceae	<i>Dicliptera ciliata</i>	
Aizoaceae	<i>Sesuvium portulacastrum</i>	Sea purslane
Amaranthaceae	<i>Achyranthes aspera</i>	Chaff-flower
Arecaceae	<i>Cocos nucifera</i>	Coconut palm, Kelapa (besar, betul, rambai)
Boraginaceae	<i>Heliotropium foertherianum</i> (formerly <i>Argusia argentea</i>)	Octopus tree, Kayu Sirch
Boraginaceae	<i>Cordia subcordata</i>	Ironwood, Gerong gang
Caesalpinaceae	<i>Caesalpinia bonduc</i>	Grey-nicker
Capparaceae	<i>Cleome gynandra</i>	African cabbage
Caricaceae	<i>Carica papaya</i> *	Pawpaw, papaya, Katis
Clusiaceae	<i>Calophyllum inophyllum</i>	Ball tree, Alexandrian laurel
Combretaceae	<i>Terminalia catappa</i>	Indian almond, Ketapang
Convolvulaceae	<i>Ipomoea macrantha</i>	Moon flower
	<i>Ipomoea pes-caprae</i> ssp. <i>brasiliensis</i>	Kangkong meryap
Cyperaceae	<i>Mariscus javanicus</i>	Javanese flatsedge
Euphorbiaceae	<i>Acalypha indica</i> *	Indian acalypha, Indian nettle
	<i>Acalypha lanceolata</i> *	
Fabaceae	<i>Canavalia cathartica</i>	Maunaloa
	<i>Erythrina variegata</i>	Indian coral tree, Dadup Keyu Dedap
Goodeniaceae	<i>Scaevola taccada</i>	Cabbage tree, Kayu Kankong
Hernandiaceae	<i>Hernandia nymphaeifolia</i>	Sea hearse, Kayu Jambu Hutan
Hydrocharitaceae	<i>Thalassia hemprichii</i>	Turtle grass
Lamiaceae	<i>Premna serratifolia</i>	Coastal premna

Family	Species	Common name
Lythraceae	<i>Pemphis acidula</i>	Tea shrub, Mentigi, Kayu Burong
Malvaceae	<i>Sida acuta</i>	Common wireweed, spinyhead sida
Nyctaginaceae	<i>Boerhavia albiflora</i>	
	<i>Boerhavia repens</i>	Spreading hogweed, red spiderling
	<i>Pisonia grandis</i>	Ampol
Pandanaceae	<i>Pandanus tectorius</i> spp. <i>cocosensis</i>	Pokok Pandan
Phytolaccaceae	<i>Rivina humilis</i> *	Coral berry
Poaceae	<i>Lepturus repens</i>	Stalky grass
	<i>Paspalum vaginatum</i>	Saltwater couch
	<i>Stenotaphrum micranthum</i>	
Portulacaceae	<i>Portulaca oleracea</i> *	Purslane
Rubiaceae	<i>Guettarda speciosa</i>	Beach gardenia. Kembang melati hutan
	<i>Morinda citrifolia</i>	Cheese fruit, Mengkudu
Rutaceae	<i>Triphasia trifolia</i> *	Limeberry
Sapindaceae	<i>Allophylus cobbe</i>	Tit-berry
Solanaceae	<i>Physalis minima</i> *	Wild gooseberry
Urticaceae	<i>Laportea aestuans</i>	West Indian woodnettle
Verbenaceae	<i>Clerodendrum inerme</i>	Scrambling clerodendrum

Appendix G

Invertebrates, echinoderms and decapod crustaceans of the Cocos (Keeling) Islands

Invertebrates (Wells 1994)

Bold indicates species not recorded elsewhere in the Cocos Islands

Class	Family	Species
Gastropoda	Trochidae	<i>Monilea cf. nucleus</i>
	Turbindae	<i>Astralium calcar</i>
		<i>Turbo lajonkairii</i>
	Neritopsidae	<i>Neritopsis radula</i>
	Architectonicidae	<i>Helicacis sp.</i>
	Cerithiidae	<i>Cerithium atomarginatum</i>
		<i>Cerithium column</i>
		<i>Cerithium echinatum</i>
		<i>Cerithium egenum</i>
		<i>Cerithium cf. ianthinum</i>
		<i>Cerithium nesioticum</i>
		<i>Cerithium rarinnaculatum</i>
		<i>Cerithium rostratum</i>
		<i>Rhinoclavis dicadema</i>
	Eulimidae	<i>Balcis curningi</i>
	Naticidae	<i>Polinices tumidus</i>
	Ovulidae	<i>Calpurneus lacteus</i>
	Cypridae	<i>Cypraea carneola</i>
		<i>Cypraea fimbriata</i>
		<i>Cypraea helvola</i>
<i>Cypraea histrio</i>		
<i>Cypraea isahella</i>		
<i>Cypraea labrolineata</i>		

Class	Family	Species
		<i>Cypraea poraria</i>
		<i>Cypraea punctata</i>
		<i>Cypraea stolidia</i>
		<i>Cypraea talpa</i>
		<i>Cypraea teres</i>
	Cymatiidae	<i>Cyrnatum ruhecullm</i>
		<i>Gelagna succincta</i>
	Bursidae	<i>Bursa cruentata</i>
		<i>Bursa granularis</i>
	Muricidae	<i>Chicoreus saulii</i>
	Thaididae	<i>Drupella rubusidaeus</i>
		<i>Drupella chaidea</i>
		<i>Maculotriton digitalis</i>
		<i>Maculotriton seriale</i>
		<i>Morula margariticola</i>
		<i>Morula nodicostata</i>
		<i>Morula spinosa</i>
		<i>Morula uva</i>
	Coralliophilidae	<i>Coralliophila erosa</i>
		<i>Coralliophila robillardi</i>
		<i>Coralliophila violacea</i>
		<i>Quoyula madreporarum</i>
		<i>Rapa rapa</i>
	Columbellidae	<i>Pyrene obtusa</i>
		<i>Pyrene turturim</i>
		<i>Pyrene varians</i>
	Buccinidae	<i>Cantharus pulcher</i>
<i>Engina lineata</i>		

Class	Family	Species
		<i>Engina parva</i>
	Nassariidae	<i>Nassarius graniferus</i>
		<i>Nassarius papillmus</i>
	Fasciolaridae	<i>Latirus polygonus</i>
		<i>Latirus turritus</i>
		<i>Latirus sp</i>
		<i>Peristernia nassatula</i>
	Olividae	<i>Oliva annulata</i>
		<i>Oliva caerulea</i>
		<i>Oliva panniculara</i>
	Mitridae	<i>Imbricaria conovula</i>
		<i>Mitra contracts</i>
		<i>Mitra fraga</i>
		<i>Mitra ticaonica</i>
	Costellariidae	<i>Vexillum cancellarioides</i>
		<i>Vexillum pardalis</i>
		<i>Vexillum speciosum</i>
	Turridae	<i>Clavus lamberti</i>
		<i>Clavus sp.</i>
		<i>Crassispira sp.</i>
		<i>Daphnella sp.</i>
		<i>Turridrupa sp.</i>
	Conidae	<i>Conus capitaneus</i>
		<i>Conus imperialis</i>
		<i>Conus lividus</i>
		<i>Conus miles</i>
		<i>Conus miliaris</i>
		<i>Conus moreleti</i>

Class	Family	Species	
		<i>Conus musicus</i>	
		<i>Conus obscurus</i>	
		<i>Conus pertusus</i>	
		<i>Conus pulicarius</i>	
		<i>Conus rattus</i>	
		<i>Gonus sponsalis</i>	
		<i>Conus straitellus</i>	
		<i>Conus tenuistriatus</i>	
		<i>Conus vexillum</i>	
	Terebridae	<i>Hastula penicillata</i>	
		<i>Terebra affinis</i>	
		<i>Terebra argus</i>	
		<i>Terebra babylonia</i>	
		<i>Terebra crenulata</i>	
		<i>Terebra dimidiata</i>	
		<i>Terebra funiculata</i>	
		<i>Terebra lanceata</i>	
		<i>Terebra maculata</i>	
		<i>Terenolla pygmaea</i>	
	Pyramidellidae	<i>Pyramidella acus</i>	
	Gastropteridae	<i>Gastropteron sp.</i>	
	Dorididae	<i>Platydorid scabra</i>	
	Phyllidiidae	<i>Phyllidia elegans</i>	
		<i>Phyllidia sp. 3</i>	
	Ellobiidae	<i>Melampus flavus</i>	
	Bivalvia	Arcidae	<i>Arca plicata</i>
		Pinnidae	<i>Streptopinna saccata</i>
Isogonomonidae		<i>Isogonomon perna</i>	

Class	Family	Species
	Pectinidae	<i>Chlamys irregularis</i>
		<i>Chlamys sp.</i>
	Spondylidae	<i>Spondylus nicobaricus</i>
		<i>Spondylus sanguineus</i>
	Limidae	<i>Lima cf. annulata</i>
		<i>Limaria orientalis</i>
	Lucinidae	<i>Codakia punctata</i>
	Carditidae	<i>Cardita variegata</i>
	Tellinidae	<i>Arcopagia scobinata</i>
		<i>Tellina robusta</i>
		<i>Tellina tongana</i>

Echinoderms (Marsh 1994)

Bold indicates species not recorded elsewhere in the Cocos (Keeling) Islands; common names from codes for Australian aquatic biota (CAAB) – where no common name is designated, the group or type of organism is provided <http://www.cmar.csiro.au/caab/caabsearch.htm>

Class	Family	Species	Common name / type
Crinoidea	Mariametridae	<i>Stephanometra spicata</i>	Indian feather star
Asteroidea	Ophidiasteridae	<i>Fromia milleporella</i>	A sea star
		<i>Linckia multifora</i>	A sea star
Ophiuroidea	Ophiotrichidae	<i>Ophiactis savignyi</i>	Savigny's brittlestar
	Ophiocomidae	<i>Ophiarthrum elegans</i>	A brittle star
		<i>Ophiocoma dentata</i>	A brittle star
		<i>Ophiocoma erinaceus</i>	A brittle star
		<i>Ophiocoma pica</i>	Brown and gold brittlestar
		<i>Ophiocoma pusilla</i>	A brittle star
Ophiodermatidae	<i>Ophiarachnella similis</i>	A brittle star	
Echinoidea	Cidaridae	<i>Eucidaris metularia</i>	A sea urchin

Decapod crustaceans (Morgan 1994)

Bold indicates species not recorded elsewhere in the Cocos (Keeling) Islands; common names from CAAB – where no common name is designated, the group or type of organism is provided <http://www.cmar.csiro.au/caab/caabsearch.htm>

Order	Family	Species	Common name / type
Anomura	Diogenidae	<i>Aniculus retipes</i>	A hermit crab
		<i>Calcinus minutus</i>	A hermit crab
		<i>Calcinus pulcher</i>	A hermit crab
		<i>Calcinus sp. 1</i>	A hermit crab
		<i>Dardanus crassimanus</i>	A hermit crab
		<i>Dardanus lagopodes</i>	A hermit crab
		<i>Paguristes sp.</i>	A hermit crab
	Paguridae	<i>Pagurixus sp.</i>	A hermit crab
		<i>Pylopaguropsis magnimanus</i>	A hermit crab
	Coenobitidae	<i>Birgus latro</i>	Coconut crab (robber crab)
		<i>Coenobita brevimanus</i>	A land hermit crab
		<i>Coenobita perlatus</i>	A land hermit crab
		<i>Coenobita rugosus</i>	A land hermit crab
	Brachyura	Dynomenidae	<i>Dynomene cf. pilumnoides</i>
<i>Dynomene praedator</i>			A crab
Majidae		<i>Schizophrys aspera</i>	Red spider crab
Portunidae		<i>Thalamitoides quadridens</i>	A swimmer crab
Xanthidae		<i>Liomera venosa</i>	A crab
		<i>Paramedaeus simplex</i>	A crab
		<i>Platypodia pseudogranulosa</i>	A crab
		<i>Paraetisus sp.</i>	A crab
		<i>Tweedieia odhneri</i>	A crab
Trapeziidae		<i>Trapezia cymodoce</i>	A crab
		<i>Trapezia ferruginea</i>	A crab

Order	Family	Species	Common name / type
	Menippidae	<i>Geograpsus crinipes</i>	A shore crab
	Grapsidae	<i>Daira perlata</i>	A shore crab
		<i>Geograpsus grayi</i>	A shore crab
	Gecarcinidae	<i>Gecarcoidea natalis</i>	Red crab
		<i>Cardisoma carnifex</i>	Purple crab
		<i>Discoplax rotunda</i>	A crab

Appendix H

Fish species of Pulu Keeling National Park

Species list compiled from Hobbs 2009; Lincoln-Smith et al. 1995

Species name	Common name	Malay name	Distribution
Carcharhinidae – Requiem sharks			
<i>Carcharhinus amblyrhynchos</i>	Blacktail reef shark	Yu tongkol	Indo-Pacific
<i>C. melanopterus</i>	Blacktip reef shark		Indo-Pacific
Mobulidae – Manta rays			
<i>Manta birostris</i>	Manta ray		Cosmopolitan
Muraenidae – Moray eels			
<i>Gymnothorax pictus</i>	Painted moray		Indo-Pacific
Albulidae – bonefishes			
<i>Albula glossodonta</i>	Bonefish		Indo-Pacific
Chanidae – Milkfishes			
<i>Chanos chanos</i>	Milkfish	Ikan bandang laut	Indo-Pacific
Belonidae – Needlefishes			
<i>Tylosurus crocodilus</i>	Hound needlefish		Indo-Pacific
Holocentridae – Squirrelfishes			
<i>Myripristis pralinia</i>	Scarlet soldierfish		Indo-Pacific
<i>Sargocentron diadema</i>	Crown squirrelfish		Indo-Pacific
<i>S. microstoma</i>	Smallmouth squirrelfish		Indo-Pacific
<i>S. spiniferum</i>	Sabre squirrelfish		Indo-Pacific
Scorpaenidae – Scorpionfishes			
<i>Pterois radiata</i>	Radiata lionfish		Indo-Pacific
Caracanthidae – Orbicular velvetfishes			
<i>Caracanthus unipinna</i>	Coral croucher		Indo-Pacific
<i>C. maculatus</i>	Spotted coral croucher		West Pacific
Serranidae – Sea basses			
<i>Anyperodon leucogrammicus</i>	White-lined rockcod	Kerapu cicak	Indo-Pacific
<i>Cephalopholis argus</i>	Peacock rockcod	Kerapu hitam	Indo-Pacific
<i>C. miniata</i>	Coral cod		Indo-Pacific
<i>C. urodeta</i>	Darkfin hind		Indo-Pacific
<i>Epinephelus fuscoguttatus</i>	Flowery cod		Indo-Pacific

Species name	Common name	Malay name	Distribution
<i>E. hexagonatus</i>	Starspotted grouper		Indo-Pacific
<i>E. merra</i>	Honeycomb grouper		Indo-Pacific
<i>E. spilotoceps</i>	Foursaddle grouper		Indo-Pacific
<i>E. tauvina</i>	Greasy grouper		Indo-Pacific
<i>Gracila albomarginata</i>	Red-edged cod		Indo-Pacific
<i>Grammistes sexlineatus</i>	Golden-striped grouper		Indo-Pacific
<i>Pseudanthias evansi</i>	Yellowback anthias		Indian Ocean
<i>P. smithvanizi</i>	Princess anthias		West Pacific
<i>Variola louti</i>	Coronation trout	Kerapu boronok	Indo-Pacific
Kuhliidae – Flagtails			
<i>Kuhlia mugil</i>	Flagtail	Ikan kerong	Indo-Pacific
Apogonidae – Cardinalfishes			
<i>Apogon taeniophorus</i>	Reef-flat cardinalfish		Indo-Pacific
Carangidae – Trevallies			
<i>Carangoides ferdau</i>	Blue trevally		Indo-Pacific
<i>C. orthogrammus</i>	Island trevally		Indo-Pacific
<i>Caranx ignobilis</i>	Giant trevally		Indo-Pacific
<i>C. lugubris</i>	Black trevally		Cosmopolitan
<i>C. melampygus</i>	Bluefin trevally		Indo-Pacific
<i>Decapterus macarellus</i>	Mackerel scad		Cosmopolitan
<i>Elagatis bipinnulatus</i>	Rainbow runner	Salmon puteh	Cosmopolitan
<i>Trachinotus bailloni</i>	Black-spot dart	Ikan talang	Indo-Pacific
<i>T. blochii</i>	Snubnose pompano		Indo-Pacific
Lutjanidae – Snappers			
<i>Aphareus furca</i>	Small-toothed jobfish	Ikan benita/ salmon kuning	Indo-Pacific
<i>Aprion virescens</i>	Green jobfish	Salmon biru	Indo-Pacific
<i>Lutjanus bohar</i>	Red bass	Bambangan	Indo-Pacific
<i>L. fulvus</i>	Blacktail snapper		Indo-Pacific
<i>L. gibbus</i>	Humpback red snapper		Indo-Pacific
<i>L. kasmira</i>	Common bluestripe snapper		Indo-Pacific
<i>L. monostigma</i>	One-spot sapper		Indo-Pacific
<i>L. rivulatus</i>	Blubberlip snapper		Indo-Pacific
<i>Macolor niger</i>	Black sea perch	Ikan tausong	Indo-Pacific

Species name	Common name	Malay name	Distribution
Caesionidae – Fusiliers			
<i>Caesio lunaris</i>	Lunar fusilier		Indo-Pacific
<i>C. teres</i>	Yellow and blueback fusilier		Indo-Pacific
<i>Pterocaesio tile</i>	Dark-banded fusilier		Indo-Pacific
Lethrinidae – Emperors			
<i>Gnathodentex aurolineatus</i>	Gold lined sea bream		Indo-Pacific
<i>Lethrinus atkinsoni</i>	Yellow-tail emperor		West Pacific
<i>L. obsoletus</i>	Yellow striped emperor		Indo-Pacific
<i>L. xanthochilus</i>	Yellowlip emperor		Indo-Pacific
<i>Monotaxis grandoculis</i>	Big-eye bream	Ikan gigi orang	Indo-Pacific
Gerreidae – Mojarras			
<i>Gerres acinaces</i>	Longfin biddy	Ikan puteh	Indo-Pacific
Mullidae – Goatfishes			
<i>Mulloidichthys flavolineatus</i>	Pallid goatfish	Ikan jangut kuning	Indo-Pacific
<i>M. vanicolensis</i>	Yellowfin goatfish		Indo-Pacific
<i>Parupeneus trifasciatus</i>	Doublebar goatfish		Indo-Pacific
<i>P. cyclostomus</i>	Gold-saddle goatfish		Indo-Pacific
<i>P. macronemus</i>	Long-barbel goatfish		Indo-Pacific
Kyphosidae – Rudderfishes			
<i>Kyphosus vaigiensis</i>	Lowfin drummer		Indo-Pacific
Pempheridae – Sweepers			
<i>Pempheris oualensis</i>	Silver sweeper		Indo-Pacific
Chaetodontidae – Butterflyfishes			
<i>Chaetodon auriga</i>	Threadfin butterflyfish		Indo-Pacific
<i>C. citrinellus</i>	Citron butterflyfish		Indo-Pacific
<i>C. decussatus</i>	Indian vagabond butterflyfish		Indian Ocean
<i>C. ephippium</i>	Saddle butterflyfish		Indo-Pacific
<i>C. guttatissimus</i>	Peppered butterflyfish		Indian Ocean
<i>C. lineolatus</i>	Lined butterflyfish		Indo-Pacific
<i>C. lunula</i>	Raccoon butterflyfish		Indo-Pacific
<i>C. melannotus</i>	Black-backed butterflyfish		Indo-Pacific
<i>C. meyeri</i>	Scrawled butterflyfish		Indo-Pacific
<i>C. ornatissimus</i>	Ornate butterflyfish		Indo-Pacific

Species name	Common name	Malay name	Distribution
<i>C. trifascialis</i>	Chevron butterflyfish		Indo-Pacific
<i>C. trifasciatus</i>	Melon Butterflyfish		Indo-Pacific
<i>C. ulietensis</i>	Doublesaddle butterflyfish		West Pacific
<i>C. unimaculatus</i>	Teardrop butterflyfish		Indo-Pacific
<i>Forcipiger flavissimus</i>	Longnose butterflyfish		Indo-Pacific
<i>F. longirostris</i>	Longnose butterflyfish		Indo-Pacific
<i>Hemitaenichthys polylepis</i>	Pyramid butterflyfish		West Pacific
<i>Heniochus chrysostomus</i>	Threeband pennantfish		Indo-Pacific
<i>H. monoceros</i>	Masked bannerfish		Indo-Pacific
Pomacanthidae – Angelfishes			
<i>Apothemichthys trimaculatus</i>	Threespot angelfish		Indo-Pacific
<i>Centropyge flavissimus</i>	Lemonpeel angelfish		Indo-Pacific
<i>C. jocularis</i>	Cocos pygmy angelfish		Endemic
<i>Paracentropyge multifasciatus</i>	Multibarred angelfish		West Pacific
<i>Pomacanthus imperator</i>	Emperor angelfish		Indo-Pacific
<i>Pygoplites diacanthus</i>	Regal angelfish		Indo-Pacific
Pomacentridae – Damselfishes			
<i>Abudefduf notatus</i>	Yellowtail sergeant		Indo-Pacific
<i>A. septemfasciatus</i>	Banded sergeant		Indo-Pacific
<i>A. sordidus</i>	Blackspot sergeant		Indo-Pacific
<i>A. vaigiensis</i>	Indo-Pacific sergeant		Indo-Pacific
<i>Amphiprion clarkii</i>	Yellowtail clownfish		Indo-Pacific
<i>Chromis margaritifer</i>	Bicolor Chromis		West Pacific
<i>C. nigrura</i>	Blacktail chromis		Indian Ocean
<i>C. opercularis</i>	Doublebar chromis		Indian Ocean
<i>C. ternatensis</i>	Ternate Chromis		Indo-Pacific
<i>Chrysiptera glauca</i>	Grey demoiselle		Indo-Pacific
<i>Dascyllus aruanus</i>	Whitetail dascyllus		Indo-Pacific
<i>D. trimaculatus</i>	Domino damselfish		Indo-Pacific
<i>Plectroglyphidodon dickii</i>	Blackbar devil		Indo-Pacific
<i>P. imparipennis</i>	Brighteye damselfish		Indo-Pacific
<i>P. johnstonianus</i>	Blue-eye damselfish		Indo-Pacific
<i>P. lacrymatus</i>	Jewel damselfish		Indo-Pacific
<i>P. phoenixensis</i>	Phoenix devil		Indo-Pacific

Species name	Common name	Malay name	Distribution
<i>Stegastes albifasciatus</i>	Whitebar gregory		Indo-Pacific
<i>S. fasciolatus</i>	Pacific gregory		Indo-Pacific
<i>S. insularis</i>	Island gregory		West Pacific
<i>S. nigricans</i>	Dusky farmerfish		Indo-Pacific
Cirrhitidae – Hawkfishes			
<i>Paracirrhites arcatus</i>	Arc-eye hawkfish		Indo-Pacific
<i>P. forsteri</i>	Blackside hawkfish		Indo-Pacific
<i>P. hemistictus</i>	Whitespot hawkfish		Indo-Pacific
Mugilidae – Mullet			
<i>Crenimugil crenilabis</i>	Fringelip mullet		Indo-Pacific
<i>Liza vaigiensis</i>	Squartail mullet		Indo-Pacific
Sphyrnaeidae – Barracudas			
<i>Sphyrna barracuda</i>	Great barracuda	Ikan aloh-aloh	Cosmopolitan
Labridae – Wrasses and p arrotfishes			
<i>Anampses caeruleopunctatus</i>	Bluespotted wrasse		Indo-Pacific
<i>A. meleagrides</i>	Yellowtail wrasse		Indo-Pacific
<i>A. twistii</i>	Yellowbreasted wrasse		Indo-Pacific
<i>Bodianus anthioides</i>	Lyretail hogfish		Indo-Pacific
<i>B. axillaris</i>	Axilspot hogfish		Indo-Pacific
<i>Cheilinus trilobatus</i>	Tripletail wrass, Maori wrasse		Indo-Pacific
<i>C. undulatus</i>	Humphead wrasse		Indo-Pacific
<i>Cheilio inermis</i>	Cigar wrasse		Indo-Pacific
<i>Chlorurus sordidus</i>	Daisy parrotfish		Indo-Pacific
<i>C. strongylocephalus</i>	Steephead parrotfish		Indian Ocean
<i>Coris aygula</i>	Clown coris wrasse		Indo-Pacific
<i>C. gaimard</i>	African coris		Indo-Pacific
<i>Gomphosus varius</i>	Bird wrasse		West Pacific
<i>Halichoeres hortulanus</i>	Checkerboard wrasse		Indo-Pacific
<i>H. margaritaceus</i>	Pink-belly wrasse		West Pacific
<i>H. marginatus</i>	Dusky wrasse		Indo-Pacific
<i>H. ornatissimus</i>	Ornamented wrasse		West Pacific
<i>H. trimaculatus</i>	Threespot wrasse		West Pacific
<i>Hemigymnus fasciatus</i>	Fiveband wrasse		Indo-Pacific

Species name	Common name	Malay name	Distribution
<i>Hipposcarus harid</i>	Candelamao parrotfish		Indian Ocean
<i>Hologymnosus annulatus</i>	Ring wrasse		Indo-Pacific
<i>Labroides bicolor</i>	Bicolor cleaner wrasse		Indo-Pacific
<i>L. dimidiatus</i>	Bluestreak cleaner wrasse		Indo-Pacific
<i>Labrichthys unilineatus</i>	Tubelip wrasse		Indo-Pacific
<i>Macropharyngodon meleagris</i>	Leopard wrasse		West Pacific
<i>Novaculichthys taeniourus</i>	Rockmover wrasse		Indo-Pacific
<i>Oxycheilinus unifasciatus</i>	Ringtail maori wrasse		West Pacific
<i>Pseudocheilinus hexataenia</i>	Sixline wrasse		Indo-Pacific
<i>Scarus forsteni</i>	Forsten's parrotfish	Ikan kakatua	West Pacific
<i>S. globiceps</i>	Globehead parrotfish		Indo-Pacific
<i>S. rubroviolaceus</i>	Ember parrotfish		Indo-Pacific
<i>Stethojulis bandanensis</i>	Red shoulder wrasse		West Pacific
<i>Thalassoma amblycephalum</i>	Bluntheaded wrasse		Indo-Pacific
<i>T. hardwicke</i>	Sixbar wrasse		Indo-Pacific
<i>T. janseni</i>	Jansen's wrasse		Indo-Pacific
<i>T. lutescens</i>	Yellow-brown wrasse		Indo-Pacific
<i>T. purpureum</i>	Surge wrasse		Indo-Pacific
<i>T. quinquevittatum</i>	Fivestripe wrasse		Indo-Pacific
<i>T. trilobatum</i>	Christmas wrasse		Indo-Pacific
Blenniidae – Blennies			
<i>Cirripectes stigmaticus</i>	Red-streaked blenny		Indo-Pacific
Pinguipedidae – Sandperches			
<i>Parapercis clathrata</i>	Latticed sandperch		Indo-Pacific
<i>P. hexophthalma</i>	Speckled sandperch		Indo-Pacific
Ptereleotridae – Dartfishes			
<i>Ptereleotris evides</i>	Blackfin dartfish		Indo-Pacific
<i>P. zebra</i>	Zebra dartfish		Indo-Pacific
Acanthuridae – Surgeonfishes and unicornfishes			
<i>Acanthurus blochii</i>	Ringtail surgeonfish		Indo-Pacific
<i>A. guttatus</i>	Whitespotted surgeonfish		West Pacific
<i>A. leucosternon</i>	Powderblue surgeonfish		Indo-Pacific
<i>A. lineatus</i>	Striped surgeonfish		Indo-Pacific

Species name	Common name	Malay name	Distribution
<i>A. mata</i>	Elongate surgeonfish		Indo-Pacific
<i>A. nigricans</i>	Whitecheek surgeonfish		West Pacific
<i>A. nigricauda</i>	Wpaulette surgeonfish		Indo-Pacific
<i>A. nigrofuscus</i>	Brown surgeonfish		Indo-Pacific
<i>A. olivaceus</i>	Orangespot surgeonfish		West Pacific
<i>A. thompsoni</i>	Thompson's surgeonfish		Indo-Pacific
<i>A. triostegus</i>	Convict surgeonfish		Indo-Pacific
<i>A. xanthopterus</i>	Yellowfin surgeonfish		Indo-Pacific
<i>Ctenochaetus striatus</i>	Striated surgeonfish		Indo-Pacific
<i>C. truncatus</i>	Spotted bristletooth tang		Indian Ocean
<i>Naso annulatus</i>	Whitemargin unicornfish	Ikan chula	Indo-Pacific
<i>N. elegans</i>	Elegant unicornfish		Indian Ocean
<i>N. hexacanthus</i>	Sleek unicornfish		Indo-Pacific
<i>N. lituratus</i>	Orangespine unicornfish		West Pacific
<i>N. unicornis</i>	Bluespine unicornfish		Indo-Pacific
<i>Zebрасoma desjardini</i>	Red Sea sailfin tang / Indian Ocean sailfin tang		Indian Ocean
<i>Z. scopas</i>	Twotone tang		Indo-Pacific
Zanclidae – Moorish idols			
<i>Zanclus cornutus</i>	Moorish idol		Indo-Pacific
Siganidae – Rabbitfishes			
<i>Siganus argenteus</i>	Streamlined spinefoot		Indo-Pacific
Scombridae – Tunas			
<i>Acanthocybium solandri</i>	Wahoo		Cosmopolitan
<i>Gymnosarda unicolor</i>	Dogtooth tuna	Kandang duek	Indo-Pacific
<i>Thunnus albacares</i>	Yellowfin tuna		Cosmopolitan
Bothidae – Flounders			
<i>Bothus mancus</i>	Flowery flounder		
Balistidae – Triggerfishes			
<i>Balistapus undulatus</i>	Orange-lined triggerfish		Indo-Pacific
<i>Balistoides viridescens</i>	Titan triggerfish		Indo-Pacific
<i>Melichthys indicus</i>	Indian triggerfish	Ikan hitam	Indo-Pacific
<i>M. niger</i>	Black triggerfish		Cosmopolitan
<i>M. vidua</i>	Pinktail triggerfish		Indo-Pacific

Species name	Common name	Malay name	Distribution
<i>Rhinecanthus aculeatus</i>	White-banded triggerfish		Indo-Pacific
<i>R. rectangulus</i>	Wedge-tail triggerfish		Indo-Pacific
<i>Sufflamen bursa</i>	Boomerang triggerfish		Indo-Pacific
<i>S. chrysopterus</i>	Halfmoon triggerfish		Indo-Pacific
Monacanthidae – Leatherjackets			
<i>Aluterus scriptus</i>	Scribbled leatherjacket filefish		Cosmopolitan
<i>Cantherines dumerilli</i>	Whitespotted filefish		Indo-Pacific
Ostraciontidae – Boxfishes			
<i>Ostracion cubicus</i>	Yellow boxfish		Indo-Pacific
Tetraodontidae – Puffers			
<i>Canthigaster amboinensis</i>	Spider-eye puffer		Indo-Pacific
Diodontidae – Porcupinefishes			
<i>Diodon hystrix</i>	Spot-fin porcupinefish		Cosmopolitan

Appendix I

Compliance with reserve management and planning principles

Australian IUCN reserve management principles

EPBC Regulation 10.04 – Schedule 8

EPBC Regulation schedules and management principles	Sections of management plan that address principles
Australian IUCN reserve management principles	
<i>Part 1 – General administrative principles</i>	
1 Community participation	6.1
Management arrangements should, to the extent practicable, provide for broad and meaningful participation by the community, public organisations and private interests in designing and carrying out the functions of the reserve or zone.	Consultations opportunities in the preparation of plan provided in accordance with s.368 of the EPBC Act
2 Effective and adaptive management	2.1, 3.1 to 3.3, 4.1
Management arrangements should be effective and appropriate to the biodiversity objectives and the socio-economic context of the reserve or zone. They should be adaptive in character to ensure a capacity to respond to uncertainty and change.	
3 Precautionary principle	3.3
A lack of full scientific certainty should not be used as a reason for postponing measures to prevent degradation of the natural and cultural heritage of a reserve or zone where there is a threat of serious or irreversible damage.	
4 Minimum impact	3, 4, 5, 7.1
The integrity of a reserve or zone is best conserved by protecting it from disturbance and threatening processes. Potential adverse impacts on the natural, cultural and social environment and surrounding communities should be minimised as far as practicable.	
5 Ecologically sustainable use	3.3, 5.1, 5.2
If resource use is consistent with the management principles that apply to a reserve or zone, it should (if it is carried out) be based on the principle (the principle of ecologically sustainable use) that:	
(a) natural resources should only be used within their capacity to sustain natural processes while maintaining the life-support systems of nature; and	
(b) the benefit of the use to the present generation should not diminish the potential of the reserve or zone to meet the needs and aspirations of future generations.	
6 Transparency of decision-making	7.1, 7.5
The framework and processes for decision-making for management of the reserve or zone should be transparent. The reasons for making decisions should be publicly available, except to the extent that information, including information that is culturally sensitive or commercial-in-confidence, needs to be treated as confidential.	

Part 2 – Principles for each IUCN category**1 Strict nature reserve (category Ia)**

- | | |
|---|-----------------|
| (1) The reserve or zone should be managed primarily for scientific research or environmental monitoring based on the following principles. | |
| (2) Habitats, ecosystems and native species should be conserved in as undisturbed a state as possible. | 2.1, 3.1 to 3.3 |
| (3) Genetic resources should be maintained in a dynamic and evolutionary state. | 3.1 to 3.3 |
| (4) Established ecological processes should be maintained. | 3.1 to 3.3 |
| (5) Structural landscape features or rock exposures should be safeguarded. | 3.1, 3.3 |
| (6) Examples of the natural environment should be secured for scientific studies, environmental monitoring and education, including baseline areas from which all avoidable access is excluded. | 3.1, 3.3, 5.3 |
| (7) Disturbance should be minimised by careful planning and execution of research and other approved activities. | 3.3, 5.1, 7.1 |
| (8) Public access should be limited to the extent it is consistent with these principles. | 3.1, 7.1, 7.2 |

3 National park (category II)

- | | |
|---|-----------------------------|
| (1) The reserve or zone should be protected and managed to preserve its natural condition according to the following principles. | |
| (2) Natural and scenic areas of national and international significance should be protected for spiritual, scientific, educational, recreational or tourist purposes. | 2.1, 3.1 to 3.3, 5.1 |
| (3) Representative examples of physiographic regions, biotic communities, genetic resources, and native species should be perpetuated in as natural a state as possible to provide ecological stability and diversity. | 3.1 to 3.3, 7.1 |
| (4) Visitor use should be managed for inspirational, educational, cultural and recreational purposes at a level that will maintain the reserve or zone in a natural or near natural state. | 5.1, 5.2 |
| (5) Management should seek to ensure that exploitation or occupation inconsistent with these principles does not occur. | 3.3, 5.1, 5.2, 7.1 |
| (6) Respect should be maintained for the ecological, geomorphologic, sacred and aesthetic attributes for which the reserve or zone was assigned to this category. | 3.1 to 3.3, 4.1, 5.1 to 5.3 |
| (7) The needs of indigenous people should be taken into account, including subsistence resource use, to the extent that they do not conflict with these principles. | N/A |
| (8) The aspirations of traditional owners of land within the reserve or zone, their continuing land management practices, the protection and maintenance of cultural heritage and the benefit the traditional owners derive from enterprises, established in the reserve or zone, consistent with these principles should be recognised and taken into account. | N/A |

Compliance with reserve management and planning principles – continued

Management plans for Commonwealth Heritage places

(See also Appendix D – Commonwealth Heritage values of North Keeling Island)

EPBC Regulation 10.03B – Schedule 7A

EPBC Commonwealth Heritage requirement	Compliance reference
A management plan must:	
(a) establish objectives for the identification, protection, conservation, presentation and transmission of the Commonwealth Heritage values of the place; and	Page 2-3 – Park vision, park values and objectives of the plan 3. – Natural heritage management 4. – Cultural heritage management 5.3 – Communicating park values
(b) provide a management framework that includes reference to any statutory requirements and agency mechanisms for the protection of the Commonwealth Heritage values of the place; and	3. – Natural heritage management 4. – Cultural heritage management 7.1 – Assessment of proposals Page 73 – Planning process and legislative context
(c) provide a comprehensive description of the place, including information about its location, physical features, condition, historical context and current uses; and	3. – Natural heritage management 4. – Cultural heritage management Page 43 – A description of the Cocos (Keeling) Islands and Pulu Keeling National Park
(d) provide a description of the Commonwealth Heritage values and any other heritage values of the place; and	Page 2-3 – Values of the park Page 43 – A description of the Cocos (Keeling) Islands and Pulu Keeling National Park Appendix D – Commonwealth Heritage values of North Keeling Island
(e) describe the condition of the Commonwealth Heritage values of the place; and	3. – Natural heritage management 4. – Cultural heritage management Page 43 – A description of the Cocos (Keeling) Islands and Pulu Keeling National Park Appendix D – Commonwealth Heritage values of North Keeling Island
(f) describe the method used to assess the Commonwealth Heritage values of the place; and	3. – Natural heritage management 4. – Cultural heritage management Appendix D – Commonwealth Heritage values of North Keeling Island Page 125 – Bibliography and further reading

EPBC Commonwealth Heritage requirement	Compliance reference
<p>(g) describe the current management requirements and goals, including proposals for change and any potential pressures on the Commonwealth Heritage values of the place; and</p>	<p>Page 2-3 – Park vision and objectives of the plan</p> <p>3. – Natural heritage management</p> <p>4. – Cultural heritage management</p> <p>5. – Visitor management and park use</p> <p>7.1 – Assessment of proposals</p> <p>7.2 – Capital works and infrastructure</p> <p>Page 43 – A description of the Cocos (Keeling) Islands and Pulu Keeling National Park</p>
<p>(h) have policies to manage the Commonwealth Heritage values of a place, and include in those policies, guidance in relation to the following:</p> <p>(i) the management and conservation processes to be used;</p> <p>(ii) the access and security arrangements, including access to the area for indigenous people to maintain cultural traditions;</p> <p>(iii) the stakeholder and community consultation and liaison arrangements;</p> <p>(iv) the policies and protocols to ensure that Indigenous people participate in the management process;</p> <p>(v) the protocols for the management of sensitive information;</p>	<p>Sections 3 to 9 of this plan provide a broad spectrum of management processes that will be used to conserve the natural and cultural heritage of the site.</p> <p>2.1 – IUCN category and zoning</p> <p>4.1 – Cultural heritage site management</p> <p>5.1 – Visitor access and use</p> <p>5.2 – Commercial tourism and other commercial activities</p> <p>7.3 Compliance and enforcement</p> <p>3. – Natural heritage management</p> <p>4. – Cultural heritage management</p> <p>6.1 – Community, stakeholders and partnerships</p> <p>The island is not home to Indigenous people.</p> <p>The Cocos-Malay community on the southern atoll is consulted in relation to the park and issues that concern the community. A Pulu Keeling National Park Community Management Committee is established under the Lease to consult on the management of the park. See also Section 6.</p> <p>N/A – No sensitive Indigenous knowledge or sites, and no sensitive information stored or managed.</p>
<p>(vi) the planning and management of works, development, adaptive reuse and property divestment proposals;</p>	<p>7.1 – Assessment of proposals</p> <p>7.2 – Capital works and infrastructure</p>

EPBC Commonwealth Heritage requirement	Compliance reference
<p>(vii) how unforeseen discoveries or disturbance of heritage are to be managed;</p> <p>(viii) how, and under what circumstances, heritage advice is to be obtained;</p> <p>(ix) how the condition of Commonwealth Heritage values is to be monitored and reported;</p> <p>(x) how records of intervention and maintenance of a heritage places register are kept;</p> <p>(xi) the research, training and resources needed to improve management;</p> <p>(xii) how heritage values are to be interpreted and promoted; and</p>	<p>3.3.1 – Changes in the landscape</p> <p>3.1.2 – Rectify impacts to the values of the park</p> <p>3.1.6 – Invasive species and pathogens</p> <p>3.3 – Research and monitoring</p> <p>6.1.7 – Documenting heritage sites and artefacts</p> <p>5.1.22, 6.1.8 – Rectifying impacts of unauthorised arrivals</p> <p>7.5 – New activities not otherwise specified in this plan</p> <p>3.3.2 – Gaps in baseline data</p> <p>3.3 – Research and monitoring</p> <p>4.1.2 – Manage to minimise disturbance</p> <p>4.1.3 – Care of grave sites</p> <p>4.1.5 – Documenting heritage sites and artefacts</p> <p>6.1 – Stakeholders and partnerships</p> <p>7.1 – Assessment of proposals</p> <p>3. – Natural heritage management</p> <p>3.3 – Research and monitoring</p> <p>4. – Cultural heritage management</p> <p>3. – Natural heritage management</p> <p>4.1.5 – Documenting heritage sites and artefacts</p> <p>4.1.6 – Heritage register and maintenance schedule</p> <p>3. – Natural heritage management</p> <p>3.3 – Research and monitoring</p> <p>4. – Cultural heritage management</p> <p>5.3 – Communicating park values</p> <p>5.3 – Communicating park values</p>
<p>(i) include an implementation plan; and</p>	<p>4.1.6 – Heritage register and maintenance schedule</p> <p>7.6 – Management plan implementation and evaluation</p>
<p>(j) show how the implementation of policies will be monitored; and</p>	<p>7.6.6 – Report on the plan's implementation</p> <p>7.6.7 – Audit the plan's implementation before preparing the next management plan</p>

EPBC Commonwealth Heritage requirement	Compliance reference
(k) show how the management plan will be reviewed.	7.6.6 – Report on the plan's implementation 7.6.7 – Audit the plan's implementation before preparing the next management plan Page 74: Management plans

Compliance with reserve management and planning principles – continued

Australian Ramsar management planning principles

EPBC Regulation 10.2 – Schedule 6 (2)

EPBC Australian Ramsar management principles	Compliance reference
A management plan for a declared Ramsar wetland should:	
(a) describe its ecological character;	Page 43 – A description of the Cocos (Keeling) Islands and Pulu Keeling National Park
(b) state the characteristics that make it a Wetland of International Importance under the Ramsar Convention	Page 81 – Ramsar listing criteria
(c) state what must be done to maintain its ecological character	3.1 to 3.3
(d) promote its conservation and sustainable use for the benefit of humanity in a way that is compatible with maintenance of the natural properties of the ecosystem	5.1 to 5.3
(e) state mechanisms to deal with the impacts of actions that individually or cumulatively endanger its ecological character, including risks arising from:	
(i) physical loss, modification or encroachment on the wetland; or	3.1 to 3.3
(ii) loss of biodiversity; or	4.1, 5.1, 5.4
(iii) pollution and nutrient input; or	4.1, 5.4
(iv) changes to water regimes; or	5.1, 5.4
(v) utilisation of resources; or	5.1 to 5.4, 7.1
(vi) introduction of invasive species	3.1.6, 3.1.10, 3.1.11
(f) state whether the wetland needs restoration or rehabilitation	3.1
(g) if restoration or rehabilitation is needed – explain how the plan provides for restoration or rehabilitation	3.1
(h) provide for continuing monitoring and reporting on the state of its ecological character	3.3
(i) be based on an integrated catchment management approach	N/A
(j) include adequate processes for public consultation on the elements of the plan	6.1 Consultation opportunities in preparation of plan provided in accordance with s.368 of the EPBC Act

EPBC Australian Ramsar management principles	Compliance reference
(k) be reviewed at intervals of not more than 7 years.	N/A – Commonwealth reserve management plan to be reviewed after 10 years under the EPBC Act. Management of the park is reviewed and reported annually in the Director of National Parks Annual Report.

Appendix J

Summary of results for the Technical Audit of the third management plan for Pulu Keeling National Park

Prior to preparing this plan an audit of the second management plan for the park was conducted to assess its effectiveness and to provide recommendations to assist with the preparation of this plan. The audit (DNP 2011) assessed the status and trend in relation to management performance against the management areas indentified in the previous plan.

A summary of the audit results is provided below.

Zoning and IUCN category

Aim: *To have a zoning scheme for Pulu Keeling National Park that provides for appropriate use of the park, while protecting its natural and cultural features.*



Status: Healthy

Trend: Stable

Rationale

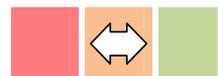
Management and permitted activities complied with the assigned IUCN categories.

Access to and use of the park's terrestrial areas was managed primarily for nature conservation and scientific research with some limited opportunities for educational use/visitation. Minimal infrastructure is provided.

The park's marine areas were managed in accordance with the IUCN national park category. The conservation of the marine environment was the primary focus, but visitor access and activities such as fishing were provided for under permit.

Terrestrial flora

Aim: *To protect and manage the native vegetation communities of North Keeling Island and prevent the introduction of invasive species.*



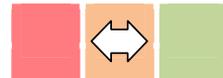
Status: Concerned

Trend: Stable

Rationale

No new weed species were detected. However, some increases in the distribution and abundance of existing weeds were thought to be occurring. The 2009 Island Wide Survey results will provide a baseline for future weed monitoring and management and identified that weeds were estimated to cover approximately 40 per cent of the understorey of the island. A program to monitor and assess/manage weed impacts on native vegetation commenced in 2010.

Terrestrial fauna



Aim: *To protect and manage native fauna and the natural functioning ecosystems of which they are a part, and prevent the introduction of exotic or feral species.*

Status: Concerned

Trend: Stable

Rationale

Surveys indicated that the red-footed booby population was stable although taking of seabirds from the park is still thought to be occurring. Monitoring of buff-banded rail populations indicated that they appear stable. However, as PKNP contains their only populations, a catastrophic event (e.g. cyclone, disease outbreak) could threaten their existence.

There were no known new invasive species introduced but crazy ant super-colonies were detected.

Marine flora and fauna



Aim: *To protect and manage flora and fauna and preserve their habitats in their natural condition.*

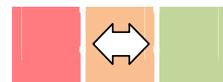
Status: Healthy

Trend: Stable

Rationale

Available evidence from studies shows that the marine habitats and species populations are largely intact and healthy. Setting of fishing bag limits may need to be considered in the future.

Research and monitoring



Aim: *To conduct and support research which will lead to a better understanding of the natural and cultural heritage of the park; to provide information that will contribute to effective management of the park and surrounding region; and to identify any changes in the park environment, which will provide an indication of the effectiveness of management and which may be linked to the condition of the environment.*

Status: Concerned

Trend: Stable

Rationale

Although the research priorities identified in the plan were largely achieved and helped to assess the status of biodiversity, securing funding or providing in-kind support for their implementation was an issue of concern and may continue to be in the future.

Cultural heritage management

Aim: *To protect and preserve the park's cultural heritage values.*



Status: Healthy

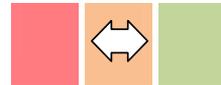
Trend: Stable

Rationale

There were no incidents involving impacts on cultural heritage. Malay graves were maintained to a standard agreed to by the Cocos-Malay Community.

Public access and use

Aim: *To protect and preserve the park from adverse impacts of visitation, and ensure, as far as possible, a safe and enjoyable experience for all people visiting the park.*



Status: Concerned

Trend: Stable

Rationale

Many prescriptions relating to this section were policies which were enforced through the issue of permits. However, it should be noted that illegal entry to the park is likely to still be occurring. It is difficult to determine any trends or numbers, but illegal access is an issue of concern due to potential seabird poaching, unmanaged fishing and quarantine risks (see 'Compliance and enforcement').

Commercial tourism and other commercial activities

Aim: *To permit commercial operations that provide exceptional opportunities for the enjoyment of nature without disturbance to the park's natural and heritage resources.*



Status: Healthy

Trend: Stable

Rationale

Visits provided an exceptional visitor experience and feedback from visitors was generally highly positive, although no visitor surveys were conducted by park staff.

Communicating park values

Aim: *To encourage an informed and positive attitude from visitors and the community towards the ongoing protection and conservation of the park and its values.*



Status: Healthy

Trend: Stable

Rationale

A wide range of interpretive and educational materials, activities and strategies were provided including a targeted school education program which is now being implemented.

It is difficult to fully assess the number of illegal incidents but impacts of these incidents on the park were not obvious. Community awareness of compliance issues was thought to be increasing (also see 8.4).

Stakeholders and partnerships

Aim: *To work cooperatively and productively with stakeholders to achieve the management prescriptions of this plan.*



Status: Concerned

Trend: Improving

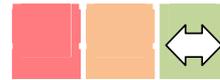
Rationale

While the trend is upward in relation to working cooperatively and productively with stakeholders, stakeholders expressed concern about the capacity for staff to maintain their efforts.

During consultations for the preparation of the next management plan local stakeholders, including the PKNPCMC, commented that there were very positive changes in the local profile of PKNP and relations with staff over recent years. However, stakeholders expressed concern that reduced staff numbers (in 2008) and resources will result in a reduced capacity to maintain community liaison and environmental educational programs (e.g. school activities, public presentations, PKNPCMC meetings and compliance activities) and other conservation programs, particularly crazy ant and weed control. Abolishing the local trainee position (management plan prescription 8.1.4) was a major issue of concern.

Operational management

Aim: *To manage the park in an effective and efficient manner and in accordance with the obligation under the management plan and the lease agreement.*



Status: Healthy

Trend: Stable

Rationale

PKNP was managed in accordance with the management plan, lease and other legal obligations. Most management plan actions were complete or progressed.

While loss of local staff reduced the local capacity to implement some management plan operations/prescriptions, increased staff support from CINP enabled the Island Wide Survey to be conducted in 2009.

Resource use in park operations

Aim: *To ensure best practice use of resources.*



Status: Healthy

Trend: Stable

Rationale

An energy audit was conducted annually and actions to minimise resource use are taken (within the capacity to do so – e.g. bicycles are used as transport where possible). Some responses, such as the use of alternative energy, require island-wide responses.

Capital works and infrastructure

Aim: *To provide visitors and staff with safe, functional facilities to the best possible standard with minimal impact on the environment. To ensure an effective and efficient maintenance program that protects park assets.*



Status: Healthy

Trend: Stable

Rationale

There is minimal infrastructure in the park. However, requirements of the management plan in relation to capital works and infrastructure were met.

Compliance and enforcement

Aim: To encourage compliance with relevant legislation, protect the park environment and encourage and promote appropriate use and appreciation of the park.



Status: Unknown but an issue of ongoing concern

Rationale

Poaching of seabirds and illegal fishing occurred, as evident by the presence of seabirds on Home Island. It is difficult to know what the status/trend of these activities is and what their impacts are.

Compliance activities were refocused from a law enforcement approach to an educational approach which helped build better relations with the community. The results of this approach in relation to reducing illegal activities are yet to be determined.

Congress was provided with funds to prepare a management plan for red-footed boobies for consideration for approval under the EPBC Act.

Environmental assessment and approval

Aim: To protect and manage the park to preserve its undisturbed condition.



Status: Healthy
Trend: Stable

Rationale

No significant or unacceptable environmental impacts from the establishment of infrastructure, implementation of park operations or conducting of activities were detected/known to have occurred.

Financial management

Aim: To responsibly manage Cocos (Keeling) Islands conservancy to ensure the aims of this plan are met in a way which maximises the benefit to conservation programs, the community and visitors to the park.



Status: Healthy
Trend: Stable

Rationale

The park's resources and finances were managed in accordance with the Chief Executive Officer's instructions.

Performance assessment



Aim: *To evaluate progress in implementing this plan and to conduct a final technical audit of the implementation of the plan.*

Status: Healthy

Trend: Stable

Rationale

Park operations were all consistent with and/or identified in the management plan and implementation schedule.

A management plan implementation schedule was prepared but the schedule was not fully maintained for the life of the plan, possibly due to reduced staffing levels.

A technical audit was undertaken in 2010 (the plan's sixth year) in consultation with the PKNPCMC, and the Director also prepared annual reports on the management of PKNP.

The complete audit document can be accessed from:

www.environment.gov.au/parks/publications/christmas/pubs/christmas-tech-audit-02-09.pdf

Key:



Status is critical



Trend improving



Status is of concern



Trend stable



Status is healthy



Trend declining

Bibliography and further reading

- Ackrill, M. (1984). The origins and nature of the first permanent settlement on the Cocos-Keeling Islands. *Historical Studies*, 21, 229–244.
- Airservices Australia (2003). En-route Supplement Australia (ERSA). Effective 20 March 2003.
- Algar, D. and Brazell, R.I. (2008). *A bait-suspension device for the control of feral cats*. *Wildlife Research*, 35, 471–476, CSIRO publishing, Canberra.
- Allen, G.R. (1989). Fishes. In *Survey of the Marine Fauna of Cocos (Keeling) Islands, Indian Ocean*. (Ed. P.F. Berry). (Western Australian Museum: Perth, Western Australia).
- Allen, G.R. and Smith-Vaniz, W.F. (1994). Fishes of the Cocos (Keeling) Islands. In *Ecology and Geomorphology of the Cocos (Keeling) Islands*. *Atoll Research Bulletin*, 399–414, Chapter 140.
- Allen, G.R., and Steene, R.C. (1987). *Fishes of Christmas Island, Indian Ocean*. Christmas Island Natural History Association.
- Anonymous (1830). Some account of the Cocos or Keeling Islands: and of their recent settlement. *Gleanings in Science (Calcutta)*, 2, 293–301. Reprinted in *Journal of the Malayan Branch Royal Asiatic Society* (1952) 25, 174–191.
- Anonymous (1990). Tourism in the Indian Ocean Territories. Report of the House of Representatives Standing Committee on Environment, Recreation and the Arts. Commonwealth of Australia.
- Anonymous (1991a). Islands in the Sun: the Legal Regimes of Australia's External Territories and the Jervis Bay Territory. Report of the House of Representatives Standing Committee on Legal and Constitutional Affairs. Commonwealth of Australia.
- Anonymous (1991b). Planning for Tourism in the Cocos (Keeling) Islands. Pacific Asia Travel Association.
- Anonymous (1992). Cocos (Keeling) Islands Land Use Plan and Planning Scheme. National Capital Planning Authority and the Department of the Arts, Sport, the Environment and Territories.
- Australian Biological Resources Study (1993). *Flora of Australia: Vol. 50*. Oceanic Islands 2. (AGPS: Canberra).
- Australian Committee for the International Union for Conservation of Nature and Natural Resources (ACIUCN) (1986). *Australia's Marine and Estuarine Areas – A Policy for Protection*. Occasional Paper Number 1.
- Ayrem, D.J. and Hughes, T.P. (2004) *Climate change, genotypic diversity and gene flow in reef-building corals*. *Ecology Letters*: 7:273.
- Baker, G.B. and Cunningham, R.B. (2007). *Data Analysis System for Red-footed Booby Program at Cocos (Keeling) Islands 2007*. Report prepared for the Department of Environment and Water Resources, Canberra.
- Barnes, D.K.A. (2004) *Natural and plastic flotsam stranding in the Indian Ocean*. John Davenport and Julia L. Davenport (eds.) *The Effects of Human Transport on Ecosystems: Cars and Planes, Boats and Trains*, 193–205. Dublin: Royal Irish Academy.
- Berry, P.F. (Ed.) (1989). *Survey of the Marine Fauna of the Cocos (Keeling) Islands, Indian Ocean*. Report to the Australian National Parks and Wildlife Service. (Western Australian Museum: Perth).
- Bezrukov, P.L. (1973). Principal scientific results of the 54th cruise of the R.V. Vitian in the Indian and Pacific Oceans (Feb–May 1973). *Oceanology* 13, 761–766.
- Brewer, D.T., Potter, A., Skewes, T.D., Lyne, V., Anderson, J., Davies, C., Taranto, T., Heap, A.D., Murphy, N.E., Rochester, W.A., Fuller, M. and Donovan, A. (2009) *Conservation values in commonwealth waters of the Christmas and Cocos (Keeling) Islands Remote Australian territories*. CSIRO, Cleaveland.
- Bunce, P. (1988). *The Cocos (Keeling) Islands: Australian Atolls in the Indian Ocean*. (The Jacaranda Press: Milton, Queensland).
- Cameron, MacNamara Consultants (1984). Geophysical Report Vol 4, Cocos (Keeling) Islands. Report No 84/G8.
- Carlsen, J. (1995). Socio-Economic Impacts of Tourism Development on Cocos (Keeling) Islands.
- Carter, M.J. (1994). Birds of the Cocos-Keeling Islands. *Wingspan*, September 1994, 14–18.
- Chamberlain, N.G. (1960). Cocos Island magnetic survey, 1946. Bureau of Mineral Resources, Record, 1960/124.
- Claussen, J. and Slip, D. (2002). The status of exotic plants on the Cocos (Keeling) Islands Indian Ocean (Unpub. report for PAN Cocos)

- Cogger, H. G. (1996). *Reptiles and Amphibians of Australia*. Reed Books, Australia.
- Colin, P. L. (1977). The reefs of Cocos-Keeling atoll, eastern Indian Ocean. *Proceedings of the 3rd International Coral Reef Symposium* 1, 63–68.
- Commonwealth of Australia (2003). *Recovery Plan for Marine Turtles in Australia*. Marine Species Section Approvals and Wildlife Division, Environment Australia, in consultation with the Marine Turtle Recovery Team. Environment Australia, Canberra.
- Commonwealth of Australia (2006). *National Recovery Plan for the Buff-banded Rail (Cocos (Keeling) Islands) Gallirallus philippensis andrewsi*. Department of the Environment and Heritage, Canberra.
- Commonwealth of Australia (2009a) *Threat abatement plan for the impacts of marine debris on vertebrate marine life*. Department of the Environment, Water, Heritage and the Arts, Canberra.
- Commonwealth of Australia (2009b) *Background paper for the threat abatement plan for the impacts of marine debris on vertebrate marine life*. Department of the Environment, Water, Heritage and the Arts, Canberra.
- Cunningham, R. and Baker, B. (2001). Assessment of Methodology and Statistical Accuracy of Annual Red Footed Booby Surveys on Pulu Keeling National Park. (Unpub. report for PAN Cocos).
- Customer Focus WA, (2005). *A Sustainable Future for Recreational Fishing in the Cocos (Keeling) Islands*. Fisheries Management Paper No. 192, Department of Fisheries, Government of Western Australia.
- Darwin, C. (1842). *The Structure and Distribution of Coral Reefs*. (Smith, Elder and Co: London).
- Darwin, C. (1845). *Journal of Researches into the Natural History and Geology of Countries Visited During the Voyage of H.M.S. Beagle round the world, under the command of Capt. Fitzroy R.N.* (John Murray: London).
- Darwin, C. (1979). *The Journal of a Voyage in HMS Beagle*. (Genesis Publications: Guildford).
- Royal Irish Academy (2004) *The Effects of Human Transport on Ecosystems: Cars and Planes, Boats and Trains* Proceedings of a seminar of the National Committee for Biology held on 1st and 2nd April, 2003. Royal Irish Academy National Committee for Biology Seminars.
- Director of National Parks. (2010a) – *Pulu Keeling National Park Management Plan 2004–2011 Draft Technical Audit*. Department of Sustainability, Environment, Water, Population and Communities, Canberra, Australia
- Director of National Parks (2010b). *Booderee National Park Climate Change Strategy 2010–2015*. Department of Sustainability, Environment, Water, Population and Communities, Canberra, Australia.
- Director of National Parks (2014). *Christmas Island Biodiversity Conservation Plan*. Department of the Environment, Canberra.
- Dudley, N. (Ed.) (2008). *Guidelines for Applying Protected Area Management Categories*. Gland, Switzerland: IUCN.
- Dunlop, M. and Brown, PR. 2008. *Implications of climate change for Australia's National Reserve System: A preliminary assessment*. Report to the Department of Climate Change, February 2008. Department of Climate Change, Canberra, Australia.
- Dworschak, PC. (2014). *The Axiidea (Crustacea, Decapoda) of Cocos (Keeling) and Christmas Islands, with description of a new species of Eucalliax* Manning & Felder, 1991. Raffles Bulletin of Zoology. Supplement No. 30: 230-245
- Environment Australia (2002). *Christmas Island National Park Management Plan*. Commonwealth of Australia.
- The Ecology Lab Pty Ltd (1994). Cocos (Keeling) Islands: Quantitative Baseline Surveys for Core Marine Reserves and Biosphere Reserve in the South Keeling Lagoon. Draft of Final Report, Institute of Marine Ecology. (University of Sydney), Tables 3, 7, 9 and 10.
- Falkland, AC. (1988). Cocos (Keeling) Islands water resources and management study. Vol. 1, Main report. Hydrology and Water Resources Unit, Rpt. No 88/12, ACT Electricity and Water.
- Falkland, AC. (1992). Further investigations of the Northern Freshwater Lens, West Island, Cocos (Keeling) Islands. Hydrology and Water Resources Branch, Rpt. No 92/02, ACT Electricity and Water.
- Falkland, AC. (1994). Climate, hydrology and water resources of the Cocos (Keeling) Islands. In ecology and geomorphology of the Cocos (Keeling) Islands. *Atoll Research Bulletin* Nos 399– 414.
- Feare, CJ. (1984). Seabird status and conservation in the tropical Indian Ocean. In International Council for Bird Preservation Technical Publication Number 2.
- Finlayson, DM. (1970). First-order regional magnetic survey at Cocos Island, Southern Cross and Augusta. Bureau of Mineral Resources, Record, 1970/101.

- Fitzroy, R. (1839). *Narrative of the Surveying Voyages of His Majesty's Ships Adventure and Beagle, Between the Years 1826 and 1836, Describing their Examination of the Southern Shores of South America, and the Beagle's Circumnavigation of the Globe*. (H. Colburn: London).
- Forbes, HO. (1885). *A Naturalist's Wanderings in the Eastern Archipelago. A Narrative of Travel and Exploration from 1878 to 1883*. (Sampson Row: London).
- Garnett, S. (1992). *The Action Plan for Australian Birds*. (Australian National Parks and Wildlife Service: Canberra).
- Gibson-Hill, CA. (1947). Notes on the Cocos-Keeling Islands. *Journal of the Malayan Branch of the Royal Asiatic Society* **20**, 140–202.
- Gibson-Hill, CA. (1948). The Island of North Keeling. *Journal of the Malayan Branch of the Royal Asiatic Society*. **21**, 68–103.
- Gibson-Hill, CA. (1949). The birds of the Cocos-Keeling Islands (Indian Ocean). *Ibis* **91**, 221–243.
- Gibson-Hill, CA. (1950a). Hemiptera collected on the Cocos-Keeling Islands, January–October 1941. *Bulletin of the Raffles Museum*. **23**, 206–211.
- Gibson-Hill, CA. (1950b). The Myriapoda found on the Cocos-Keeling Islands January–October 1941. *Bulletin of the Raffles Museum*. **22**, 103–104.
- Gibson-Hill, CA. (1950c). A note on the Cocos-Keeling Islands. *Bulletin of the Raffles Museum*. **22**, 11–28.
- Gibson-Hill, CA. (1950d). A note on the reptiles occurring on the Cocos-Keeling Islands *Bulletin of the Raffles Museum*. **22**, 206–211.
- Gibson-Hill, CA. (1950e). Notes on the birds of the Cocos-Keeling Islands. *Bulletin of the Raffles Museum*. **22**, 212–270.
- Gibson-Hill, CA. (1950f). Notes on the insects taken on the Cocos-Keeling Islands. *Bulletin of the Raffles Museum*. **22**, 149–165.
- Gibson-Hill, CA. (1950g). Papers on the fauna of the Cocos-Keeling Islands. Based on material and data collected in the group by C.A. Gibson-Hill, M.A., between December 1940 and November 1941. Introduction. *Bulletin of the Raffles Museum*. **22**, 7–10.
- Gibson-Hill, C. (Ed.) (1953). Documents relating to John Clunies Ross, Alexander Hare and the settlement on the Cocos-Keeling Islands. *Journal of the Malayan Branch of the Royal Asiatic Society*. **25**, 1–306.
- Gunn, B.F., Baudouin, L., Olsen, KM. (2011). *Independent Origins of Cultivated Coconut (Cocos nucifera L.) in the Old World Tropics*. PLoS ONE 6(6): e21143. doi:10.1371/journal.pone.0021143.
- Guppy, HB. (1889). The Cocos-Keeling Islands. *Scott. Geogr. Mag.* **5**, 281– 297, 457–474, 569–588.
- Guppy, HB. (1890). The dispersal of plants as illustrated by the flora of the Keeling or Cocos Islands. *Journal and Transactions of the Victorian Institute*. London **24**, 267–306.
- Hale, J. (2010). *Ecological Character Description for the Pulu Keeling National Park Ramsar Site*. Report to the Department of the Environment, Water, Heritage and the Arts, Canberra.
- Hender, J., McDonald, C. and Gilligan J. (2001). *Baseline survey of marine environments and stock size estimates of marine resources of the South Cocos (Keeling) Atoll (0-15m), Eastern Indian Ocean*. (report for FRRF).
- Hobbs, J-PA. Hender, J. and Gilligan, J.J. (2005). *The status of the coral reef community at the Cocos (Keeling) Islands, Eastern Indian Ocean, 1997–2005*.
- Hobbs, J-PA. (2009). *Fishes of North Keeling Island (Pulu Keeling National Park) and the impact of the lagoon closure*. Report to Parks Australia Cocos (Keeling) Islands, November.
- Hobbs, J-PA., Frisch, A.J., Allen, G.R. and van Herwerden, L. (2008). *Marine hybrid hotspot at Indo-Pacific biogeographic border*. *Biology Letters* **5**:258–261.
- Hobbs, J-PA. (2010). *Status of the coral reefs of North Keeling Island and new records of fishes within Pulu Keeling National Park, 2010*, Report to Parks Australia North – Cocos (Keeling) Islands, April.
- Hobbs, J-PA. and Frisch A.J., (2010a). *Coral disease in the Indian Ocean: taxonomic susceptibility, spatial distribution and the role of host density on the prevalence of white syndrome*. ARC Centre of Excellence for Coral Reef Studies, School of Marine and Tropical Biology, James Cook University, Townsville, Queensland 4811, Australia.
- Hobbs, J-PA. and McDonald, CA. (2010b) *Increased temperature and decreased dissolved oxygen triggers fish kill at the Cocos (Keeling) Islands, Indian Ocean*. *Journal of Fish Biology*; **77**:1219.

- Hobbs, J-PA, Jones, GP., Munday, PL., Connolly, SR. and Srinivasan, M. (2012) *Biogeography and the structure of coral reef fish communities on isolated islands*. *Journal of Biogeography*. 39:130.
- Hobbs J-PA. and Macrae, H. (2012) *Unusual weather and trapped coral spawn leads to fish kill at a remote coral atoll*. *Coral Reefs*; 31:961.
- Hobbs, J-PA, Newman, SJ., Gabby EA, Mitsopoulos, GEA., Travers, MJ., Skepper, CL., Gilligan, JJ., Allen, GR., Choat, HJ., Ayling, AM. (2014a) *Fishes of the Cocos (Keeling) Islands: new records, community composition and biogeographic significance*. *Raffles Bulletin of Zoology*. Supplement No. 30: 203–219.
- Hobbs, J-PA. and Allen, GR. (2014b) *Hybridisation among coral reef fishes at Christmas Island and the Cocos (Keeling) Islands*. *Raffles Bulletin of Zoology*. Supplement No. 30: 220-226.
- Hobbs, J-PA., Coker, DJ, Green, PT., James, DJ., Humphreys, WF., McAllan, IAW., Newman, SJ., Pratchett, MS., Staudle, TM., and Whiting, SD. (2014c) *An annotated bibliography of the research on marine organisms and environments at Christmas Island and the Cocos (Keeling) Islands*. *Raffles Bulletin of Zoology*. Supplement No. 30: 419-468.
- Holloway, JD. (1982). *On the Lepidoptera of the Cocos-Keeling Islands in the Indian Ocean, with a review of the *Nagia linteola* complex (Noctuidae)*. *Entomologia Gen.* 8, 99–110.
- Hourston, M. (2010). *Review of the exploitation of marine resources of the Australian Indian Ocean Territories: the implications of biogeographic isolation for tropical island fisheries*. Report for the Government of Western Australia Department of Fisheries, Perth.
- Hughes, JS. (1950). *Kings of Cocos: the Story of the Settlement on the Atoll of Keeling-Cocos in the Indian Ocean*. (Methuen: London).
- Hyder Consulting Pty Ltd (2008). *The Impacts and Management Implications of Climate Change for the Australian Government's Protected Areas*. A report to the Department of the Environment, Water, Heritage and the Arts and the Department of Climate Change. Department of Climate Change, Canberra, Australia.
- Intergovernmental Panel on Climate Change (IPCC) (2007). *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. IPCC, Geneva, Switzerland.
- Jacobson, G. (1976). *The freshwater lens on Home Island in the Cocos (Keeling) Islands*. *BMR, J. Aust. Geol. Geophys.* 1/4, 335–343.
- Jones, DS. (1994). *Barnacles (Cirripedia, Thoracica) of the Cocos (Keeling) Islands*. In *Ecology and Geomorphology of the Cocos (Keeling) Islands*. *Atoll Research Bulletin* Nos 399–414.
- Jongsma, D. (1976). *A review of the geology and geophysics of the Cocos Islands and Cocos Rise*. Bureau of Mineral Resources, *Record 1976/38*.
- Karlson, RH. and Hurd, LE. (1993). *Disturbance, coral reef communities and changing ecological paradigms*. *Coral Reefs*. 12, 117–125.
- Kench, P. (1994). *Hydrodynamic Observations of the Cocos (Keeling) Islands Lagoon*. *Atoll Research Bulletin* Nos 399–414.
- Kenneally, KF. (1972). *Tropical seeds and fruits washed up on the south-west coast of Western Australia*. *The Western Australian Naturalist*. 12, 73–80.
- Kentish, B., Grant, A. and Ryan, P. (1996). *A review and critique of the methodologies used to estimate population size of the Red-footed booby (Sula sula) on North Keeling Island: A report to the Australian Nature Conservation Agency*. Centre for Environmental Management Uni of Ballarat.
- Kiat, TS., and Low, MEY. (2014). *Checklist of the Mollusca of Cocos (Keeling) / Christmas Island ecoregion*. *Raffles Bulletin of Zoology*. Supplement No. 30: 313-375.
- Lincoln-Smith, M., Skilleter, G., Underwood, A., Smith, A., Hawes, P., Howitt, L., Stark, J. and Chapman, M. (1993). *Study of the Impact of Harvesting Marine Invertebrates and Fish on the Ecosystems of Cocos (Keeling) Islands*. Unpublished report to the Australian Nature Conservation Agency by the Institute of Marine Ecology, University of Sydney.
- Lux, K. (2008). *The Conservation Genetics of the Cocos Buff-banded Rail Gallirallus philippensis andrewsi*. Thesis towards requirements of B.Sc. (Hons) in the Botany and Zoology School at the Australian National University.
- McLean, R.F. and Hosking, P.L. (1991). *Geomorphology of reef islands and atoll motu in Tuvalu*. *South Pacific Journal of Natural Science*. 11, 167–189.

- Macrae, I. and Whiting, S. (2014) *Positive conservation outcome from religious teachings: changes to subsistence turtle harvest practices at Cocos (Keeling) Islands, Indian Ocean*. Raffles Bulletin of Zoology. Supplement No. 30: 162–167.
- Maes, V.O. (1967). The littoral marine molluscs of the Cocos-Keeling Islands (Indian Ocean). *Proceedings of the Academy of Natural Sciences of Philadelphia*, **119(4)**, 93–217.
- Marchant, S. and Higgins, P. (Coordinators) (1990). *Handbook of Australian, New Zealand and Antarctic Birds*. Vol. 1. (Oxford University Press: Melbourne).
- Marsh, L.M. (1994). Echinoderms of the Cocos (Keeling) Islands. In Ecology and Geomorphology of the Cocos (Keeling) Islands. *Atoll Research Bulletin* Nos 399–414.
- Marshall, N.B. (1950). Fishes from the Cocos-Keeling Islands. Papers on the fauna of the Cocos-Keeling Islands. *Bulletin of the Raffles Museum*. **22**, 166–205.
- McColl, G., Fairbairn, Te’O., Appleyard, R., Zerby, J., Bowden, P., Titcombe, K. and Dwyer, L. (1994). Cocos (Keeling) Islands Development Strategy. (UNISEARCH Ltd: Canberra).
- Mendoza, JCE. And Ng, PKL. (2014). *On the crabs of the genus Pseudozius Dana, 1851 (Crustacea: Brachyura: Pseudoziidae) from Christmas Island and the Cocos (Keeling) Islands*. Raffles Bulletin of Zoology. Supplement No. 30: 301-304.
- Misso, M. and MacRae, I. (2014) *The conservation management of Pulu Keeling National Park: challenges and perspectives*. Raffles Bulletin of Zoology, Supplement No. 30: 24–28.
- Mitchell, A., Bellis, G., Curran, J. and Weinert, M. (2000). *North Australia Quarantine Strategy Survey of Cocos (Keeling) Islands and Christmas Island 21 May to 3 June 2000*. (Unpub. report to AQIS).
- Morgan, G.J. (1994). Decapod Crustaceans of the Cocos (Keeling) Islands. In Ecology and Geomorphology of the Cocos (Keeling) Islands. *Atoll Research Bulletin* Nos 399–414.
- Neumann, G. (1968). *Ocean Currents*. (Elsevier Publishing Company: New York).
- Ng, PKL. and Naruse, T. (2014) *The lobsters of Christmas Island and Cocos (Keeling) Islands, with new records of Palinurellus wieneckii (De Man, 1881) and Enoplometopus voigtmani Türkay, 1989 (Crustacea: Decapoda: Palinuridae, Scyllaridae, Enoplometopidae)*. Raffles Bulletin of Zoology. Supplement No. 30: 305-312.
- Nias, RC. and Ball, D. (2010) *National Island Biosecurity Initiative: a proposal to build ecosystem health and resilience on Australia’s islands through improved biosecurity*.
- Nuemann, G., Green, PT. and O’Dowd, DJ. (2011). *First Record of Pulvinaria urbicola (Hemiptera: Coccidae), a Potentially Damaging Scale Insect, on Christmas Island, Indian Ocean*, Department of Botany, La Trobe University, Bundoora, Victoria, Australia and Australian Centre for Biodiversity, School of Biological Sciences, Monash University, Australia.
- Oberdorfer, JA. and Buddemeier, RW. (1988). Climate change: effects on reef island resources. *Proceedings of the 6th International Coral Reef Symposium*. **3**, 523–527.
- Parks Australia (1999). *Pulu Keeling National Park Plan of Management*. Commonwealth of Australia.
- Prudent-Richard, G., Mackay, P. and Hoesktra-Fokkink, L. (2010). *Indian Ocean Territory Climate Change Risk Assessment*, Report for Commonwealth Attorney-General’s Department by AECOM Australia Pty Ltd, Canberra.
- Randall, JE. and Randall, HA. (1987). Annotated checklist of the fishes of Enewetak Atoll and other Marshall Islands. In *The Natural History of Enewetak Atoll*. Vol. 2 (Eds D.M. Devaney, E.S. Reese, B.L. Burch and P. Helfrich) US Department of Energy Office of Scientific and Technical Information.
- Reid, J. (2000). Survey of the Buff-banded Rail (*Rallus philippensis andrews*) in Pulu Keeling National Park, Cocos Islands, Indian Ocean. (Unpub. report for PAN Cocos).
- Renoize, SA. (1979). The origins of Indian Ocean floras. In *Plants and Islands* (Ed. D. Bramwell). pp. 107–129. (Academic Press: New York).
- Richards, ZT. and Hobbs J-PA. (2014). *The status of hard coral diversity at Christmas Island and Cocos (Keeling) Islands*. Raffles Bulletin of Zoology. Supplement No. 30: 376-398.
- Ridley, HN. (1930). *The Dispersal of Plants Throughout the World*. (L. Reeve and Company: Kent, United Kingdom).
- Russell, RJ. and McIntire, WG. (1965). Southern Hemisphere beach rock. *Geographical Review* **55**, 17–45.
- Ryan, PL. (undated). Cyclone over Cocos. File report, Government Conservator, Australian Nature Conservation Agency, Cocos (Keeling) Islands office.

- Scott, GAJ. and Rotondo, GM. (1983). A model to explain the differences between Pacific plate island atoll types. *Coral Reefs* **1**, 139–150.
- Searle, D.E. (1994). Late Quaternary Morphology of the Cocos (Keeling) Islands. In Ecology and Geomorphology of the Cocos (Keeling) Islands. *Atoll Research Bulletin* Nos 399–414.
- Simpson, C.J., Cary, J.L. and Masini, L.J. (in press). Destruction of corals and other reef animals by coral spawn slicks on Ningaloo Reef, Western Australia. *Coral Reefs*.
- Slip, D. and Comport, S. (2002). The status of the yellow crazy ant (*Anoplolepis gracilipes*) on the Cocos (Keeling) Islands. (Unpub. report to PAN Cocos).
- Smith-Vaniz, WF. and Randall, J.E. (1974). Two new species of angelfishes (*Centropyge*) from the Cocos (Keeling) Islands. *Proceedings of the Academy of Natural Sciences, Philadelphia*, **126**(8), 105–113.
- Smithers, S.G. (1994). Sediment Facies of the Cocos (Keeling) Islands Lagoon. In Ecology and Geomorphology of the Cocos (Keeling) Islands. *Atoll Research Bulletin* Nos 399–414.
- Stokes, T. (1982). Birds of the Cocos (Keeling) Islands, Indian Ocean. Australian National Parks and Wildlife Service Internal Report.
- Stokes, T. (1994). An update on birds of the Cocos (Keeling) Islands. In *Ecology and Geomorphology of the Cocos (Keeling) Islands*. (Education. C.D. Woodroffe). *Atoll Research Bulletin* Nos 399–414. (National Museum of Natural History, Smithsonian Institution: Washington).
- Stokes, T., Shiels, W. and Dunn, K. (1984). Birds of the Cocos (Keeling) Islands. *The Emu* Vol 84, 23–28.
- Stokes, T. and Cogger, H. (1987). Report of the gecko *Lepidodactylus lugubris* from North Keeling Island, Indian Ocean. *Herpetological Review* **18** (2), 40.
- Stokes, T. and Goh, P. (1987). Records of Herald Petrels and the Christmas Frigatebird from North Keeling Island, Indian Ocean. *The Australian Bird Watcher* **12**, 132–133.
- Veron, JEN. (1990). Re-examination of the reef corals of Cocos-Keeling Islands and Fanning Island. *Papers from the Department of Marine Biology of the Carnegie Institution of Washington*. **9**, 51–234.
- Veron, JEN. (1994). Hermatypic Corals of Cocos (Keeling) Islands: a Summary. In Ecology and Geomorphology of the Cocos (Keeling) Islands. *Atoll Research Bulletin* Nos 399–414
- Watling and Assoc. (1996). The Indian Ocean Territories Regional Tourism Strategy. Unpublished data.
- WBM Oceanics Australia (1995). Draft Guidelines for Managing Visitation to Seabird Breeding Islands. Prepared for GBRMPA and ANCA.
- WBM Oceanics Australia and Claridge, G., (1997) *Guidelines for Managing Visitation to Seabird Breeding Islands*, guidelines prepared for the Great Barrier Reef Marine Park Authority and Environment Australia, Brisbane, Australia.
- Wells, FE. (1994). Marine Molluscs of the Cocos (Keeling) Islands. In Ecology and Geomorphology of the Cocos (Keeling) Islands. *Atoll Research Bulletin* Nos 399–414.
- Whiting, S. (1999). Initial Baseline Data and Proposed Preliminary Monitoring program for Sea Turtles at the Cocos Keeling) Islands. (Unpub. report for PAN Cocos).
- Whiting, S. (2000). Sea Turtle Study Cocos (Keeling) Islands, Indian Ocean, Year 2 November 2000. (Unpub. report for PAN Cocos).
- Whiting, S. (2002). Sea Turtle Study Cocos (Keeling) Islands, Indian Ocean, Year 3 February 2002. (Unpub. report for PAN Cocos).
- Whiting, S. (2003). Sea Turtle Study Cocos (Keeling) Islands, Indian Ocean, Year 4 January 2003. (Unpub. report for PAN Cocos).
- Whiting, S. (2006). *Sea Turtle Study Cocos (Keeling) Islands, Indian Ocean, Year 7*, Parks Australia, Canberra
- Whiting, S. D., Macrae, I., Murray, W., Thorn, R. and Whiting A. U. (2014). *Sea turtles of the Cocos Keeling Islands, Indian Ocean*. Raffles Bulletin of Zoology. Supplement No. 30: 168-183
- Williams, DG. (1990). An annotated bibliography of the natural history of the Cocos (Keeling) Islands, Indian Ocean. *Atoll Research Bulletin* **331**, 1-17.
- Williams, DG. (1994a). Vegetation and Flora of the Cocos (Keeling) Islands. In Ecology and Geomorphology of the Cocos (Keeling) Islands. *Atoll Research Bulletin* Nos 399–414, 1–29.

- Williams, WG. (1994*b*). Marine Habitats of the Cocos (Keeling) Islands. In Ecology and Geomorphology of the Cocos (Keeling) Islands. *Atoll Research Bulletin* Nos 399–414.
- Winterbottom, RW., Emery, AR. and Holm, E. (1989). An annotated checklist of the fishes of the Chagos Archipelago Central Indian Ocean. *Life Sciences Contrib. 145 Royal Ontario Mus*: 1–226.
- Woinarski, J. and Detto, T. (2013). *Translocation of the Cocos Buff-Banded Rail from Pulu Keeling to Horsburgh Island, April 2013*: Report to the Department of Sustainability, Environment, Water, Population and Communities. Commonwealth of Australia 2012
- Woinarski, JCZ., Detto, T and MacRae, I. (2014) *The other subpopulation of Christmas Island White-eye Zosterops natalis (Aves: Zosteropidae): a historic introduction has led to an enduring subpopulation on Horsburgh Island, Cocos (Keeling) Islands group*. *Raffles Bulletin of Zoology Supplement* No. 30: 65–70.
- Wood-Jones, F. (1909). The fauna of the Cocos-Keeling Atoll. *Proceedings of the Linnean Society of London 1909*, 132–160.
- Wood-Jones, F. (1912). *Coral and Atolls: a History and Description of the Keeling-Cocos Islands, With an Account of their Fauna and Flora, and a Discussion of the Method of Development and Transformation of Coral Structures in General*. (Lovell Reeve and Co: London).
- Woodroffe, CD. (Ed.) (1994). *Atoll Research Bulletin Nos 399-414*. Ecology and Geomorphology of the Cocos (Keeling) Islands. National Museum of Natural History, Smithsonian Institute, Washington DC. USA.
- Woodroffe, CD. and Berry, PF. (1994). Scientific Studies In the Cocos (Keeling) Islands: an Introduction. In Ecology and Geomorphology of the Cocos (Keeling) Islands. *Atoll Research Bulletin* Nos 399–414.
- Woodroffe, CD. and McLean, RF. (1993). Cocos (Keeling) Islands, Vulnerability to Sea-Level Rise. Report to Climate Change and Environmental Liaison Branch, DASET, Canberra.
- Woodroffe, CD. and McLean, RF. (1994). Reef Islands of the Cocos (Keeling) Islands. In Ecology and Geomorphology of the Cocos (Keeling) Islands. *Atoll Research Bulletin* Nos 399-414.
- Woodroffe, CD., McLean, RF. and Wallensky, E. (1990*a*). Darwin's coral atoll: geomorphology and recent development of the Cocos (Keeling) Islands. *Indian Ocean. Nat. Geog. Res.* **6**, 262–275.
- Woodroffe, C.D., McLean, RF. and Wallensky, E. (1994). Geomorphology of the Cocos (Keeling) Islands. In Ecology and Geomorphology of the Cocos (Keeling) Islands, *Atoll Research Bulletin* Nos 399–414.
- Woodroffe, CD., McLean, RF., Polach, H. and Wallensky, E. (1990*a*). Sea level and coral atolls: Late Holocene emergence in the Indian Ocean. *Geology* **18**, 62–66.



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