



COMMONWEALTH OF AUSTRALIA

Environment Protection and Biodiversity Conservation Act 1999

CHRISTMAS ISLAND NATIONAL PARK

MANAGEMENT PLAN

Director of National Parks

2002

Third Christmas Island National Park Management Plan

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FOREWORD

Christmas Island supports a wide range of unique and unusual species and habitats, and is of great international conservation and scientific interest. Although the island has been mined for phosphates for much of the past century, most of its natural ecosystem remains intact.

The declaration of the Christmas Island National Park in 1980, and extensions in 1986 and 1989, placed over sixty percent of the island under the formal protection of the *National Parks and Wildlife Conservation Act 1975* (now the *Environment Protection and Biodiversity Conservation Act 1999*). The Park provides the last remaining nesting habitat for the endangered Abbott's Booby and Christmas Island Frigatebird, and supports many endemic plants and animals as well as many species of land crabs. The island's geology, unique rainforest, and spectacular views are well represented in the Park. The Park's significance for conservation is reflected in the large number of nationally listed species (endangered and migratory), many of which depend on the Park for their survival.

This, the third Management Plan for Christmas Island National Park, was prepared by Parks Australia staff. The Plan takes into account representations made in response to an invitation for public input requested in December 1998, and comments received on the draft Plan released in February 2000 and subsequent on-island meetings.

The next seven years are likely to see considerable change on the island with the continuing development of the tourism industry and other enterprises. It is inevitable that the Park will face greater pressures. Relatively undisturbed natural areas are an increasingly scarce resource in the context of a globally expanding population and the loss of natural habitats, particularly in the tropics. The island's unique tropical rainforest, large variety of endemic plants and animals, extensive coral reefs and spectacular landscapes are outstanding natural features. Maximising the opportunity for people to appreciate these, without damaging the environment is a major management challenge.

Meeting the challenge will require the involvement and support of the Christmas Island Community – and the wider world community. The purpose of this Management Plan is to establish the framework to continue to conserve the Park and its values, in the face of the pressures that will be placed upon it in the next seven years.

Peter Cochrane
Director of National Parks

ACKNOWLEDGMENTS

The Director of National Parks is grateful to the many organisations and individuals who provided information and assistance during preparation of this Plan. Special acknowledgment is due to Faridah Bahrom and Zuraidah Mohamed (Bahasa Malay) for their assistance with translations of the Plan and to Dr W.F. Humphreys for new sections on Anchialine and Subterranean ecosystems.

The design and layout of the cover is by Max Orchard and photographs were supplied as follows

Front cover:

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UNDERSTANDING THIS DOCUMENT

This document is presented in three sections:

- A summary of the Plan in Chinese (Mandarin), Bahasa Malay and English.
- A location and description of Christmas Island National Park provides relevant historical, cultural and natural history information and the basis for management.
- The Management Plan for Christmas Island National Park provides the management arrangements for the Park in the form of background information, objectives and prescriptions. A comprehensive Bibliography and a Glossary have also been included at the end of this Part.

This Management Plan outlines the management direction of Christmas Island National Park for 7 years from the day of its commencement. The Plan will ensure consistent and coordinated management appropriate for a park of such national and international significance.

The Plan takes account of submissions received in response to the Christmas Island National Park 'Have Your Say' brochure, comments provided at Christmas Island community meetings and input and advice from the Christmas Island National Park Advisory Committee (CINPAC). It also incorporates matters raised in submissions received as a result of the release of the Draft Plan.

YELLOW CRAZY ANTS ON CHRISTMAS ISLAND

The exotic invasive yellow crazy ant (*Anoplolepis gracilipes*) arrived on Christmas Island more than 70 years ago, and is now widespread throughout rainforest and settled areas on the island. These ants have the ability to form multi-queened "supercolonies", in which the ants occur at enormously high densities. Supercolony formation on the island has been a relatively recent phenomenon; the first being discovered in 1989. Further dramatic increases in supercolony formation began around the mid-late 1990's.

At supercolony densities, this invasive ant species is having a devastating impact on the island's ecosystems. Red crabs, robber crabs, blue crabs and most other ground dwelling animals such as reptiles and leaf litter fauna have been, and are continuing to be, severely impacted, sometimes to the point of local extinction in heavily infested areas. By eliminating local populations of red crabs, the ants are also having a marked effect on forest composition and structure, and litter dynamics, in infested areas. Further, the feeding activities of these ants and their mutualistic scale insects can fatally stress large trees, and cause widespread canopy dieback in areas of supercolony infestation.

Following the submission, in January 1999, of a report from the Centre for the Analysis and Management of Biological Invasions (CAMBI) at Monash University, titled 'Alien Ant Invasion and Ecosystem Collapse on Christmas Island, Indian Ocean', a cooperative agreement was entered into whereby Parks Australia North and CAMBI jointly undertook to conduct research and control of this invasive species on Christmas Island.

Management and research of crazy ants was subsequently given an immediate and high priority, and progress in both areas has been steady and consistent. The implementation of objectives and prescriptions listed in the Management Plan for other Park management activities, and resources

necessary for these, will be highly dependent on the requirements and outcomes of the yellow crazy ant control and research programs.

Further details about the colonisation of Christmas Island by these ants, their biology, impacts on native fauna and flora, and research and management strategies are contained in the Management Plan.

PROPOSED SATELLITE LAUNCHING FACILITY

At the time this Management Plan was being prepared a proposal to develop a satellite launching facility at South Point was being progressed. The potential environmental impacts of this proposal were assessed under the former *Environment Protection (Impact of Proposals) Act 1974* (which was replaced by the *Environment Protection and Biodiversity Conservation Act 1999* on 16 July 2000) and approval was given subject to a number of recommendations. Should this development take place there may be impacts on the National Park that require a restructuring of the priorities of the objectives and prescriptions in the Management Plan for Park management activities. One of the conditions for approval was that a program to monitor the potential impact on seabirds be conducted by the proponent. This program was developed by the proponent with input and approval by an independent group of seabird experts. Field surveys prior to launching were started during the preparation of this Plan. Should this program detect serious impacts on the seabirds, a condition of approval requires launching to be suspended until the impact can be mitigated. Should this development proceed it is likely that the population of Christmas Island will increase and hence increase the number of visitors using the National Park. This may necessitate a change in priorities for Park management activities.

Christmas Island National Park - Management Plan

SUMMARY

This is the Management Plan for the Christmas Island National Park. A Management Plan is a requirement for all Commonwealth reserves managed by the Director of National Parks and sets out the way in which it is proposed to manage a reserve in order to provide for its protection and conservation. The legal basis for this Plan is the *Environment Protection and Biodiversity Conservation Act 1999*.

In preparing this Management Plan the Director of National Parks has considered and taken into account:

- public comments and community consultations;
- the encouragement and regulation of the appropriate use, appreciation and enjoyment of the Park by the public;
- the preservation of the Park in its natural condition and the protection of its special features;
- the protection, conservation and management of biodiversity and heritage within the Park; and
- the protection of the Park against damage.

When approved by the Minister for the Environment and Heritage, the Management Plan will be tabled in both Houses of the Commonwealth Parliament and may be disallowed by either the House of Representatives or the Senate on a notice of motion brought within 15 sitting days. The Plan will be in effect for 7 years unless it is revoked or amended by a new Management Plan before then.

The Management Plan includes new information available from research carried out over the last five years, comments from the local community following public consultation and recent developments such as the space satellite launching proposal, closure of the casino resort and the impact of the crazy ant outbreak on the local environment.

The Christmas Island National Park Advisory Committee (CINPAC) will assist the Director of National Parks in implementing the Plan. CINPAC is made up of the Director of National Parks and representatives of the local community. Its structure will be reviewed at least once during the life of the Plan. The terms of reference for CINPAC are to:

- advise the Government Conservator on implementation of the Management Plan; and
- advise the Shire of Christmas Island and the Director of National Parks on matters relevant to the Christmas Island National Park.

The Plan is divided into two parts:

Part 1 - A Description of Christmas Island and the National Park

This part talks about the history of the island (including the first written record of the island in 1615), the history of the Park and its natural and physical characteristics such as climate, geology, habitats and the various plants and animals. Animals or plants which have been

introduced, either accidentally or deliberately, such as feral cats, rats and crazy ants are also mentioned. The objectives of national parks are discussed and the conservation significance of Christmas Island National Park is explained. Christmas Island is very important and needs to be protected because most other islands in the Indian Ocean and South-East Asia region are losing habitat because of increasing human populations.

Christmas Island is a nearly intact ecosystem. The island supports the last remaining nesting habitat of the Abbott's Booby, many endemic species of plants and animals, and the world's largest remaining population of the robber crab.

Part 1 also includes lists of most animals and plants and gives their common names, their scientific names and their Malay names. Not all species of plants have a common name or a Malay name.

Part 2 - Christmas Island National Park Management Plan

This part is the formal Management Plan and sets out the specific ways in which the Park will be managed. The Director of National Parks is responsible for management of the Park. The Director discharges this responsibility through the Government Conservator and other Parks Australia staff, and with advice provided by the Christmas Island National Park Advisory Committee. Part 2 also talks in detail about how issues such as rainforest rehabilitation, weeds, feral animals, rare and endangered species, fishing, tourism, public education and research will be managed in the Park.

Each section in Part 2 gives a description or background of the particular activity, and a list of what actions the Director of National Parks will take to manage that particular activity during the life of the Plan. The lists of actions to be taken are called 'Prescriptions'.

This Management Plan will be in effect from 2002 until 2008. Towards the end of the Plan, there will be a technical audit carried out to assess how well the prescribed management actions have been implemented.

Part 2A - Introductory Provisions

Sections 1 – 6

This part includes definitions of various terms and the full title of many Government Agencies and Organisations.

The purposes of the Park under the *Environment Protection and Biodiversity Conservation Act 1999* are the preservation of the area in its natural condition; and the encouragement and regulation of the appropriate use, appreciation and enjoyment of the area by the public.

Part 2B - Objectives and Prescribed Management Actions

For Management purposes, the Park has been divided into Two Zones - Terrestrial (land) and Marine (sea).

Section 7. Terrestrial Vegetation

Approximately 25% of the island's rainforest has been cleared to mine phosphate. Management of vegetation today largely consists of efforts to revegetate mined areas, and to control the spread of introduced weeds.

When mining finishes in some current mine lease areas, these leases may be handed over to the Director of National Parks for rehabilitation and incorporation into the Park.

The Christmas Island Rainforest Rehabilitation Program (CIRRP) began in 1989 to revegetate old mine workings. The program is funded from a royalty, paid by the mining company to the Commonwealth Government.

Weeds are a serious problem on Christmas Island and a number of exotic trees, shrubs and vines are established in disturbed areas throughout the island. The weed section of the Plan talks about some of the major weeds and how they will be controlled. It also talks about the need to prevent the introduction and spread of any new weeds. Parks Australia staff will work closely with Quarantine and Customs to prevent further introductions.

Section 8. Terrestrial and Anchialine Animals

This section deals with the current status of the island's native animals - many of these have been affected by human activity such as settlement, mining, hunting and fishing and the introduction of exotics. Mining resulted in the loss of approximately a quarter of the primary rainforest habitat, which was accompanied by corresponding declines in the populations of many forest animals. No further clearing of primary native vegetation that would result in habitat loss will be allowed in the Park.

One of the major threats to the island's native animals is posed by exotic animals and plants. A number of animals are thought to have been introduced to the island since human settlement. This section provides a list of exotic wild animals, their perceived threat to native species, and proposed control actions.

Section 9. Marine Area

Native plants and animals of Christmas Island and the territorial sea around the Island outside the Park are protected by Part 9 of the *Environment Protection and Biodiversity Conservation Regulations 2000*. Part 9 of the Regulations provides for the Minister for the Environment and Heritage to approve management plans that provide for the taking of protected species.

Approximately 42 kilometres (63%) of the island shoreline is in the Park. The sea, extending 50 metres seaward of the low water mark, where the land part of the Park meets the coast, is included in the Park (a total area of about 2.1 square kilometres). With a view to regulating fishing in all of the territorial sea around the island in a consistent way (allowing for on-going recreational fishing in the Park) an Integrated Marine Management Program (IMMP) was drafted while the *National Parks and Wildlife Conservation Act 1975* and the *National Parks and Wildlife Regulations* were in force, and has been extensively discussed in recent years by many people in the community. It is hoped that the Program will be introduced under the *Environment Protection and Biodiversity Conservation Act 1999* and *Environment Protection and Biodiversity Conservation Regulations 2000* during the life of this Management Plan.

This section also considers diving, boating and restrictions on taking certain species of fish in the Park.

Section 10. Access

This section describes the network of roads, tracks and walking trails in the National Park. Existing roads and tracks will be maintained and progressively upgraded to allow continued access while maintaining low environmental impact. Development of any new roads and tracks will require thorough justification and environmental impact assessment.

Section 11. Tourism

The island's natural environment, much of which is now protected within the National Park, is a major feature of interest to island visitors. The Park will therefore play a key role in the economic development of the island as an eco-tourism destination. The Director of National Parks, through Parks Australia, is involved in a range of tourism related initiatives on the island, and is actively involved in the Christmas Island Tourism Association (CITA).

At present, the land areas of the Park are used by local people and tourists for camping, walking, running, sightseeing and the enjoyment of wildlife. The coastal areas are used for boating, beach going, swimming, diving and angling.

The section also outlines the objectives for management of tourism, including preservation of the natural and artificial features of the landscape, and management of visitor access.

Section 12. Interpretation

This section talks about interpretation, which is the communication, education and information process which aims to explain about our cultural and natural heritage. Parks Australia and the Christmas Island Tourism Association provide a range of interpretation brochures, maps, photographs and displays.

The National Park has a number of interpretive signs at popular visitor sites such as Margaret Knoll, Martin Point, the Dales and the Blowholes.

The Director of National Parks and Parks Australia will continue, during the life of this Plan, to work closely with the Community in providing a range of high quality interpretive services.

This section also describes specific interpretive objectives and prescriptions during the life of this Plan, including multi-lingual information.

Section 13. Research

This section describes the research that is required in order to properly manage the National Park. Some research is undertaken by Parks Australia staff but much is undertaken by consultants and university researchers. There is a list of research activities carried out under the previous plan and a list of research priorities for this Plan. A high priority for research efforts during this Plan will be studies on the control, impact and dynamics of the yellow crazy ant.

Section 14. Administration

This section describes the Director's operations on Christmas Island, including current Parks Australia staff levels and the type of work carried out by staff. Details of Park infrastructure and equipment are provided, as are environmental assessment and surveillance and law enforcement operations.

Section 15. Occupancies

When the Park was declared and later extended, it incorporated or enclosed land with a number of existing uses and occupancies whose continued presence in the Park had to be formally accommodated. These include:

- The Jedda Cave pumping station and waterline easement;
- The Christmas Island Power Authority's power line easement;

- Two Chinese temples; and
- A residential occupation at Grants Well.

This section discusses how these uses and occupancies will be managed during the life of this Plan.

Section 16. Park Extensions

During the life of this Plan, Parks Australia will work closely with the Christmas Island National Park Advisory Committee, Shire of Christmas Island, CI Phosphates Pty Ltd and the Christmas Island Administration to identify any areas which could be included in the Park, and other areas, which should be excluded from any proposed Park extensions.

Part 2C – Additional Management Provisions

Sections 17 to 23

These sections talk about: delegation of powers of the Director; the *Environment Protection and Biodiversity Conservation Act 1999* and other relevant legislation; international agreements which apply to or affect Christmas Island or the operation of the Park such as the Japan-Australia Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA); significant leases outside the Park; and, rainforest protection.

SUMMARY IN BAHASA MALAY
to be found in Associated Documents

SUMMARY IN MANDARIN
to be found in Associated Documents

**A DESCRIPTION OF
CHRISTMAS ISLAND
AND THE NATIONAL PARK**

PART 1 - A DESCRIPTION OF CHRISTMAS ISLAND AND THE NATIONAL PARK

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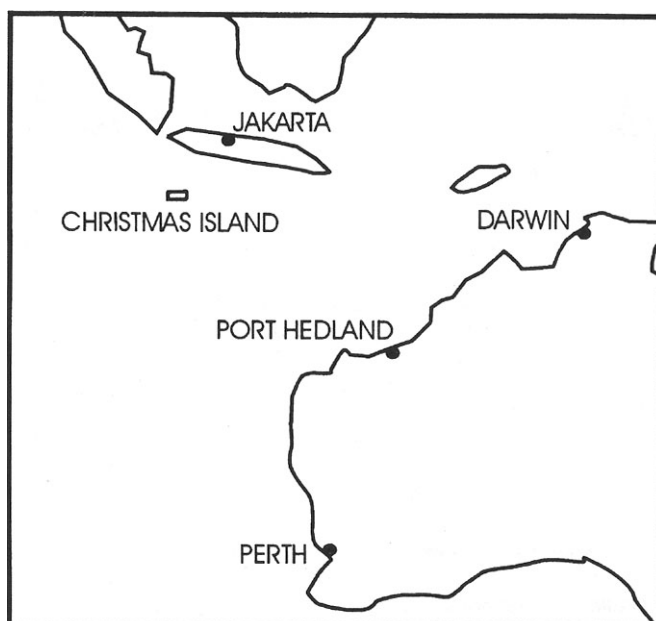
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1. LOCATION AND ACCESS

Christmas Island is located in the Indian Ocean at 10° 25'S and 105° 40'E. It is approximately 2800 kilometres (km) west of Darwin, 2600 km north-west of Perth, and 360 km south of the western head of Java (Figure 1). The island covers approximately 135 sq km, of which about 85 sq km (63%) is Christmas Island National Park (the Park, Figure 2). In addition to this terrestrial area, the Park includes a marine area extending 50 m seaward of the low water mark where terrestrial areas of the Park include the coastline. This marine area incorporates approximately 46 km (63%) of the island's 73 km of coastline.

Air services to the island have been variable in recent years, with one provider withdrawing from the scheduled Perth service in 1997. At March 2002, regular passenger transport from Perth via Cocos (Keeling) Islands is currently operated by National Jet Systems under a charter arrangement with the Commonwealth. There is also a scheduled return passenger service from Jakarta in Indonesia, operated by the Community airline. There is a reasonably safe anchorage at Flying Fish Cove during the dry season (approximately April to October). Two shipping companies operate a regular shipping service ex-Perth and Singapore via Cocos (Keeling) Islands carrying essential supplies. A network of roads and tracks provides access to most parts of the island including the Park.

Figure 1. Location of Christmas Island



2. HISTORY OF CHRISTMAS ISLAND

The first written record of the island was made by John Milward on board the *Thomas* in 1615. On 25 December 1643, Captain William Mynors of the *Royal Mary* saw the island and named it after the day. Mynors could not find an anchorage and so did not land.

The first recorded landing was in 1688 by a crew from the British buccaneer vessel, *Cygnets*, who were sent ashore by William Dampier for water and timber. From Dampier's description it seems that this landing was near the Dales (see Figure 3). Although several landings were made in the next 69 years, it was not until 1857 that an attempt was made by the crew of the *Amethyst* to explore the island. Their venture was limited by the inland cliffs and dense jungle.

The first extensive exploration was in 1887, when a small party from *HMS Egeria* reached the summit of Murray Hill (see Figure 3). It was this party that collected the rock specimens of almost pure phosphate of lime that were to determine the future of the island over the next century.

Figure 2. Christmas Island National Park Boundaries

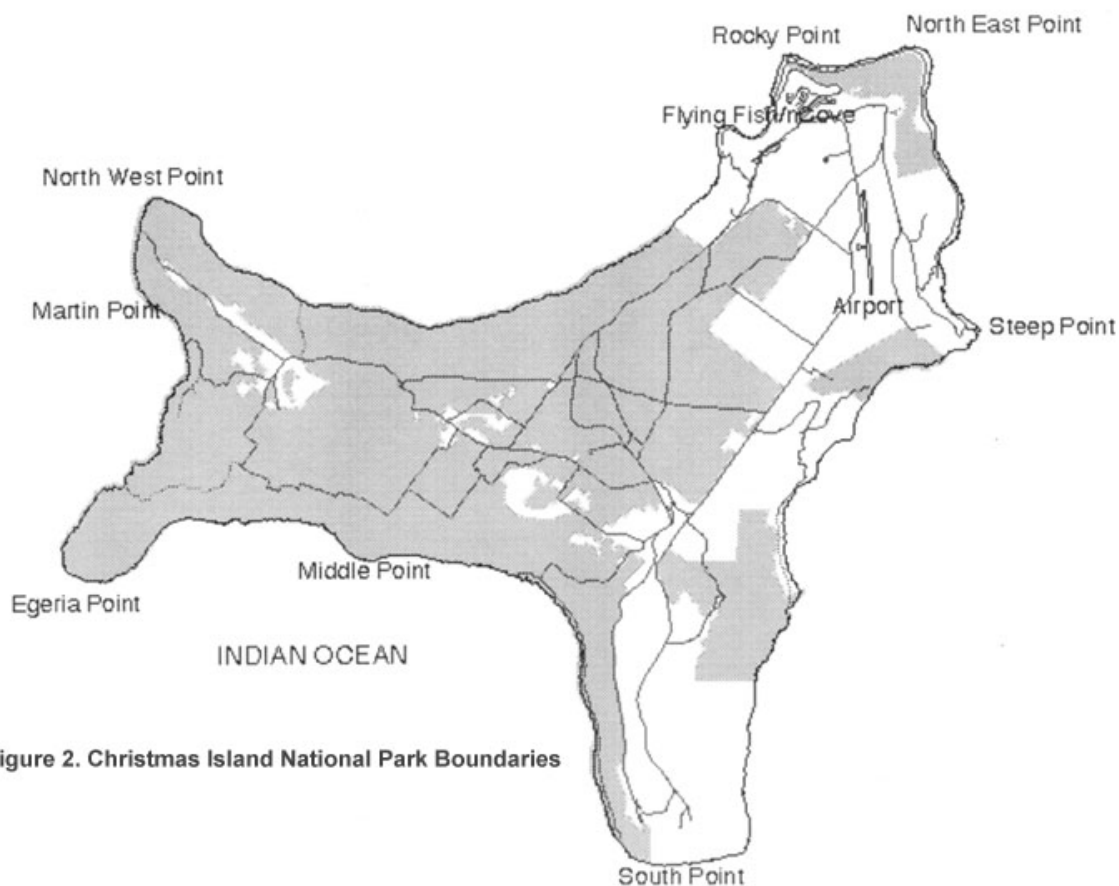
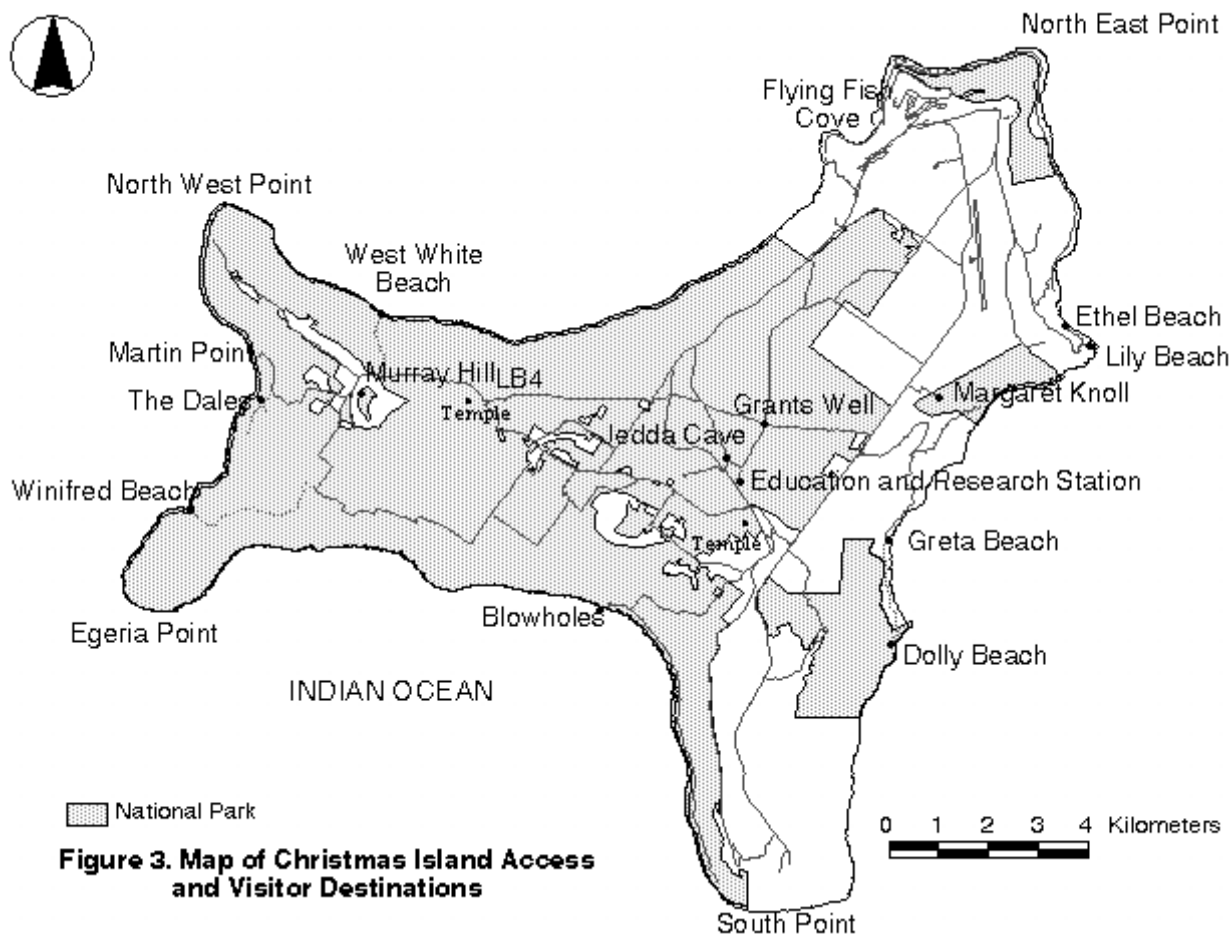


Figure 2. Christmas Island National Park Boundaries

In 1888 Christmas Island was declared part of the British Dominion as the result of pressure from two prospective entrepreneurs. In November 1888 George Clunies-Ross from the Cocos (Keeling) Islands landed his brother Andrew and family to establish the first settlement at Flying Fish Cove. Clunies-Ross wanted exploitation rights, and John Murray, a Scottish scientist, wanted to mine phosphate. They negotiated a joint lease for the whole of the island in 1891 to export timber, phosphate and other minerals and in 1897 formed the Christmas Island Phosphate Company. About 200 Chinese labourers, 8 Europeans and 5 Sikh policemen arrived in 1898 and phosphate mining commenced in the Phosphate Hill area. C.W. Andrews of the British Museum was commissioned by Murray to undertake a ten-month study of the island's natural history. Andrews did a comparative study when he returned in 1908. His monograph remains the classic scientific reference on the island's natural history.

The first commercial shipment of phosphate was made in 1901. The mining operation was labour intensive, and continued until World War II, when many of the European residents were evacuated in anticipation of a Japanese invasion. The Japanese invaded in 1942 and the island was occupied until 1945. During this time some phosphate was mined, but this was discontinued after the first two shiploads were torpedoed.

Figure 3. Map of Christmas Island Access and Visitor Destinations



After the war, the lease and assets of the Christmas Island Phosphate Company were sold to the Australian and New Zealand Governments. Through the *Christmas Island Agreement of 1949*, the Christmas Island Phosphate Commission (CIPC) was formed, with the British Phosphate Commissioners (BPC) appointed as managing agents. Phosphate mining resumed in 1946 and has continued since, except for the two years 1988–89 during which ownership of the mining lease changed. Mining began on the eastern side of the island, but spread progressively west. In the late 1960s the phosphate reserves were accurately mapped. This involved clearing parallel grid lines every 400 feet (120 m) over most of the top of the island.

On 1 January 1958, Christmas Island, which had until then been administered as part of the Colony of Singapore, became a separate colony of Great Britain. On 1 October 1958, sovereignty was transferred to Australia, and since that time the Commonwealth Government has been increasingly involved in Island affairs.

The ethnic make-up of Christmas Island is diverse. The first settlement of the Clunies-Ross family included some Javanese people, as well as Cocos-Malays. Chinese labourers were contracted when the mine was first established, and other workers came from Java and Ambon. Indians were brought to the island to supervise the labourers.

In the early days life was very difficult for the labourers working far from their families and homelands. The living conditions were primitive and work for the mine, or building railways and roads, was exhausting. Some workers lost their lives from diseases such as *beri-beri*, and due to harsh conditions and inadequate nutrition. In order to supplement their deficient diets, the Chinese, Malay

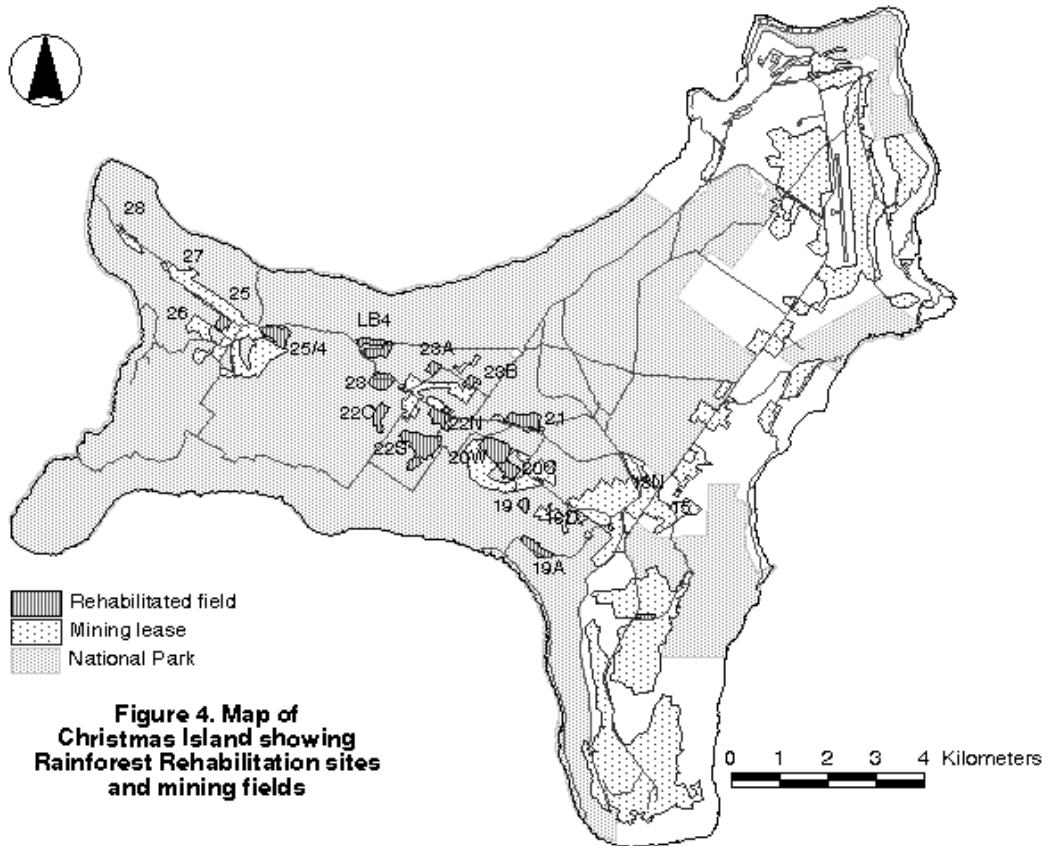
and other Asian workers hunted some of the edible wildlife and harvested fish and other marine animals. The natural resources of the island environment were essential for the survival of these new Islanders. Despite the difficult conditions, Chinese and Malay people established strong religious and cultural practices on the island, which remain today.

Following World War II, more workers were employed from Malaysia, Singapore and the Cocos (Keeling) Islands, to assist in re-establishing the mining operation and to build infrastructure. Although the mining operation was increasingly mechanised, conditions for workers remained poor. Local social and political changes occurred with the formation of the Union of Christmas Island Workers in 1975. The Union campaigned to bring island working conditions into line with mainland conditions, and for higher wages. Throughout the 1980s working conditions slowly improved. The Union remains a strong force in island social and political affairs.

In 1980, Mr W.W. Sweetland was commissioned by the Government to investigate the future of the phosphate industry. In December 1985, following the recommendations of a Government working party on the future of Christmas Island, the operations of the Phosphate Mining Company of Christmas Island were transferred to the Phosphate Mining Corporation of Christmas Island. On 11 November 1987, citing diminishing resources and industrial unrest, the Government ceased mining and began winding-up the corporation. On 26 September 1990, a lease providing for limited phosphate mining was signed between the Government and a private company, Phosphate Resources Limited (PRL). A subsequent lease was signed in 1997 for a further 21 years. This operation was limited to previously mined areas (Figure 4), and a condition of the lease is that no more primary rainforest be cleared and that a conservation levy be paid to the Commonwealth Government by the company.

The population in 1991 was 1275, of whom three-quarters were of Chinese descent, about 15% of European or Australian descent and about 8% of Malay descent. The population later increased to about 2500 following the development of a resort and casino and the launching of a 10-year, Commonwealth-funded rebuilding program to upgrade island infrastructure. Subsequent closure of the resort and casino and completion of the rebuilding program has seen the island population fall to around that of 1991.

Figure 4. Map of Christmas Island showing Rainforest Rehabilitation sites and mining fields.



Most redundant mining infrastructure has been removed and transported off the island. Privatisation of a number of Government services such as stevedoring, environmental protection and monitoring, asset services and social security has occurred.

There is currently a proposal by a private consortium to develop and construct a satellite launching facility at South Point. Mining and the public service account for most employment of residents, with the Christmas Island Shire Council and the private sector providing a varying number of jobs. Politically, Christmas Islanders are represented by the Shire Council and the federal seat of Lingiari.

3. HISTORY OF THE NATIONAL PARK

Since the first exploration of Christmas Island, there has always been interest in its natural history. John Murray (one of the partners in the original Christmas Island Phosphate Company), recognised that phosphate mining would have an impact, and commissioned C.W. Andrews of the British Museum to study the natural history of the island prior to the start of mining and after 10 years of mining. This study has served as a baseline for later natural history investigations.

The prevailing view until the late 1960s was that mining would not cause excessive damage to the natural environment, because it was planned to mine only limited areas of the island.

However, the impact of mining became a matter of general concern when the Phosphate Hill and South Point phosphate deposits were worked out and mining activities commenced in the western sector of the island. This new mining activity was obviously affecting a rare Indian Ocean seabird, Abbott's Booby, whose last remaining nesting habitat is the inland forest of Christmas Island. Scientists and nature conservation organisations expressed their concern about the threat to Abbott's

Booby and the island environment in general. In 1973 the island Administrator formed an environmental advisory committee to report and advise on general environmental topics, and in 1974 the British Phosphate Commissioners appointed a conservation officer.

In 1974 the House of Representatives Standing Committee on Environment and Conservation examined the effect of mining and other activities on the flora and fauna of Christmas Island, with special reference to bird species in danger of extinction. It also examined rainforest rehabilitation following mining and advised on further measures to protect the environment.

One of the Standing Committee's recommendations was that an area be reserved for conservation. As a result of this report a reconnaissance team of scientists visited Christmas Island in 1975 and broadly endorsed the recommendations of the Standing Committee. Many of the Committee's recommendations have since been implemented and significant progress has been made with nature conservation. Some of the important developments were the appointment in 1977 of a Government Conservator to advise and assist the Administrator on conservation, the initiation of a comprehensive program monitoring the breeding success and conservation of Abbott's Booby and the declaration of Christmas Island National Park in 1980. The appointment of the first Conservator from the New Zealand Government reflected the interest of both Governments in the island's phosphate reserves.

The original recommendation for a reserve on Christmas Island came from members of the reconnaissance team who suggested that an area be reserved in the vicinity of Murray Hill. Declaration of the National Park followed extensive discussions between the then Australian National Parks and Wildlife Service (ANPWS), and interested parties. The reserve area was extended to include the entire south-west corner of the island, including Murray Hill. This proposal was supported by the former Department of Home Affairs and the Department of Administrative Services. In December 1978, the Christmas Island Phosphate Commission accepted the creation of a National Park in this area, and the New Zealand Government later gave their formal approval.

A notice of intent to recommend the declaration of the Christmas Island National Park and seeking public representations was published in the Gazette on 4 October 1979. Nine representations were received all supporting establishment of the Park. Subsequently Christmas Island National Park was declared by Proclamation under the *National Parks and Wildlife Conservation Act 1975* on 21 February 1980.

The 1983 Senate inquiry, *The Preservation of the Abbott's Booby on Christmas Island*, recommended investigation of the 'possible extension of the Christmas Island National Park to include Block 22 A and Smithson's Bight Terraces'. Christmas Island (Stage Two) National Park, including the shore terraces around North West Point, and Christmas Island (Stage Three) National Park, on the eastern side of the original Park, were proclaimed on 31 January in 1986.

On 20 December 1989 the three National Parks together with additional areas of freshwater mangroves and other unique vegetation, much of the remaining undisturbed rainforest, crucial areas of habitat for species such as Abbott's Booby, the Christmas Island Frigatebird and blue and red crabs, and the area extending 50 metres offshore, were incorporated into a single Park, the current Park named Christmas Island National Park.

On 16 July 2000 the *National Parks and Wildlife Conservation Act 1975* was replaced by the *Environment Protection and Biodiversity Conservation Act 1999* and the Park is now a Commonwealth Reserve under that Act.

Before the 1986 and 1989 Proclamations, Australian and international public opinion was sought on the proposals. On both occasions many representations (mostly non-residents) were received recommending that not only the proposed extensions be proceeded with, but also that further areas be incorporated into the National Park. In response to this expression of concern for the preservation of Christmas Island and its unique environment the Australian Nature Conservation Agency (formerly

ANPWS), now Parks Australia, was instructed by the Minister to prepare a proposal for further extensions to the National Park. Opposition to this action was received from the local community and as yet the proposed extensions have not been initiated. However, the current Park boundaries are generally in the process of being reviewed, particularly in the north east area, as the golf course, community purpose land use areas and quarry operations may overlap with the gazetted Park boundaries.

4. PHYSICAL CHARACTERISTICS

4.1 Climate

Christmas Island lies at the southern edge of the equatorial low pressure belt that moves north and south of the equator during the course of the year. This confers a typical tropical, equatorial climate with a wet and a dry season. The wet season is from December to April when the north-west monsoon blows. For the rest of the year south-east trade winds bring slightly lower temperatures and humidity, and much less rain. Although the seasons are distinct, south-easterly winds may occur in the wet season and some rain may fall in any month of the year.

Rainfall: The mean annual rainfall (based on data collected over the last 25 years) is 2154 millimetres. Most falls between November and May with February and March the wettest months. August, September and October are the driest months. The pattern of the average number of rain-days per month follows that of the average monthly rainfall, decreasing from 20 in March to 9 in September/October. During the monsoon, heavy downpours lasting several days and periods of humid calm weather are punctuated by gusty north-westerly winds. From May to November, long dry periods with steady south-east trade winds and occasional showers predominate. In years of significant El Nino activity in the Pacific Ocean, rainfall on the island tends to be relatively low. Cyclones and cyclonic swells from the north-west sometimes affect the island during the wet season.

Humidity: Because of the oceanic influence, relative humidity does not vary seasonally as much as rainfall, usually ranging from 80–90%. Cloud mists at higher altitudes occur during the wet season and dews are occasional.

Temperature: As with relative humidity, temperatures on the island vary little from month to month. The average daily maximum temperature reaches 28° Celsius in March/April and the average daily minimum temperature falls to 22° Celsius in August/September.

4.2 Geology

Andrews (1900), Trueman (1965), Barrie (1967), Barrett (1973), Pettifer and Polak (1979), Veeh (1985), and Varne (1988) have variously described the formation and geology of Christmas Island. The island is believed to be on a tectonic plate moving northwards a few centimetres a year that puts its present location some 700 km, or about 15 degrees of latitude, north of where it first emerged from the sea (see Figure 5). One theory is that about 60 million years ago an undersea volcano rose to the surface and a coral atoll formed. Some 20 million years ago, the atoll began to subside and limestone accumulated as the corals sank. About 10 million years ago the subsidence reversed and an island emerged in a series of uplifts that give it a stepped appearance. Each terrace was formed by the combined effects of fringing reef development and erosion of the sea cliff before the next uplift occurred. Examples of more recent faulting with lava flows (which probably occurred underwater) can be seen at the Dales, Dolly Beach, Waterfall, Ross Hill Gardens, Winifred Beach and Egeria Point. Caves and sinkholes typical of limestone formations occur at many points on the island.

Phosphate deposits: The phosphorites commonly found on coral islands were thought to originate from guano, but are now believed to result from lagoonal marine sediments on Christmas Island, although the chemistry of their formation is unclear.

4.3 Soils

The soils of Christmas Island are derived from two sources – limestone (terra rossa soils) or basaltic extrusive rocks (krasnozem soils).

Terra rossa soils: Occur mainly on exposed terraces, and are predominantly thin, red-grey soils that dry out rapidly. They may have a high phosphate content and be over 30 m deep.

Krasnozem soils: Occur in areas of volcanic activity or in fault or fissure zones. They are red brown in colour.

However, as there has been no systematic evaluation of the non mined/non phosphate reserve regions of the island it is possible that other soil types may exist. Soil microbial processes involved in nutrient cycling are not well understood and further research in this area would be desirable.

The soils are usually neutral to alkaline (pH of 7.0–8.0). The soil horizons are locally referred to in terms of C, B and A-grade ores. C-grade soils (the ‘overburden’ of miners) are the highest in the soil profile and are a reddish brown colour, with a low phosphate content and composed of the minerals crandallite and millisite. B-grade is light brown to cream in colour and composed of a mix of crandallite, millisite and apatite. A-grade material is cream to white in colour, with a high phosphate content and consists of apatite.

4.4 Topography

The coast consists of mostly sheer, rocky cliffs from 10–20 m high with a few, small sand and coral rubble beaches. The interior is a slightly undulating plateau, from 160–360 m above sea level. A series of steep slopes or cliffs with intervening narrow terraces separate the central plateau from the shore. Generally a wider terrace is located immediately inland above the shoreline.

Figure 5. Map Showing Surface Geology

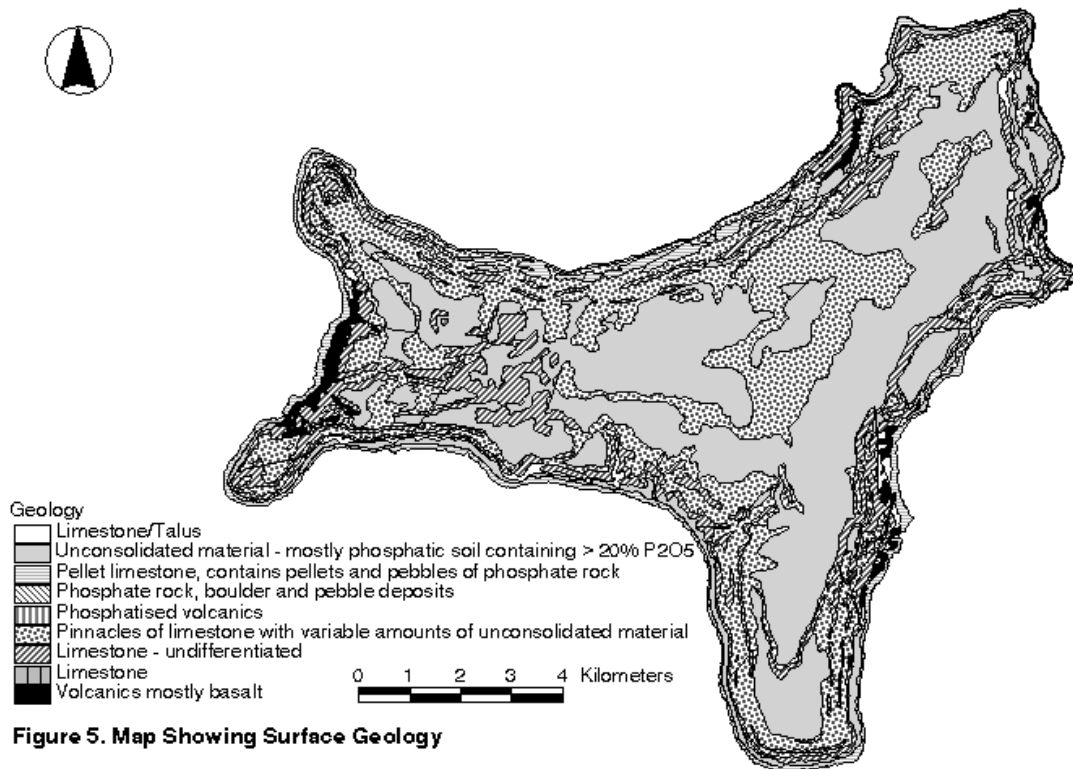


Figure 5. Map Showing Surface Geology

4.5 Hydrology

Most rain percolates through the soil and limestone and surface run-off only occurs after heavy rain. A few perennial streams flow at the Dales, Ross Hill Gardens, The Ravine, Jones Spring, Freshwater Spring, Dolly Beach, Hosnie's Spring and Waterfall. These streams begin as springs at the interface of limestone and less porous basalt and remain at the surface where they flow over volcanic rock. A few streams reach the sea, while others flow underground where they meet limestone. Underground water accumulates at the interface of limestone and the underlying volcanic rock strata. Here it either flows along the interface, as in the case of the flow system from Grant's Well through Jedda Cave and Jane-up beyond, or flows down fractures in the volcanic rock. The flows along the limestone-volcanic rock interface emerge in some places as springs.

Groundwater: Underground water accumulates at the interface of limestone and the underlying volcanic rock strata. Here it either flows along the interface, as in the case of the flow system from Grant's Well through Jedda Cave and Jane-up beyond, or flows down fractures in the volcanic rock. Where the limestone capping is below sea level, the water enters the sea via fissures, as at the 'waterfall' (or 'gusher') in the lower Daniel Roux Cave, or as more diffuse flows through smaller fissures, often within cave systems such as Freshwater Cave at Smithson's Bight, Runaway Cave near the Golf Course and Lost Lake Cave on the north coast. There is evidence of a freshwater lens floating on top of underlying seawater. The flows just above sea level from some of the cave systems on the island are thought to be the outflows from the edges of such a lens.

It is believed that the water table in the volcanic centre of the island is higher than elsewhere owing to the relatively low permeability of that type of rock. At the edges of the island the water table drops to just above sea level owing to the much higher permeability of limestone.

5. HABITATS

Christmas Island can be viewed as a series of terraces around an irregular plateau with the lower terrace cliffs steeper and higher than the upper terraces. The deepest soils occur on the central plateau and the upper terraces. The distribution of plants can be correlated to soil depth and moisture, exposure and distance from the sea. The coastal zone is generally saline with thin soils. The zone immediately behind this is also a harsh habitat for most plants, especially where it faces the prevailing south-easterly winds. *Pandanus* spp. and *Scaevola taccada* are typical of places exposed to salt spray. Further inland, the environment becomes more sheltered and rainforest exists with structure and floristics determined by the depth and type of soil.

The island environment can be classified into 12 broad habitats.

1. Marine – the ocean waters, sand flats, caves, coral reefs and outer reef slopes and drop-offs, and coral heads or ‘bommies’.

2. Shoreline rock platforms – these occur at many locations around the island, more extensively on the western coastline between North West Point and Egeria Point. At low tide there are many tidal rock pools with a variety of marine invertebrates and fish.

3. Beaches – formed of coarse coral and shell rubble, often with limestone outcrops; there are some small sand beaches on the north and east coasts. Dolly and Greta Beaches provide habitat for hermit and ghost crabs and are the only beaches with sufficient and stable deposits of sand to support turtle nesting activity.

4. Sea cliffs – these average 10-20 m high, rising to 60 m at Steep Point. A harsh environment, exposed to salt spray and salt laden wind where plants such as *Pemphis acidula*, *Pandanus christmatensis*, *Argusia argentea* and *Scaevola taccada* are common. This is also a Silver Booby and Brown Booby nesting habitat.

5. Terrace rainforest – an area of generally shallow soils prone to dehydration in the dry season. Open, semi-deciduous rainforest is typical on the coastal terraces, with scrambling and spiny shrubs and vines. Both vine and canopy forests also occur. Typical species are *Acronychia trifoliolata*, *Berrya cordifolia*, *Calophyllum inophyllum*, *Erythrina variegata*, *Hibiscus tiliaceus*, *Kleinhovia hospita*, *Ochrosia ackeringae*, *Pandanus elatus*, *Pisonia grandis*, *Gyrocarpus americanus* and *Terminalia catappa*.

6. Shallow soil rainforest on the higher terraces – generally thin soils and exposed limestone pinnacles. Typical canopy species include *Celtis timorensis*, *Dysoxylum gaudichaudianum*, *Ficus microcarpa*, *Arenga listeri*, *Planchonella nitida* and *Tristiropsis acutangula*. Vegetation has a lower upper canopy and is floristically richer than the primary evergreen rainforest of the plateau. Pockets of deeper soil occur in this region, supporting primary evergreen rainforest.

7. Limestone scree slopes and pinnacles – the inland cliffs rise out of the semi-deciduous terrace rainforest and support *Ficus microcarpa*, *Maclura cochinchinensis*, *Gyrocarpus americanus*, *Erythrina variegata*, *Derringtonia amaranthoides* and *Dendrocnide* spp.

8. Deeper plateau and terrace soils evergreen rainforest – typically a tall evergreen rainforest with emergent trees to 45 m and the habitat for the Abbott’s Booby. Typical emergent species are *Syzygium nervosum*, *Ficus microcarpa*, *Planchonella nitida* and *Hernandia ovigera*.

The upper canopy is comprised of *Barringtonia racemosa*, *Inocarpus fagifer*, *Cryptocarya nitens*, *Dysoxylum gaudichaudianum* and *Tristiropsis acutangula*. The understory is composed of *Arenga listeri*, *Pandanus elatus*, *Leea angulata*, *Ochrosia ackeringae*, *Pisonia umbellifera* and various shrubs and ferns.

9. Mangrove forest – there are no coastal mangroves, but a stand of normally estuarine *Bruguiera gymnorhiza* and *B. sexangula* occurs at Hosnie’s Spring (listed as a Wetland of International Importance under the Ramsar Convention) about 50 metres above sea level. Two other mangrove species occur on the east coast. *Heritiera littoralis* occurs on the inland terrace above Greta Beach (outside the Park) and further south towards Dolly Beach, as well as a discrete stand on the terrace above Dean’s Point. *Cynometra ramiflora* occurs in a single stand south of Ross Hill summit, at 220–300 m altitude, on damp soil near basalt outcrops.

10. Perennially wet areas – typically support *Inocarpus fagifer* and other common species and are habitat for blue crabs.

11. Karst, comprising caves, overhangs, rock crevices and sinkholes – glossy swiftlets nest in the caves and overhangs (refer to the cave management plan for details of other cave fauna).

12. Mining fields – typically limestone pinnacles, boulders, chalk and very thin soils remain after mining. These thin soils support the ferns *Nephrolepis multiflora* and *Psilotum nudum* and the exotics *Mimosa invisa*, *M. pudica* and *Muntingia calabura*. Stockpiles of topsoil are colonised by *Claoxylon indicum*, *Macaranga tanarius*, *Melochia umbellata* and the exotics, *Leucaena leucocephala* and *Muntingia calabura*.

6. LAND AREA

Flora

6.1 Terrestrial Vegetation

Three main categories of forest vegetation can be distinguished on Christmas Island: primary rainforest; marginal rainforest; and scrub forest (DuPuy 1988). Other restricted vegetation types, coastal fringe, and shorecliff and spray zone (DuPuy 1988), occur on the inland cliffs and scree slopes and at the coastal edge. These five types of natural vegetation are protected on Christmas Island under Part 9 (Schedule 12) of the *Environment Protection and Biodiversity Conservation Regulations 2000*.

Mitchell (1974) grouped the principal canopy communities according to three altitude zones: 0–130 m, with 35 taxa represented; 130–200 m, with 31 taxa; and over 200 m, with 26 taxa.

Mitchell recognised climax edaphic (in a stable condition influenced by the soil), climax climatic (in a stable condition and influenced by climate) and seral (successional stage) vegetation. These were subdivided as follows:

climax edaphic

- tall closed forest, deep soil phase
- closed forest, shallow soil phase
- closed forest, scree and pinnacle phase
- open forest and vine woodland
- closed forest, freshwater seepage

climax climatic

- heath shrubland
- low, closed woodland

seral vegetation

- natural vegetative colonisation of human disturbance areas
- storm damaged and tree fall sites

Tracey (1991) recognised two groups of plateau forest based on structure: – semi-deciduous mesophyll vine forest (SDMVF) and complex mesophyll vine forest (CMVF) – that he noted as being floristically simpler than CMVFs elsewhere. He classified the terrace forest into SDMVF and deciduous vine forest, and noted that ‘The common canopy species eg *Pisonia grandis*, *Erythrina variegata* and *Terminalia catappa* are shared with Australia’s tropical coastline, and *Gyrocarpus americanus* is widespread throughout tropical Australia but never reaches the size common in this forest type on Christmas Island.’

The Christmas Island vegetation map (Figure 7) has been adapted from Mitchell (1984), the Christmas Island Geographic Information System (Bureau of Rural Science 1996), and observations made by Parks Australia North staff and P. Green (Monash University), and is the model generally used for management and research purposes.

Figure 6. Map Showing Vegetation

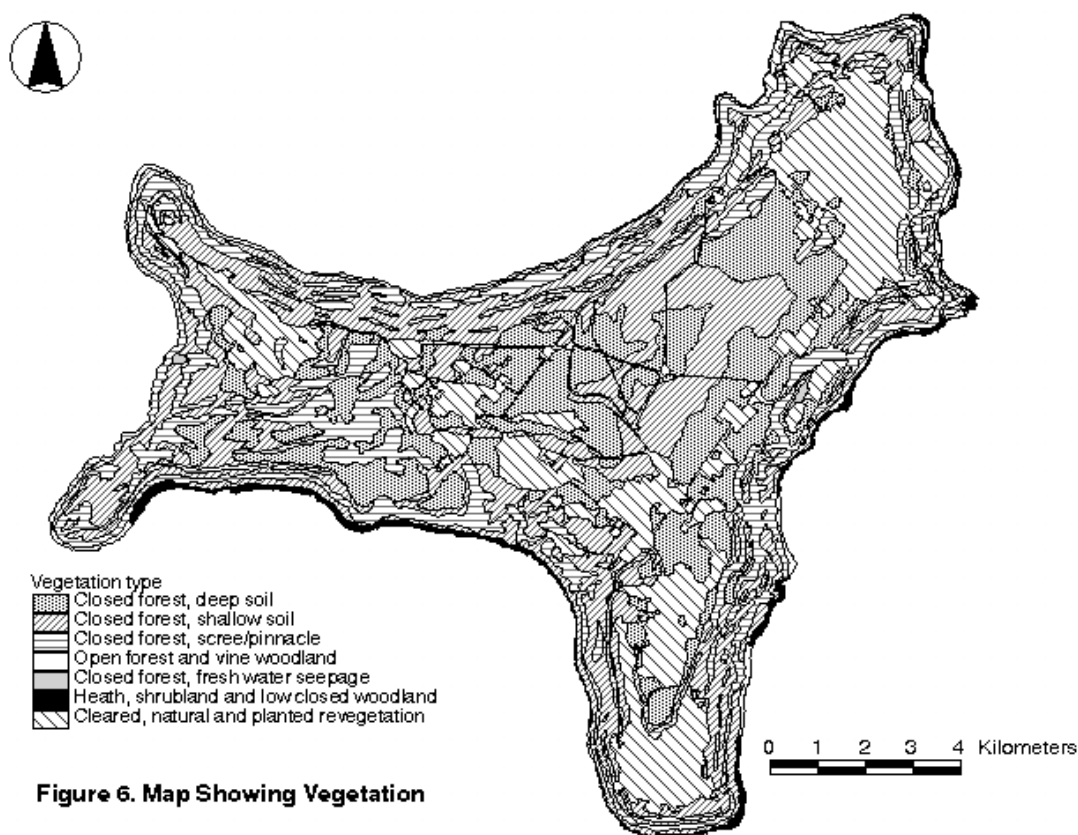


Figure 6. Map Showing Vegetation

There are 18 species that are endemic to the island (see Table 1)

Table 1. Endemic plants

<i>Abutilon listeri</i>	shrub	coast and shore terraces	frequent
<i>Arenga listeri</i>	palm	most habitats	frequent
<i>Asplenium listeri</i>	fern	Margaret Knoll	very rare
<i>Asystasia alba</i>	herb	terrace forest	occasional
<i>Brachypeza archytas</i>	epiphytic orchid	terrace forest	frequent
<i>Colubrina pedunculata</i>	shrub	terrace vegetation	occasional
<i>Dendrocnide peltata</i>	tree	tops of inland cliffs	occasional

<i>var. murrayana</i>			
<i>Dicliptera maclearii</i>	herb	lower terraces marginal forest	rare
<i>Flickingeria nativitatis</i>	epiphytic orchid	primary rainforest	occasional
<i>Grewia insularis</i>	tree	terrace forest	occasional
<i>Hoya aldrichii</i>	epiphytic vine	forest canopy	abundant
<i>Ischaemum nativitatis</i>	grass	pinnacles behind sea cliffs	occasional
<i>Pandanus elatus</i>	shrub or tree	forest understorey	frequent
<i>Pandanus christmatensis</i>	shrub	tops of shore & inland cliffs	abundant
<i>Peperomia rossii</i>	epiphytic herb	distribution unknown	possibly extinct
<i>Phreatia listeri</i>	epiphytic orchid	tall plateau forest canopy	occasional
<i>Zeuxine exilis</i>	terrestrial orchid	distribution unknown	possibly extinct
<i>Zehneria alba</i>	vine	shrubby margins or in forest	extinct

Plants rare to the island. Several small, isolated occurrences of plants are known which are consequently rare on the island, though not necessarily rare elsewhere.

- Two mangroves, *Bruguiera gymnorhiza* and *B. sexangula*, occur as unusually tall trees in a half-hectare stand at Hosnie's Spring, about 1 km east of Gannet Hill on a basalt outcrop on the shore terrace 50 m above sea level. These trees are presumed to have persisted since the area was at sea level, and the locality is listed by the Ramsar Convention as a Wetland of International Importance.
- *Cynometra ramiflora* – a mangrove up to 20 m tall, characteristic of the less saline areas of coastal mangrove forests. There is a single stand south of Ross Hill – another example of a coastal mangrove far from the sea.
- *Bauhinia binata* – a climbing shrub known from a single locality at North West Point.
- *Clerodendron inerme* – a scrambling shrub known from a single locality above Greta Beach.
- *Commicarpus chinensis* – a scrambling herb that grows on rock ledges at North West Point.
- *Cycas rumphii* – a cycad that occurs individually on the East Coast and as a stand near North West Point at about 300 m above sea level. This species is usually distributed by sea, suggesting that the sparse population has persisted since the island was at sea level.
- *Dioscorea bulbifera* – a climbing vine known from two localities: south of Camp Hill and the Greta Beach terrace.
- *Entada rheedii* – a huge, woody vine growing on the shore terrace of Greta Beach. The 4 cm wide, disc-shaped seeds are often washed up on this beach.
- *Ischaemum muticum* – a stoloniferous grass found only on the back dunes of Dolly Beach.
- *Ophioglossum reticulatum* – a small terrestrial fern known only in an old minefield south of Wharton Hill.
- *Spondias cytherea* – a large, deciduous tree known only from three localities.
- *Sporobolus virginicus* – a tufted grass occurring in the spray zone at Norris Point.

- *Vitis flexuosa* – a vine known only from three localities.

Note: some of the endemic plants described above are also rare eg. *Asplenium listeri*, *Peperomia rossii* and *Zeuxine exilis*.

Exotic plants. Most of the exotic plants of Christmas Island are in the settled area and along road verges and mine fields. Unfortunately, some including *Cocos nucifera*, *Mangifera odorata*, *Aleurites moluccana* var. *molucanna*, *Adenantha pavonia*, *Barringtonia asiatica*, *Spathodea campanulata*, *Delonix regia*, *Pterocarpus indicus*, *Muntingia calabura* and *Tecoma stans* were planted during former minefield rehabilitation operations and most of these species are spreading in disturbed areas. Others, like *Carica papaya*, *Psidium guajava*, *Mikania micrantha*, *Ricinus communis*, *Tithonia diversifolia*, *Clausena excavata*, *Antigonon leptopus*, *Paederia foetida*, *Macropodium atropurpureum*, *Ipomoea* spp., *Stachytarpheta jamaicensis*, *Cordia curassavica*, *Celosia argentea*, *Leucaena leucocephala*, *Mimosa invisa* and *Mimosa pudica* are also spreading quickly in disturbed areas.

Fauna

The terrestrial fauna of Christmas Island is dominated by land crabs and in particular by the red land crab *Gecarcoidea natalis*. Red crabs are the dominant consumers on the forest floor, and they play a major role in determining the structure and function of the rainforest on Christmas Island.

6.2 Terrestrial Vertebrates

Native Mammals. Of the five native mammals, two have become extinct since the arrival of humans. Two rat species apparently went extinct within a few years of the introduction of exotic rodents by early human colonisers. The Christmas Island shrew was thought to be extinct before two specimens were found in 1984 and 1985, and it is now listed as Critically Endangered. Despite extensive surveys in 1997–98 and 2000, there have been no confirmed sightings since. The Christmas Island pipistrelle, which is an endemic small insectivorous bat, was previously common and widespread on the island. However, in the last decade it has declined markedly in distribution and abundance, and is now classified as Endangered. It is not fully understood what has caused this rapid decline.

The Christmas Island flying-fox is an endemic subspecies which is widespread across the island. In contrast to most species of bats it is largely diurnal, and so can be easily seen in flight during the day.

Introduced mammals. Two exotic wild mammals have been introduced, the black rat (or ‘ship rat’ as it is now more commonly called) and the house mouse. There are doubtful references to two other rats – the Pacific and brown – but if they were introduced they have not survived. Feral domestic cats are numerous and widespread. Goats and pigs were once present but have now been eradicated from the island. Stray dogs occur round the settled areas.

Native reptiles. Of six native terrestrial reptiles, five are endemic. The sixth is the foreshore skink (*Emoia atrocostata*), common also on other oceanic islands. The five endemics include two skinks, the blue-tailed skink (*Cryptoblepharus egeriae*) and the forest skink (*Emoia nativitatis*); two geckos, the giant gecko (*Cyrtodactylus* sp. nov.) and the Christmas Island gecko (*Lepidodactylus listeri*); and one burrowing snake, the pink blind snake (*Ramphotyphlops exocoeti*). There has been a marked decline in the range of several species over the previous decade. The endemic blue tailed skink has virtually disappeared from the north-east and eastern parts of the island, and the Christmas Island gecko or tree gecko appears to have suffered a severe decline in numbers.

Introduced reptiles. Five exotic reptiles comprising two geckos, one skink and two snakes occur in and around the settled area. These are regionally abundant species associated with human colonisation. The house gecko (*Gehyra mutilata*), the barking gecko (*Hemidactylus frenatus*), and the black blind

snake (*Ramphotyphlops braminus*) are found in the Park. The wolf snake (*Lycodon aulicus capucinus*) appears to be moving further into the rainforest, and grass skinks (*Lygosoma bowringii*) have recently been seen on the fringe of the Park rainforest. It is possible (although this is still to be determined) that the wolf snake is having a major impact on the conservation status of the pipistrelle bat, and possibly a number of the reptile species.

Land birds. Of the 11 native land birds and shorebirds, seven are endemic species or subspecies. The glossy cave swiftlet (*Collocalia esculenta natalis*) feeds on flying insects and nests in caves or overhangs. The Imperial Pigeon (*Ducula whartoni*) feeds mainly on fruits in the rainforest and settled areas. The Emerald Dove (*Chalcophaps indica natalis*) feeds on fruits, seeds and insects on the forest floor. The Christmas Island Hawk-owl (*Ninox natalis*— listed as endangered) and the Goshawk (*Accipiter fasciatus natalis*— also listed as endangered) feed on small mammals, birds, reptiles and invertebrates. DNA sequence research has identified that the Hawk-owl should be treated as a separate species (*Ninox natalis*) from the Moluccan Hawk-owl (*Ninox squamipila*), of which it was previously thought to be a sub-species. The Christmas Island White-eye (*Zosterops natalis*) and the Christmas Island Thrush (*Turdus poliocephalus erythropleurus*) are common in the Park and feed on fruit, nectar and insects. The Australasian Kestrel (*Falco cenchroides*) and the White-faced Heron (*Ardea novaehollandae*) are established in open areas. Eastern Reef Egrets (*Egretta sacra*) occur in small numbers around the shoreline. The White-breasted Water Hen (*Amaurornis phoenicurus*) from south-east Asia is now established and breeding in the north-east section of the Park and on the fringes of the settled areas.

Seabirds. Of the eight species or sub-species of sea-birds that nest in the Park three are endemic. The most numerous sea-bird is the widespread Red-footed Booby (*Sula sula rubripes*), which nests in colonies in trees on many parts of the shore terrace and inland terraces. The widespread Brown Booby (*Sula leucogaster plotus*) nests on the ground at the edge of the seacliff and inland cliffs. Abbott's Booby (*Papasauna abbotti* – listed as endangered) nests on tall emergent trees of the western and southern plateau rainforest. This forest is the only remaining nesting habitat of Abbott's Booby left in the world. Abbott's Booby is now considered endemic to the island. The endemic Christmas Island Frigatebird (*Fregata andrewsi* – listed as endangered) has three well-defined nesting areas: one above the Golf Course; one on the western side of Smith Point below the phosphate driers; and another in the forest on the north coast between North East Point and Settlement. The widespread Great Frigatebird (*Fregata minor minor*) nests in trees on the shore terrace. The greatest concentrations are around North West Point and the western terraces of South Point. The Least Frigatebird (*Fregata ariel*) has been recorded and a nesting pair were recently observed on the shore terrace above West White Beach. The Common Noddy (*Anous stolidus pileatus*) nests on ledges along the seacliff and in trees on the shore terrace.

There are two species of Bosun or Tropicbird. The Red-tailed Tropicbird or Silver Bosun (*Phaethon rubricauda westralis*) nests in depressions along the coastal and inland cliffs while the endemic sub-species of White-tailed Tropicbird, the Golden Bosun (*Phaethon lepturus fulvus*), uses tree and cliff hollows all over the island.

Vagrants and migrant birds. Some 76 vagrant or migrant bird species have been recorded on the island from time to time and these include: the Pacific Golden Plover (*Pluvialis fulva*), Oriental Plover (*Charadrius veredus*), Red-capped/Kentish Plover (*Charadrius spp.*), Little Curlew (*Numenius minutus*), Ruddy Turnstone (*Arenaria interpres*), Common Greenshank (*Tringa nebularia*), Snipe spp. (*Gallinago spp.*), Red-necked Stint (*Calidris ruficollis*), Oriental Pratincole (*Glareola maldivarum*), Australian Pratincole (*Stiltia isabella*), Wedge-tailed Shearwater (*Puffinus pacificus*), Matsudaira's Storm-petrel (*Oceanodroma matsudairae*), Australian Pelican (*Pelicanus conspicillatus*), Great Cormorant (*Phalacrocorax carbo*), Least Frigatebird (*Fregata ariel*), Striated Heron (*Butorides striatus*), Rufous Night Heron (*Gorsachius melanolophus*), Yellow Bittern (*Ixobrychus sinensis*), Black Bittern (*Dupetor flavicollis*), Sooty Oystercatcher (*Haematopus fuliginosa*), Grey Plover (*Pluvialis squatarola*), Little Ringed Plover (*Charadrius dubius*), Black-winged Stilt (*Himantopus himantopus*), Wood Sandpiper (*Tringa glareola*), Marsh Sandpiper (*Tringa stagnatilis*), Grey Wagtail

(*Motacilla cinerea*), Yellow Wagtail (*Motacilla flava*), Red-rumped Swallow (*Hirundo daurica*), and the Fork-tailed Swift (*Apus pacificus*).

Introduced birds. Chickens have become feral and occur around the fringes of the Park, while some ducks and turkeys exist under semi free-range conditions in the settled area. Java Sparrows (*Padda oryzivora*) and Tree Sparrows (*Passer montanus*) are established round the settled area. Java Sparrows have also spread to the fringes of the Park in the Irvine Hill and Hanitch Hill area.

6.3 Aquatic Vertebrates

The limited availability of permanent, above-ground freshwater sources has restricted the numbers and types of aquatic vertebrates found on Christmas Island, although further surveys are required in this area. At least seven species have been recorded from freshwater environments on the island, all except one of which are probably introduced. Only one species, the native brown gudgeon, has been recorded from caves. Those species recorded to date are the Asian bony tongue (*Scleropages formosus*), brown gudgeon (*Eleotris fusca*), tilapia (*Oreochromis sp.*), guppy (*Poecilia reticulata*), mosquito fish (*Gambusia affinis*), swordtail (*Xiphophorus maculatus*) and 'terrapins' (Class Reptilia). Terrapins occur in the tank at Ross Hill Gardens but they have not been identified and are probably released pets or escapees.

6.4 Terrestrial Invertebrates

Most of the described terrestrial invertebrates also occur in tropical areas to the north. The inventory of the invertebrate fauna is incomplete and several hundred collected specimens await identification. To date, 20 species of terrestrial and intertidal crabs (of which 13 are regarded as true land crabs depending on the ocean only for their larval development), one freshwater prawn, 14 snails, several butterflies, some 70 moths, 90 beetles, 11 cockroaches (one of which is endemic), 30 spiders, one scorpion, five false scorpions and 1 amblypygid have been described.

The diversity and abundance of land crabs are striking features of the invertebrate fauna, not matched on any other island. All 13 species occur in the Park and all habitats support one or more species. The red crab (*Gecarcoidea natalis*) occurs only on Christmas Island (and sporadically on North Keeling Island), and Jackson's crab (*Sesama obtusifrons*) may also be endemic as it has not been recorded elsewhere. The blue crab (*Cardisoma hirtipes*), though a widespread species, occurs in its blue form only on Christmas Island. The robber crab (*Birgus latro*) is common on Christmas Island, and although it was once widespread throughout the Indo-Pacific region many of these populations have been severely depleted. All species of land crabs migrate to the sea to spawn, and live for the duration of their various larval stages in the ocean.

Introduced terrestrial invertebrates. Honeybees, a centipede, a cockroach, two termites, four species of fruit fly, several spiders and the giant African snail have been introduced to the island and all occur in the Park. During the life of the previous plan the population of the yellow crazy ant has exponentially exploded and has formed multi-queened supercolonies at several locations on the island. This population explosion has major implications for the management of the Christmas Island ecosystem.

7. MARINE AREA

Shoreline platforms slightly above sea level occur round the island, predominantly on the coast between North West Point and Egeria Point. At low tide on these platforms there are many small pools maintained by tides and wave splashes, with a variety of invertebrates and fish. There is little algal growth due to the prevailing heavy seas. The shoreline platforms descend directly to a narrow band of

shallow coral reefs with no intervening sandy, shallow reef flats. A few small beaches of coarse coral and shell rubble occur along the coastline. The shallow reefs drop off steeply so that there is little deep reef habitat before abyssal depths are reached.

7.1 Marine Vertebrates

Mammals. Spinner dolphins (*Stenella longirostris*) are frequently seen in inshore waters and common dolphins (*Delphinus delphis*) occasionally. Unidentified whale species are infrequently seen round the island. There is one substantiated sighting of a humpback whale (*Megaptera novaeangliae*) off the north-east coast.

Reptiles. Small numbers of green (*Chelonia mydas*) and very rarely hawksbill turtles (*Eretmochelys imbricata*) nest on Dolly and Greta beaches. Undetermined species of sea snakes occur round the island, with the only species recorded being the pelagic yellow-bellied sea snake (*Pelamis platurus*).

Fish. Some 575 species of fish have been identified from the island's waters. The faunal composition is typical of Indo-Pacific islands with nearly 68% of species widespread in the Pacific and Indian Oceans. Altogether, the fish fauna is more closely allied to the West Pacific province of the Indo-West Pacific faunal region than to the East Indian Ocean region. In fact, less than 10% of the fish are restricted to the Indian Ocean (Allen and Steene 1988, Berry 1988). As is the case with most Indo-Pacific islands the rate of endemism is low and only three species, the pygmy angelfish and two undescribed pseudochromids, are apparently endemic to Christmas and the Cocos (Keeling) Islands.

Whale sharks (*Rhincodon typus*) and manta rays (*Manta birostris*) occur in inshore waters all year round, higher numbers occurring November to March. Whale sharks have recently been listed as a Threatened Species under the EPBC Act in Australian waters.

7.2 Marine Invertebrates

Christmas Island has a low diversity of coral species, which is attributed to the small size of the island, its isolation from sources of planktonic coral larvae, and the limited range of marine habitats present. During a survey in 1987, 88 species of reef building corals were collected, although this did not provide a complete census of species (Berry 1988). Extensive die-off of corals took place around the island in the early 1980s, and this may have resulted in severe depletion or local extinction of some species. In 1998 there was a widespread coral bleaching event in the Pacific and Indian Oceans and South China Sea. This event may have been triggered by the El Nino weather pattern. Large areas of the Christmas Island fringing reef were affected. The most abundant octocoral on the reefs around the island is blue coral. Gorgons and antipatharians are found in the deeper slopes. Five species of clownfish sea anemones are recorded.

Numerous sponges, including endemic species and varieties, have been found around the island.

A single species of brachiopod has been recorded. A total of 313 species of molluscs were collected in the 1987 survey. Of these, 245 were gastropods, 63 were bivalves and 13 were terebrids. Of the collections of echinoderms made over the last century, eight species are crinoids, 13 are sea stars, 33 are brittlestars, 17 are sea urchins and 16 are holothurians.

A total of 204 crustacean species are listed for the island. Hermit crabs, Xanthoid crabs and Majid crabs are the dominant marine crabs in terms of species diversity. Grapsid crabs are a very obvious component of the intertidal habitats. Three species of rock lobster have been recorded.

The crustacean fauna reflects the dominance of coral and coral rubble habitats with relatively small areas of sand substrate and the minimal occurrence of mud and fine silts.

7.3 Subterranean Ecosystems

Subterranean fauna are found in air-filled (troglifauna) and water-filled (stygo fauna) voids (Figure 7). The subterranean environment of Christmas Island is diverse and includes freshwater, marine, anchialine (subterranean connections to the sea in volcanic or limestone bedrock) and terrestrial habitats (Humphreys and Eberhard 1998).

Poorly known, the cave fauna is nonetheless a significant component of the island's biodiversity.

With at least 12 endemic species, Christmas Island is a significant cave fauna province in an international context. The cave fauna comprises swiftlets, and a diverse assemblage of invertebrates, both terrestrial and aquatic, including a number of rare and endemic species of high conservation significance.

Notable amongst cave collected fauna are terrestrial isopods (Armadillidae: 3 new species: Taiti in prep), a scorpion (new species: globally only 14 blind scorpions are known, of which only two are known outside the New World tropics), an Amblypygi (new species: Harvey and West 1998), Campodeidae (Diplura: new species) and a nocticolid cockroach (new genus: Roth 1999).

But most notable is the anchialine system which contains a characteristic fauna (procardid [*Procaris* sp. nov.], alpheid, hippolytid and atyid shrimps) associated with the genus *Procaris* otherwise known only from Bermuda, Ascension Islands and Hawaii.

Anchialine waters are near coastal groundwater with no surface connection with the sea but under the influence of marine tides. This is a distinctive ecosystem and within the last decade at least ten new families of Crustacea have been described from these newly discovered ecosystems. They are very vulnerable ecosystems (Humphreys et al. 1999) and globally are the subject of widespread conservation assessment.

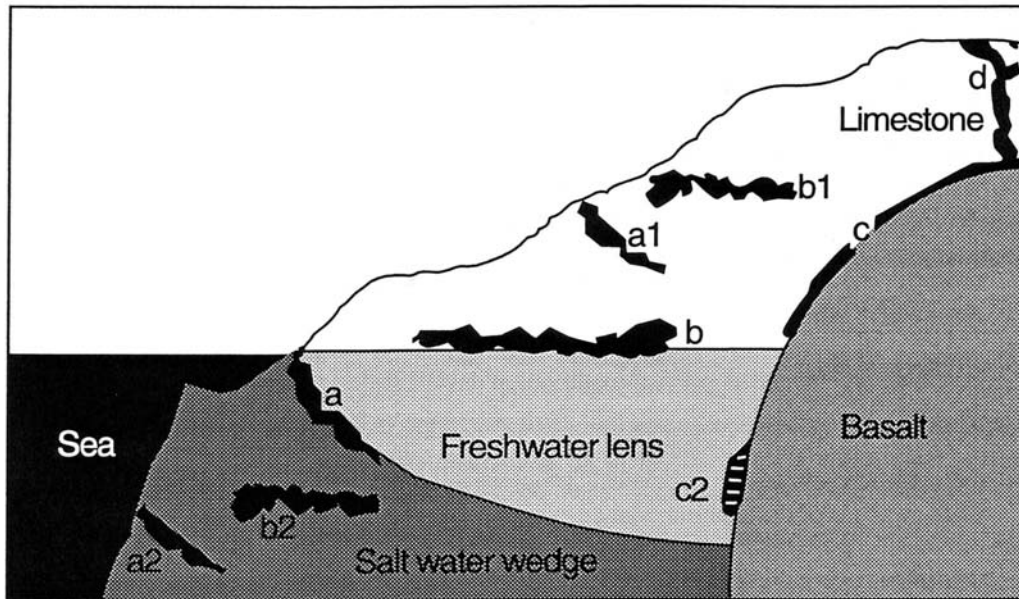
A survey of cave fauna was carried out in 1998 (Humphreys and Eberhard 1998) and a cave management plan will be prepared and implemented during the life of this Plan.

Figure 7 is a schematic section through Christmas Island that represents the known and hypothesised sites of cave development (shown in black) associated with the freshwater lens on a carbonate island on a basaltic core. The depth of the freshwater lens is greatly exaggerated to allow depiction of the basic thesis:

- a) current and former (a1) saltwater interface caves; current (b) and former (b1) air/water interface caves;
- b) lens associated caves;
- c) basalt associated caves;
- d) sinkholes.

There should be an equivalent series of drowned caves a2, b2 and c2 representing the lower sea levels that have existed though most of the Pleistone (explanation in Humphreys and Eberhard (1998) p.34, Figure 3).

Figure 7. Cave Development and Freshwater lens



8. MANAGEMENT OBJECTIVES

The Park is assigned by the Management Plan to the IUCN (World Conservation Union) protected area “national park” (IUCN category II).

IUCN has adopted the definition of a protected area as:

An area of land and/or sea especially 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 IUCN has identified six protected area management categories. Category II National Parks are defined as protected areas of land and/or sea managed mainly for ecosystem protection and recreation.

These categories are designated to:

- a) protect the ecological integrity of one or more ecosystem for future generations;
- b) exclude exploitation of or occupation contrary to the purposes of the designation of the area;
and
- c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible.

The *Environment Protection and Biodiversity Conservation Regulations 2000* prescribe Australian IUCN reserve management principles for the six IUCN protected categories. The principles are set out in Schedule 8 to the Regulations. A management plan for a Commonwealth reserve must not be inconsistent with the principles for the IUCN category to which the reserve (or a zone of the reserve) is assigned. The principles for the IUCN category national park are:

- The reserve or zone should be protected and managed to preserve its natural condition according to the following principles.
- Natural and scenic areas of national and international significance should be protected for spiritual, scientific, educational, recreational or tourist purposes.
- 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.
- 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.
- Management should seek to ensure that exploitation or occupation inconsistent with these principles does not occur.
- Respect should be maintained for the ecological, geomorphologic, sacred and aesthetic attributes for which the reserve or zone was assigned to this category.
- 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.
- 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.

9. CONSERVATION SIGNIFICANCE OF THE PARK

There are many reasons why the Park is important to conservation. Perhaps its most outstanding feature is that it is a nearly intact ecosystem – a rare attribute of any protected area anywhere in the world. It is not wholly intact because approximately 25% of the forest has been destroyed and a number of pest animals and plants are well established. However, major ecological processes have so far been comparatively unaffected by these changes.

The Park encloses the entire range of at least 24 endemic species, more than any other Australian protected area. It is part of the network of habitats of migratory species that Australia must protect under international agreements such as the Japan-Australia Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA).

Most other islands in the Indian Ocean and the South East Asia region are losing habitat to expanding human populations, so that Christmas Island, by and large, assumes an ever-increasing importance. For example the Park contains the last remaining nesting habitat of the Abbott's Booby. The Park also supports the world's largest remaining robber crab population and probably contains the largest and most diverse land crab community anywhere.

The Park provides exceptional opportunities for ecological study, as islands have always played an important role in the development of ecological theory. By regarding islands as habitats of various sizes separated from each other over a wide range of distances, ecologists have gained much insight into the basic processes of dispersal, immigration, competition, adaptation, predation and extinction. These are major factors affecting the distribution and abundance of plants and animals.

Christmas Island provides an invaluable opportunity to observe the long-term processes of immigration, colonisation and extinction, and how these events interact to influence the density of species. Two recent extinctions (the native rats) – and possibly a third (the shrew) – and three recent, successful immigrations and colonisations (the Kestrel, White-faced Heron and the White-breasted Water Hen) have occurred.

The Park is readily accessible and visitors can observe the classic patterns of island colonisation, and their evolutionary implications. The Park presents opportunities for eco-tourism because of its natural values, including its unique rainforest, the variety and number of seabirds, the spectacular red crab migration and the rugged land and seascapes.

There has been some local community interest in pursuing World Heritage listing for Christmas Island. World Heritage listing is supported by the Christmas Island Tourism Association (CITA) which is progressing the concept by seeking information from scientists familiar with the island, and consulting with Environment Australia. Some former residents of the island are also promoting World Heritage listing.

APPENDIX 1 — CHRISTMAS ISLAND NATIVE PLANTS

Although not a complete list of the plant species of the island, this listing provides the scientific names as well as common names and locally used Malay names of plants mentioned in the text. Not all species have a common name or Malay name.

<i>Scientific name</i>	<i>Common name</i>	<i>Malay name</i>
<i>Abutilon listeri</i>	lantern flower	
<i>Acronychia trifoliolata</i>	Aspen	kayu jerouk
<i>Arenga listeri</i>	arenga palm, Christmas Island palm	
<i>Argusia argentea</i>		
<i>Asplenium listeri</i>	spleenwort	
<i>Asystasia alba</i>		
<i>Bauhinia binata</i>	butterfly-leaf tree	
<i>Barringtonia racemosa</i>		putat
<i>Berrya cordifolia</i>		
<i>Brachypeza archytas</i>		
<i>Bruguiera gymnorhiza</i>	orange mangrove	tumu merah
<i>Bruguiera sexangula</i>	mangrove	tumu barau
<i>Calophyllum inophyllum</i>	Alexandrian laurel	nyamplon, bintangor laut, penanga laut
<i>Celtis timorensis</i>	stinkwood	kayu busok
<i>Claoxylon indicum</i>		
<i>Clerodendron inerme</i>	sorcerer's flower	
<i>Colubrina pendunculata</i>		
<i>Commicarpus chinensis</i>	gum fruit	
<i>Cryptocarya nitens</i>		medang
<i>Cycas rumphii</i>	cycad	
<i>Cynometra ramiflora</i>	wrinklepod mangrove	puki anjing
<i>Dendrocnide peltata</i> var. <i>murrayana</i>	stinging tree	pokok jeratang
<i>Dicliptera maclearii</i>		
<i>Dioscorea bulbifera</i>	yam	
<i>Dysoxylum gaudichaudianum</i>		
<i>Entada rheedii</i>	matchbox bean	
<i>Erythrina variegata</i>	coral tree	dedap kayu, dedap
<i>Ficus microcarpa</i>	banyan	jejawi
<i>Flickingera nativitatas</i>		
<i>Grewia insularis</i>		
<i>Gyrocarpus americanus</i>	propeller tree	kayu kolek
<i>Heritiera littoralis</i>	looking glass mangrove	dungun

APPENDIX 1 CONTINUED

<i>Scientific name</i>	<i>Common name</i>	<i>Malay name</i>
<i>Hernandia ovigera</i>	lantern fruit, hearse tree	buah keras laut
<i>Hibiscus tiliaceus</i>	cottonwood, sea hibiscus	baru-baru
<i>Hoya aldrichii</i>	hoya vine	
<i>Ischaemum muticum</i>	awnless duck beak	
<i>Ischaemum nativitatis</i>	Christmas Island duck beak	
<i>Inocarpus fagifer</i>	Tahitian chestnut	gatet
<i>Kleinhovia hospita</i>		laban, temahau
<i>Leea angulata</i>		
<i>Macaranga tanarius</i>	hairy mahang	kayu merah, mahang
<i>Maclura cochinchinensis</i> var. <i>conchinchinensis</i>		
<i>Melochia umbellata</i>		
<i>Nephrolepis multiflora</i>	scruffy sword fern	
<i>Ochrosia ackeringae</i>		
<i>Ophioglossum reticulatum</i>	adder's tongue fern	
<i>Pandanus elatus</i>	pandanus, screw pine	Pandan
<i>Pandanus christmatensis</i>	pandanus, screw pine	Pandan
<i>Pemphis acidula</i>	pemphis	Mentigi, kayu burong
<i>Peperomia rossii</i>		
<i>Phreatia listeri</i>		
<i>Pisonia grandis</i>	Cabbage tree	ampol
<i>Pisonia umbellifera</i>	bird lime tree	jamboe
<i>Planchonella nitida</i>		nyatoh
<i>Pongamia pinata</i>	Indian beach	karanda
<i>Psilotum nudum</i>		
<i>Scaevola taccada</i>	cabbage tree	kayu kankong
<i>Spondias cytherea</i>	great hog plum	kedondong
<i>Sporobolus virginicus</i>	salt couch or coastal rat-tail grass	
<i>Syzygium nervosum</i>		gowok, kelat
<i>Terminalia catappa</i>	sea almond, Indian almond	ketapang
<i>Tristiropsis acutangula</i>		
<i>Vitis flexuosa</i>		
<i>Zehneria alba</i>		
<i>Zeuxine exilis</i>		

APPENDIX 2 — CHRISTMAS ISLAND VERTEBRATES

(e) = species and subspecies endemic to the island.

Native mammals

Murray's pipistrelle bat (e)	<i>Pipistrellus murrayi</i>
Christmas Island flying fox (e)	<i>Pteropus melanotus natalis</i>
Christmas Island shrew (e ?)	<i>Crocidura attenuata trichura</i>
Maclears rat (e,x)	<i>Rattus macleari</i>
bulldog rat (e,x)	<i>Rattus nativitatus</i>

[Note: (x) = have become extinct since settlement. The status of the shrew needs to be confirmed.]

Introduced mammals

black rat (or ship rat)	<i>Rattus rattus</i>
house mouse	<i>Mus musculus</i>
domestic cat	<i>Felis catus</i>

[Note: There are doubtful references to the Pacific rat (*Rattus exulans*) and the brown rat (*Rattus norvegicus*) but these rodents have never been reliably observed.]

Native reptiles

giant gecko (e)	<i>Cyrtodactylus</i> sp. nov.
Christmas Island Gecko or tree gecko (e)	<i>Lepidodactylus listeri</i>
blue-tailed skink (e)	<i>Cryptoblepharus egeriae</i>
forest skink (e)	<i>Emoia nativitatis</i>
foreshore skink	<i>Emoia atrocostata</i>
pink blind snake (e)	<i>Ramphotyphlops exocoeti</i> ¹

Introduced reptiles

south east Asian wolf snake	<i>Lycodon aulicus capucinus</i>
black blind snake	<i>Ramphotyphlops braminus</i> ¹
grass skink	<i>Lygosoma bowringii</i>
Asian house gecko	<i>Gehyra mutilata</i>
barking gecko	<i>Hemidactylus frenatus</i>

[1 The blind snakes are provisionally assigned to *Ramphotyphlops* pending revision of this genus].

Native land and shore birds

Christmas Island Imperial Pigeon (e)	<i>Ducula whartoni</i>
Christmas Island Emerald Dove (e)	<i>Chalcophaps indica natalis</i>
Christmas Island Hawk-owl (e)	<i>Ninox natalis</i>
Christmas Island Goshawk (e)	<i>Accipiter fasciatus natalis</i>
Christmas Island Glossy Cave Swiftlet (e)	<i>Collocalia esculenta natalis</i>
Christmas Island Thrush (e)	<i>Turdus poliocephalus erythropleurus</i>
Christmas Island White-eye (e)	<i>Zosterops natalis</i>
Eastern Reef Egret	<i>Egretta sacra</i>
White Faced Heron	<i>Ardea novaehollandae</i>
White-breasted Water Hen	<i>Amaurornis phoenicurus</i>
Australian Kestrel	<i>Falco cenchroides</i>

Introduced land birds

Java Sparrow	<i>Padda oryzivora</i>
Tree Sparrow	<i>Passer montanus</i>
Feral Domestic Chicken	<i>Gallus domesticus</i>

Native sea birds

Abbott's Booby (e)	<i>Papasula abbotti</i>
Brown Booby	<i>Sula leucogaster plotus</i>
Red-footed Booby	<i>Sula sula rubripes</i>
Christmas Island Frigatebird (e)	<i>Fregata andrewsi</i>
Great Frigatebird	<i>Fregata minor minor</i>
Least Frigatebird	<i>Fregata ariel</i>
Common Noddy	<i>Anous stolidus pileatus</i>
Red-tailed Tropicbird or Silver Bosun	<i>Phaethon rubricauda westralis</i>
White-tailed Tropicbird or Golden Bosun (e)	<i>Phaethon lepturus fulvus</i>

APPENDIX 3 — Native species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (at February 2002)

Plants

-	<i>Tectaria devexa</i> var. <i>minor</i>	E
-	<i>Carmona retusa</i>	V

Mammals

Murray's pipistrelle bat (e)	<i>Pipistrellus murrayi</i>	E
Christmas Island shrew (e)	<i>Crocidura attenuata trichura</i>	E
Maclears rat (e)	<i>Rattus macleari</i>	X
Bulldog rat (e)	<i>Rattus nativitatus</i>	X

[Note: The status of the shrew needs to be confirmed.]

Reptiles

Pink blind snake (e)	<i>Ramphotyphlops exocoeti</i>	V
Green turtle	<i>Chelonia mydas</i>	V
Hawksbill turtle	<i>Eretmochelys imbricata</i>	V
Christmas Island gecko	<i>Lepidodactylus listeri</i>	V

Land and shore birds

Christmas Island Hawk-owl (e)	<i>Ninox natalis</i>	V	J
Eastern Reef Egret	<i>Egretta sacra</i>		M
Christmas Island Goshawk (e)	<i>Accipiter fasciatus natalis</i>	E	MF
Australian Kestrel	<i>Falco cenchroides</i>		MF

Sea birds

Abbott's Booby (e)	<i>Papasula abbotti</i>	E	M	S	J
Brown Booby	<i>Sula leucogaster plotus</i>		M	S	C J
Red-footed Booby	<i>Sula sula rubripes</i>		M	S	C J
Christmas Island Frigatebird (e)	<i>Fregata andrewsi</i>	V	M	S	C J
Great Frigatebird	<i>Fregata minor minor</i>		M	S	C J
Least Frigatebird	<i>Fregata ariel</i>				C J
Common Noddy	<i>Anous stolidus pileatus</i>		M	S	
Red-tailed Tropicbird or Silver Bosun	<i>Phaethon rubricauda westralis</i>			S	
White-tailed Tropicbird or Golden Bosun (e)	<i>Phaethon lepturus fulvus</i>		M	S	C J

Vagrants and migrant birds (incomplete list)

Fork Tailed Swift	<i>Apus pacificus</i>		C J
Ruddy Turnstone	<i>Arenaria interpres</i>	M	C J
Red-necked Stint	<i>Calidris ruficollis</i>	M	C J
Little Ringed Plover	<i>Charadrius dubius</i>	M	C
Red-capped/Kentish Plover	<i>Charadrius spp.</i>	MF	
Oriental Plover	<i>Charadrius veredus</i>	MF	
snipe spp.	<i>Gallinago spp.</i>	MF	C J
Oriental Pratincole	<i>Glareola maldivarum</i>		C J
Black-winged Stilt	<i>Himantopus himantopus</i>	MF	
Yellow Bittern	<i>Ixobrychus sinensis</i>		C
Yellow Wagtail	<i>Motacilla flava</i>		CJ
Little Curlew	<i>Numenius minutus</i>	MF	C
Matsudaira's Storm-petrel	<i>Oceanodroma matsudairae</i>	S	
Australian Pelican	<i>Pelicanus conspicillatus</i>	S	
Great Cormorant	<i>Phalacrocorax carbo</i>	S	
Pacific Golden Plover	<i>Pluvialis fulva</i>	MF	
Grey Plover	<i>Pluvialis squatarola</i>	MF	CJ

Wedge-tailed Shearwater	<i>Puffinus pacificus</i>		J
Wood Sandpiper	<i>Tringa glareola</i>	MF	CJ
Common Greenshank	<i>Tringa nebularia</i>	MF	CJ
Marsh Sandpiper	<i>Tringa stagnatilis</i>	MF	CJ

Additional marine species

In addition to the above, all species in the families Hydrophiidae (sea-snakes), Laticaudidae (sea-snakes), Cheloniidae (marine turtles), Syngnathidae (seahorses, sea-dragons and pipefish), and the species *Dermochelys coriacea* (leatherback turtles).

Key to codes

(e) = species and subspecies endemic to the island.

X Listed under the EPBC Act as Extinct

E Listed under the EPBC Act as Endangered

V Listed under the EPBC Act as Vulnerable

M Listed under the EPBC Act as migratory species (listed under the Bonn Convention, and/or CAMBA and/or JAMBA)

MF Within a family listed under the EPBC Act as migratory (listed under the Convention on the Conservation of Migratory Species of Wild Animals [Bonn Convention])

S Listed marine species under the EPBC Act

C 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 (CAMBA).

J Listed under 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 (JAMBA)

APPENDIX 4 – NATIVE LAND AND SHORELINE CRABS

red crab (e)	<i>Gecarcoidea natalis</i>
purple crab	<i>Gecarcoidea lalandii</i>
blue crab	<i>Cardisoma hirtipes</i>
robber crab	<i>Birgus latro</i>
little nipper	<i>Geograpsus grayi</i>
yellow nipper	<i>Geograpsus crinipes</i>
red nipper	<i>Geograpsus stormi</i>
Jackson's crab*	<i>Sesarma jacksoni</i>
yellow-eyed crab	<i>Sesarma obtusifrons</i>
white stripe crab	<i>Labuanium rotundatum</i>
grapsus	<i>Grapsus tenuicrustatus</i>
mottled crab	<i>Metasesarma rousseauxi</i>
freshwater crab	<i>Ptychognathus pusillus</i>
red hermit crab	<i>Coenobita perlata</i>
tawny hermit crab	<i>Coenobita rugosa</i>
purple hermit crab	<i>Coenobita brevimana</i>
horn-eyed ghost crab	<i>Ocypode ceratophthalma</i>
smooth-handed ghost crab	<i>Ocypode cordimana</i>
sandy rubble crab	<i>Cyclograpsus integer</i>
brown crab	<i>Epigrapsus politus</i>

[Note: *Jackson's crab has not been recorded elsewhere and may be endemic.]

APPENDIX 5 – FISHES OF CHRISTMAS ISLAND

There are many species of fish in and around the waters of Christmas Island. This list contains only those species of fish considered to be of interest to local people. A full list of Christmas Island fish species can be found in Allen and Steene (1988).

English common name	Malay common name	FAMILY NAME Scientific name
CACHARHINIDAE		
silvertip shark	ikan yu	<i>Carcharhinus albimarginatus</i>
grey whaler shark	ikan yu	<i>Carcharhinus amblyrhynchos</i>
oceanic whitetip shark	ikan yu	<i>Carcharhinus maou</i>
tiger shark	ikan yu	<i>Galeocerdo cuvieri</i>
reef whitetip shark	ikan yu	<i>Triaenodon obesus</i>
SPHYRNIDAE		
hammerhead shark	yu hamar	<i>Sphyrna lewini</i>
EXOCOETIDAE		
spotwing flyingfish	ikan terbang	<i>Cypselurus poecilopterus</i>
BELONIDAE		
longtom	ikan todak	<i>Platybelone argalus</i>
SERRANIDAE		
redmouth groper		<i>Aethaloperca rogae</i>
whitelined cod	kerapu cicak	<i>Anyperodon leucogrammicus</i>
peacock cod	kerapu hitam	<i>Cephalopholis argus</i>
orange cod	kerapu nonya	<i>Cephalopholis analis</i>
Japanese cod		<i>Cephalopholis igarashiensis</i>
coral cod	kerapu bintang	<i>Cephalopholis miniatus</i>
sixband cod	kerapu bintang	<i>Cephalopholis sexamaculatus</i>
strawberry cod	kerapu nonya	<i>Cephalopholis spiloparaea</i>
blacktipped cod		<i>Epinephelus fasciatus</i>
wirenetting cod	kerapu cicak	<i>Epinephelus hexagonatus</i>
honeycomb cod	kerapu cicak	<i>Epinephelus merra</i>
comet cod	kerapu morrhua	<i>Epinephelus morrhua</i>
brownback cod		<i>Epinephelus retouti</i>
spotty cod	kerapu cicak	<i>Epinephelus spilotoceps</i>
reef cod	kerapu cicak	<i>Epinephelus tauvina</i>
rededged cod		<i>Gracila albomarginata</i>
harlequin cod		<i>Gracila polleni</i>
deepsea cod		<i>Saloptia powelli</i>
lunartailed cod	kerapu bronok	<i>Variola louti</i>
CORYPHAENDIDAE		
dolphinfish	ikan lumadang	<i>Coryphaena hippurus</i>
CARANGIDAE		
plumed trevally		<i>Alectis indicus</i>
lowly trevally	ikan putih	<i>Caranx ignobilis</i>
black trevally	ikan putih bongkok	<i>Caranx lugubris</i>
bluefin trevally	ikan putih biru	<i>Caranx melampygus</i>
great trevally	ikan putih	<i>Caranx sexfasciatus</i>
tille trevally	ikan putih kayu	<i>Caranx tille</i>
island trevally	ikan coco	<i>Carangoides orthogrammus</i>
mackerel scad	bengol	<i>Decapterus macarellus</i>

English common name	Malay common name	FAMILY NAME Scientific name
rainbow runner golden trevally queenfish blackspotted swallowtail	salaman ikan putih ikan talang ikan cermin	<i>Elegatis bipinnulata</i> <i>Gnathanodon speciosus</i> <i>Scomberoides lysan</i> <i>Trachinotus bailloni</i>
LUTJANIDAE		
smalltoothed jobfish green jobfish ruby snapper pale snapper red bass blackspot snapper yellow-margined seaperch paddletail bluestripe snapper blubberlip snapper midnight snapper black and white snapper blue snapper goldflag jobfish oblique banded snapper	salaman karang salaman karang salaman merah salaman merah ikan merah besar ikan tanther ikan merah ayer dalam ikan nonya tai tow soong tai tow soong ikan lala ayer dalam salaman karang kuning ikan krisi	<i>Aphareus furcatus</i> <i>Aprion virescens</i> <i>Etelis coruscans</i> <i>Etelis radiosus</i> <i>Lutjanus bohar</i> <i>Lutjanus fulviflamma</i> <i>Lutjanus fulvus</i> <i>Lutjanus gibbus</i> <i>Lutjanus kasmira</i> <i>Lutjanus rivulatus</i> <i>Macolor macularis</i> <i>Macolor niger</i> <i>Paracaesio sordidus</i> <i>Pristipomoides auricilla</i> <i>Pristipomoides zonatus</i>
HAEMULIDAE		
dusky sweetlips oriental sweetlips	kerapu belang	<i>Plectorhinchus gibbosus</i> <i>Plectorhinchus orientalis</i>
LETHRINIDAE		
large-eyed seabream	ikan gigi orang	<i>Monotaxis grandoculis</i>
MULLIDAE		
pallid goatfish yellowstripe goatfish dot and dash goatfish doublebar goatfish oldsaddle goatfish banded goatfish	ikan jangut kuning ikan jagut kuning ikan jangut ikan jangut belang ikan jangut ikan jangut	<i>Mulliodes flavolineatus</i> <i>Mulliodes vanicolensis</i> <i>Parupeneus barberinus</i> <i>Parupeneus bifasciatus</i> <i>Parupeneus cyclostomus</i> <i>Parupeneus multifasciatus</i>
SPHYRAENIDAE		
great barracuda	ikan alo alo	<i>Sphyraena barracuda</i>
LABRIDAE		
giant Maori wrasse humphead wrasse thicklip wrasse surge wrasse peacock wrasse	ikan becok ikan becok ikan becok ikan lecok lecok ikan becok	<i>Cheilinus undulatus</i> <i>Coris aygula</i> <i>Hemigymnus melapterus</i> <i>Thalassoma purpuraceum</i> <i>Xyrichtys pavo</i>
GEMPYLIDAE		
conejo		<i>Promethichthys promoethus</i>
SCOMBRIDAE		
wahoo mackerel tuna dogtooth tuna skipjack tuna yellowfin tuna		<i>Acanthocybium solandri</i> <i>Euthynnus affinis</i> <i>Gymnosarda unicolor</i> <i>Katsuwonis pelamis</i> <i>Thunnus albacares</i>
ISTIOPHORIDAE		

English common name	Malay common name	FAMILY NAME Scientific name
sailfish		<i>Istiophorus platypterus</i>
blue marlin		<i>Makaira mazara</i>
striped marlin		<i>Tetrapurus audax</i>

**CHRISTMAS ISLAND
NATIONAL PARK
MANAGEMENT PLAN**

PART 2 - CHRISTMAS ISLAND NATIONAL PARK MANAGEMENT PLAN

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Christmas Island National Park

Management Plan

INTRODUCTORY PROVISIONS

1. Citation

This Management Plan may be cited as the Christmas Island National Park Management Plan.

2. Commencement and termination

This Management Plan has been prepared for approval under section 370 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Plan will cease to have effect seven years after commencement, unless it has already been revoked or replaced with a new plan.

3. Interpretation

‘Christmas Island National Park’ means the area declared under section 7 of the *National Parks and Wildlife Conservation Act 1975* to be the Park of that name and continued as a Commonwealth reserve under the EPBC Act by the *Environmental Reform (Consequential Provisions) Act 1999*;

‘CINPAC’ means the Christmas Island National Park Advisory Committee;

‘CIP’ means the company CI Phosphates Pty Ltd (formerly named Christmas Island Phosphates Pty Ltd);

‘CIRRP’ means the Christmas Island Rainforest Rehabilitation Program;

‘Director’ means the Director of National Parks under section 514A of the EPBC Act;

‘DOTARS’ means the Department of Transport and Regional Services;

‘EPBC 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’ means regulations made under the EPBC Act;

‘Gazette’ means the Commonwealth of Australia Gazette;

‘IUCN’ means the World Conservation Union (formerly known as the International Union for the Conservation of Nature and Natural Resources).

‘Park’ means Christmas Island National Park;

‘Parks Australia’ means that part of Environment Australia (the Commonwealth Department of Environment and Heritage) that assists the Director in performing the Director’s functions under the EPBC Act.

‘PRL’ means Phosphate Resources Limited, the parent company of CIP;

‘SOCl’ means the Shire of Christmas Island, previously known as the Christmas Island Shire Council (CISC).

4. Legislative Context of the Plan

The Park was proclaimed under the *National Parks and Wildlife Conservation Act 1975* (the Parks Act) which was replaced by the EPBC Act on 16 July 2000. The Park continues in existence as a Commonwealth reserve under the EPBC Act pursuant to the *Environmental Reform (Consequential Provisions) Act 1999*, which deems the Park to have been declared for the following purposes:

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

Administration and management of the Park are the function of the Director under the EPBC Act (s.514B).

The EPBC Act requires the Director to prepare management plans for a park. When prepared, a plan is given to the Minister for the Environment and Heritage for approval. A management plan is a “disallowable instrument” and when approved must be tabled in each House of the Commonwealth Parliament. Either House of the Parliament may disallow a plan. A management plan for a Commonwealth reserve has effect for seven years, subject to being revoked or amended earlier by another management plan for the reserve.

The EPBC Act requires that the Director must exercise the Director’s powers and perform the Director’s functions to give effect to a management plan; and the Commonwealth and Commonwealth agencies must not perform functions or exercise powers inconsistently with a management plan (s.362).

Under the EPBC Act (s.367) a management plan for a Commonwealth reserve must provide for the protection and conservation of the reserve and must assign the reserve to an IUCN protected area category (see section 5 below).

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

- the regulation of the use of the Park for the purpose for which it was declared; and
- the protection of the special features of the Park, including objects and sites of biological, historical, palaeontological, archaeological, geological and geographical interest; and
- the protection, conservation and management of biodiversity and heritage within the Park; and
- the protection of the Park against damage; and
- Australia’s obligations under agreements between Australia and one or more other countries relevant to the protection and conservation of biodiversity and heritage.

The EPBC Act (s.354) prohibits certain actions being taken in Commonwealth reserves except in accordance with a management plan (see section 6.6 below).

Mining operations are also prohibited in Commonwealth reserves unless the Governor-General has approved them and they are carried out in accordance with a management plan (s.355).

The EPBC Regulations regulate a range of activities in Commonwealth reserves, such as camping, use of vehicles and vessels, littering, commercial activities, commercial fishing, recreational fishing and research. The Regulations are applied by the Director, 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 Act 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.

As noted earlier, the Park was declared under the Parks Act, which was replaced by the EPBC Act on 16 July 2000. On that day the EPBC Act also replaced four other Commonwealth Acts. They were the *Environment Protection (Impact of Proposals) Act 1974*, *Endangered Species Protection Act 1992*, *Whale Protection Act 1980* and *World Heritage Properties Conservation Act 1983*. On 11 January 2002 the EPBC Act also replaced the *Wildlife Protection (Regulation of Exports and Imports) Act 1982*. These other parts of the EPBC Act may also be relevant to the management of the Park and the taking of actions in and in relation to the Park.

In particular, actions that would or are likely to have a significant impact on a specified matter of “national environmental significance”, or environmentally significant actions involving Commonwealth land, will be subject to the assessment and approval provisions of Chapters 2 to 4 of the EPBC Act (see section 6.3 of this Plan).

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. Part 13A regulates the export and import of wildlife and gives effect to Australia’s obligations under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Civil and criminal penalties may be imposed for breaches of the EPBC Act.

Copies of the EPBC Act may be purchased from Commonwealth government bookshops or the Act may be viewed on the internet at

http://www.austlii.edu.au/au/legis/cth/consol_act/epabca1999588/ or

<http://scaleplus.law.gov.au/>

The Regulations may be viewed on the internet at

http://www.austlii.edu.au/au/legis/cth/consol_reg/epabcr2000697/

4.1. IUCN Category

The EPBC Act (s.367) requires that a management plan for a Commonwealth reserve must assign the reserve to one of the following IUCN protected area categories:

- strict nature reserve (IUCN category I(a));
- wilderness area ((IUCN category I(b));
- national park (IUCN category II);
- natural monument (IUCN category III);

habitat/species management area (IUCN category IV);
protected landscape/seascape (IUCN category V); or
managed resource protected area (IUCN category VI).

The Park is hereby assigned to the IUCN category national park (IUCN category II).

The IUCN defines a national park as a natural area of land and/or sea, that is designated to: protect the ecological integrity of one or more ecosystems for present and future generations; exclude exploitation or occupation inimical to the purposes of designation of the area; and, provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible.

The EPBC Act identifies the characteristics of a Commonwealth reserve assigned to the IUCN category of national park as an area of land, sea or both in natural condition. As described in section 8 of the "Description of Christmas Island and the National Park", the EPBC Regulations prescribe Australian IUCN reserve management principles for the IUCN category "national park", with which the EPBC Act (s.367(3)) requires this Plan to be consistent.

5. Management mechanism

5.1 Role and function of the Director

The functions of the Director are:

- (a) to administer, manage and control Commonwealth reserves and conservation zones; and
- (b) to protect, conserve and manage biodiversity and heritage in Commonwealth reserves and conservation zones; and
- (c) to co-operate with any country in matters relating to the establishment and management of national parks and nature reserves in that country; and
- (d) to provide, and assist in the provision of, training in the knowledge and skills relevant to the establishment and management of national parks and nature reserves; and
- (e) to carry out alone or in co-operation with other institutions and persons, and to arrange for any other institution or person to carry out, research and investigations relevant to the establishment and management of Commonwealth reserves; and
- (f) to make recommendations to the Minister in relation to the establishment and management of Commonwealth reserves; and
- (g) to administer the Australian National Parks Fund; and
- (h) any other functions conferred on the Director under any other Act; and
- (i) to do anything incidental or conducive to the performance of any of the functions mentioned in paragraphs (a) to (h) (inclusive).

As noted in section 4, the Director is required to manage the Park to give effect to this Plan.

The Director is assisted in performing the functions and exercising the powers of the Director under the EPBC Act in relation to the Park by the Government Conservator and other Parks Australia staff, to whom the Director may delegate functions and powers under the EPBC Act. Parks Australia staff may also be appointed as wardens and rangers and have specific powers of enforcement under the EPBC Act both within and outside the Park. References in this Plan to Parks Australia means Parks Australia acting for the Director (unless the context otherwise requires).

5.2 Christmas Island National Park Advisory Committee (CINPAC)

CINPAC is a non-statutory body comprised of the Director of National Parks and representatives of a cross section of the Christmas Island Community who meet at least once a year and whose terms of reference are to:

- (a) advise the Government Conservator on effective implementation of the Management Plan for the Park; and
- (b) advise SOCI and the Director on matters relevant to the Park.

There will be at least one review of CINPAC during the life of this Plan.

5.3 Environmental assessment and approval

Under the EPBC Act an action that has, will have or is likely to have a significant impact on a matter of “national environmental significance” will *prima facie* be subject to the approval provisions in Chapters 2 and 4 of the Act. The matters of national environmental significance are:

- World Heritage properties;
- Ramsar wetlands of international importance;
- listed threatened species and communities;
- listed migratory species;
- nuclear actions;
- the Commonwealth marine environment (environmentally significant actions in or affecting Commonwealth marine areas); and
- such further actions as are prescribed by the EPBC Regulations.

Hosnie’s Spring in the Park is a Ramsar wetland (see section 21) and a number of listed threatened and migratory species under the EPBC Act occur in the Park (see Appendix 3 to the Description of Christmas Island and the National Park). The Marine Zone of the Park is a Commonwealth marine area for the purposes of the EPBC Act.

In addition actions taken on Commonwealth land that have a significant impact on the environment, or actions taken outside Commonwealth land that significantly affect the environment on Commonwealth land, will also be triggers for the assessment and approval regime. The Terrestrial Zone of the Park is Commonwealth land for the purposes of the EPBC Act.

The taking of an action in the Park that will or is likely to have a significant impact on the environment, or the taking of an action outside the Park that will or is likely to have a significant impact on the environment in the Park, will be subject to the assessment and approvals provisions of the EPBC Act. The EPBC Act (s.528) defines ‘the environment’ as ‘ecosystems and their constituent parts including people and communities ... [and their] social, economic and cultural aspects’.

Responsibility for compliance with the EPBC Act lies with persons taking relevant “controlled” actions. A person proposing to take action that the person thinks may be or is a controlled action must refer the proposal to the Minister for the Environment and Heritage for the Minister’s decision whether or not the action is a controlled action. Civil and criminal penalties may be imposed for breaches of the EPBC Act.

5.4 Operational Plans and Management Strategies

During the life of the Plan, the Director may develop operational plans and management strategies for carrying out prescriptions in the Plan dealing with conservation and Park management issues for both the marine and terrestrial areas. These conservation and management issues include but are not limited to:

- (a) management of individual species (animal or plant), including native and introduced species;

- (b) management of a number of species and/or communities;
- (c) the collecting, taking or harvesting of a species;
- (d) unplanned or unforeseen events or actions which arise during the life of the Plan; or
- (e) managing visitor access and public safety at specific locations.

Operational plans and strategies will be consistent with this Plan and will assist in its implementation, and will be prepared in the following manner:

- (f) scoping in consultation between Park staff and the local community;
- (g) preparation of a draft operational plan or strategy;
- (h) if the operational plan or strategy will or will be likely to have a significant environmental impact, assessment of the impact;
- (i) consultation with key interest groups, experts, Advisory and/or Consultative Committees;
- (j) invitation to comment and consideration of public comments;
- (k) review of the draft operational plan or strategy in light of consultation, comments and relevant environmental impact assessment; and
- (l) consideration of the operational plan or strategy by CINPAC.

5.5 Operations or activities that may be carried out in the Park

Operations or activities that may be carried out in the Park shall generally be limited to those operations or activities which are consistent with the management objectives and prescribed management actions of the Management Plan, and with the Park's assigned IUCN category listing – national park (IUCN category II). Operations and activities that may be carried out must have nil or minimal environmental impact.

5.6 Operations or activities that are prohibited or regulated in the Park

The EPBC Act (s.354) 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.

6. Technical audit

Towards the end of the currency of this Plan the Director shall form a technical audit committee with the following terms of reference to:

- (a) consider each prescribed management action and determine whether or not it was carried out;
- (b) evaluate the performance of each prescribed action in relation to the objective or objectives it was intended to serve;
- (c) determine the cause, in the case of any prescribed action that was not implemented, or which failed to achieve the desired outcome;
- (d) report the results of (a), (b) and (c) above to the Director together with an overall assessment of the delivery of the Management Plan in relation to its objectives; and

- (e) recommend to the Director, in the light of the current Plan's performance, any changes to the objectives and prescribed actions that should be considered during the preparation of the next plan.

OBJECTIVES AND PRESCRIBED MANAGEMENT ACTIONS

As provided in section 4.1 above, the Park has been divided into two zones - terrestrial and marine, because there are different management requirements for these two areas.

7. Terrestrial Vegetation

7.1 Background

Christmas Island's vegetation is like no other on earth due to its endemic plants and animals and the presence of a large population of land crabs and seabirds. The flora assemblage has developed largely due to the influences of warm temperatures, high rainfall, isolation, fauna, and geological history. The natural vegetation on Christmas Island can be categorised into main community types: Primary rainforest, Marginal Rainforest, and Scrub Forest (also referred to as open forest and vine forest). Some other types of natural vegetation are restricted to smaller areas. These include the Coastal Fringe Forest (also referred to as Shore Cliff and Spray Zone Vegetation), and areas with surface water (Hosnies Springs, the Dales, and parts of the Eastern Terraces).

The Park contains most of the plateau rainforest, south, west and north coast terrace forest, and associated inland limestone scree slopes and cliffs, as well as some of the east coast terrace forest.

There are approximately 450 plant species on Christmas Island of which 18 are endemic, approximately 126 species are not known to occur anywhere else in Australia and its Territories, and 28 species are considered rare or threatened.

Approximately 180 plant species have become established on the island after being introduced by humans over the last century. About 80 of these exotic species are now categorised as noxious weeds, threatening species, or common alien invaders of natural areas on mainland Australia, Pacific islands and tropical America.

Several exotic tree, shrub and vine species have established in the settled areas and disturbed areas throughout the island. So far, intact rainforest has not been invaded but forest margins have been colonised by exotics such as coffee bush, *Clausena excavata*, *Spathodia canpanulata* and *Tecoma stans*. The threats posed by these plants are attrition of the forest edges, and/or the interruption of natural succession. Some exotic species, such as poinciana and candle nut which were widely planted in previous rehabilitation operations, require control to prevent them spreading in disturbed areas.

Approximately 25% of the island's rainforest has been cleared to mine phosphate and build the associated infrastructure. As a result, present day management of vegetation consists largely of efforts to revegetate old mined areas, and to an increasing degree, controlling the spread of introduced species that have gained a foothold in forest edges, on disturbed ground, and in previously rehabilitated sites.

Typically, old mining fields are predominantly bare limestone pinnacles with pockets of soil and humus supporting sparse vegetation. Mining companies unsuccessfully attempted to rehabilitate some of these areas. Parts of fields 19, 19a, 20, 21, 22N, 22C, 22S, 23, 25, 27, and LB4 have been rehabilitated by the Christmas Island Rainforest Rehabilitation Program (CIRRP), which has conducted rainforest rehabilitation on Christmas Island since 1989.

Some 19.9 square kilometres (15%) of the island remain within the current mining lease. Many of these lease areas are surrounded by the Park and are likely to be worked out in the next 5–10 years. After mining, some of these mining leases may be handed over to Parks Australia for rehabilitation and incorporation into the Park.

Other issues in vegetation management include the effects of introduced animals, especially the yellow crazy ant, and the edge effects of roads and clearings.

Rehabilitation

In 1989 the CIRRP was launched with the main objective to preserve the Abbott's Booby, an endangered seabird that nests only in the canopy of the island's rainforest and nowhere else in the world. The main concern was the effect of windshear at the edge of these clearings on Abbott's Booby nesting sites in the surrounding rainforest. It was thought that the windshear caused by these clearings created extra turbulence in the surrounding rainforest canopy, resulting in unfledged Abbott's Booby chicks being blown from their nesting sites. To reduce windshear, the CIRRP planted vegetation in these clearings with the expectation that a new rainforest would be created, thus reducing this wind turbulence.

Recognising that the world's tropical rainforests are disappearing at an alarming rate, the aim of the CIRRP has now broadened to include not only the welfare of the Abbott's Booby, but to address this need to restore Christmas Island's tropical rainforest on sites where it once occurred. Approximately 3300 hectares of rainforest on Christmas Island has been cleared over the last century, with approximately 200 hectares having been rehabilitated with varying levels of success. The prioritisation of sites to be rehabilitated by the CIRRP is still based largely on areas where there are high densities of Abbott's Booby nests. Some of the old minefields will remain un-rehabilitated for heritage purposes while others may be available for urban, industrial, recreational, or agricultural developments. Funding for the CIRRP comes from a conservation levy paid to the Commonwealth Government by the current mining company. With the current mining company now responsible for rehabilitating all land that it disturbs, the CIRRP is concentrating on rehabilitating regions of old minefields disturbed by previous mining companies, and that the current mining company will not disturb.

Reafforestation practice was originally based on guidelines proposed in a study commissioned to advise on the rehabilitation of mine sites (Carew-Reid 1987). This gave the highest priority to areas adjoining Abbott's Booby nest sites in the central and western sections of the island to try to lessen wind-induced mortality in unfledged Booby chicks. Subsequent reports (Tracey 1991) supported the Carew-Reid report but a 1996 CSIRO review was critical of the CIRRP operations. To address these concerns and improve the effectiveness and efficiency of rehabilitation operations on Christmas Island, new rehabilitation methods were recommended in 2000 by the Centre for Mined Land Rehabilitation, experts in rainforest rehabilitation based at the University of Queensland.

In late 2000, the CIRRP commenced implementation of these expert recommendations. Some of the most significant changes taking place within the CIRRP as a result include: lower density plantings, using more native species, greater mechanisation of operations, shorter planting season, direct-seeding on some difficult sites, increased fertiliser application rates, less earthworks per unit area, specific species-site matching, the disuse of exotic species, and greater post-planting maintenance. Ultimately, the objective of these recommendations is to make the CIRRP more cost-effective and successful, allowing an increased area of land to be rehabilitated each year.

Trees for the CIRRP are propagated at the Parks Australia nursery, located near the Parks Australia office at Drumsite. Supported by the conservation levy, five staff members are employed to operate the nursery and to plant, maintain and monitor the trees planted in the field.

The fields listed below are indicated in Figure 4 in "A Description of Christmas Island and the National Park", which is a map of rehabilitation sites and mining fields.

Table 1. Areas requiring rehabilitation and work completed

Mining Fields	Area of Field (ha)	Area Rehabilitated (ha)	Date of Rehab	Land tenure
Field 15	43.0			ML
Field 18D	19.42			ML
Field 18N	15.48			ML
Field 19	8.0	8.0	1991	NP
Field 19A	20.0	18.0	1994/5	NP
Field 20W	30	20	2001	ML
Field 20C	21.0	10.0	1980/99	NP
Field 21	39.0	30.0	1992–98	NP
Field 22C	11	11	1984,90,97	NP
Field 22N	92	5	1998/99	NP & ML
Field 22S	36.0	36.0	1990–1993, 1998/99	NP
Field 23	50.9	5.0	1998	NP & ML
Field 23A	14	2	1984	NP
Field 23B	11	10	1984,95,96,98	NP & ML
Field 25	55.36			ML
Field 25/4	11.0	10	1985,90,91	NP
Field 26	33.2			ML
Field 27	85.78	5.0	1998	ML
LB4	24.0	18.0	1994–97	NP

Note: ML = Mining Lease; NP = National Park.

The overriding objective of the CIRRP is to deliver both efficient and effective rainforest rehabilitation in a ‘whole of island’ approach which will treat as many high priority areas as possible before the closure of the mine and cessation of the conservation levy. To achieve this, Parks Australia, the Christmas Island Administration, PRL and SOCI are working cooperatively to identify future land use options.

Weed Management

One of the principal challenges in the future management of vegetation on Christmas Island is the control of exotic plants.

The threats posed by these plants include: aggressive competition with native species for water and nutrients, the displacement of native species, the interruption of natural succession, and the alteration of natural ecological processes.

Many exotic trees, shrubs and vines are established in disturbed areas throughout the island. So far, most intact rainforest has not been invaded, but forest margins and disturbed areas have been colonised by exotics such as *Aleurites moluccana* var. *molucana*, *Adenantha pavonia*, *Barringtonia asiatica*, *Spathodea campanulata*, *Delonix regia*, *Pterocarpus indicus*, *Muntingia calabura*, *Tecoma stans*, *Carica papaya*, *Psidium guajava*, *Mikania micrantha*, *Ricinus communis*, *Tithonia diversifolia*, *Clausena excavata*, *Antigonon leptopus*, *Paederia foetida*, *Macroptilium atropurpureum*, *Ipomoea* spp., *Stachytarpheta jamaicensis*, *Cordia curassavica*, *Celosia argentea*, *Leucaena leucocephala*, *Mimosa invisa*, and *Mimosa pudica*.

As a result of prescriptions in the previous Management Plan, a consultant was contracted to produce a report on the environmental weeds and exotic plants of Christmas Island (Swarbrick 1997).

Building on the Swarbrick report, a Weed Management Strategy for Christmas Island 1999– 2003 (Hart 1998) was prepared. Weed control work commenced during in 1999 in accordance with the Weed Management Strategy, and will continue for the life of this Plan.

Most weed control work currently takes place in old mine fields about to be rehabilitated, or areas that have been rehabilitated. Many of these sites were unfortunately planted with exotics under previous rehabilitation programs and will require many years of weed suppression before the exotic populations are under control.

An eradication program has been undertaken in the vicinity of Field 23 and in the NE end of the island to remove *Clausena excavata* infestations. Some exotic species such as *Muntingia calabura*, *Leucaena leucocephala*, *Mimosa invisa* and *Mimosa pudica* are in such large numbers that control of many infestations is not feasible with current resources. These species are currently only being removed where they pose a threat to rehabilitated areas. Satellite infestations of all other exotic species are continually being identified and eliminated throughout the Park.

As further information is collected on weed biology and control methods, the strategy will progress from control to eradication of identified priority species.

Mining and Removal of Stockpiles

Because phosphate mining on the island was winding down, mining fields within the Park's outer boundaries were excluded from the Park to allow them to be worked out, subject to environmental controls designed to prevent damage to the Park. The mining company leases these excluded areas from the Commonwealth, and once mined out may be incorporated into the Park. Whilst mining will not be permitted in the Park, some stockpiles of topsoil or phosphate material inside the Park (or which beset the Park boundaries) may be considered for removal subject to the prescriptions of 7.3 below.

7.2 Objectives

The objectives for the management of vegetation are to:

- (a) preserve undisturbed native vegetation in as near natural a state as possible;
- (b) revegetate mined and disturbed areas through the CIRRP;
- (c) prevent the spread of exotic plants that are still in low enough numbers to be controlled with existing resources; and
- (d) prevent new introductions to the island.

7.3 Prescriptions

The following management actions are prescribed to meet the objectives in subsection 7.2.

- (a) No further clearing of native vegetation shall be allowed except: in accordance with 7.3(g), to maintain existing roads and tracks, enable rehabilitation, reach the site of an emergency or enable new access or other facilities that have been approved by the Director after due consultation with the CINPAC.
- (b) The CIRRP shall continue as currently scheduled with annual reviews of priorities and techniques until alternative management arrangements are established by agreement between the parties.
- (c) Advice and assistance will be given to quarantine authorities and prospective importers on the importation of exotic plants or plant material. Park staff will work closely with Quarantine Officers to prevent further introductions. A quarantine list of prohibited animals and plants not permitted into the Territory under the Christmas Island Quarantine Ordinance is at Schedule 5.

- (d) Further introductions through rehabilitation plantings of exotic plants (and their parts e.g. seeds, cuttings, leaves and any propagative material) shall not be allowed.
- (e) A plan for management of rare and threatened plants on the island shall be developed. Conservation research, management and recovery actions shall be carried out to maximise the chances of survival of plant species listed under Part 13 of the EPBC Act.
- (f) Weed management shall be carried out in accordance with the Weed Management Strategy for Christmas Island 1999–2003 or its successor.
- (g) Stockpiles of phosphate that are either wholly inside the Park or straddling the Park boundaries may be removed from the Park provided:

- the activity will benefit the management of the Park, the conservation of the Park's wildlife and/or the CIRRP, and;
- the activity will not have a significant environmental impact on the Park.

Removal of stockpiles may be undertaken under a contract, license or permit granted by the Director and in accordance with the EPBC Act. If removal is a "mining operation" within the meaning of s355 of the EPBC Act, approval of the Governor-General will be required. Any such removal will be carried out so as to avoid or minimise any adverse impact on the Park or its wildlife and the sites will be rehabilitated with native species.

- (h) Rehabilitation for each site will reflect best practice.

Table 2. Christmas Island mining fields – current rehabilitation priorities

Mining Field	Land Tenure	Mine Lease (ML)	Rehab Priority
Field 20 West	Mine Lease	ML110	1
Field 20 East	Mine Lease	ML 109	2
Field 18D	Mine Lease	ML 108	3
Field 27	Mine Lease	ML 138	4
500 foot Quarry	Mine Lease	ML 316	5
Field 23	National Park/Mine Lease	ML 116, 117	6
Field 23A	National Park		7
Completion of Field 21	National Park/Mine Lease	ML 111, 112, 113	8
Field 18 North	Mine Lease	ML 105	9
Field 18 South	Mine Lease	ML 106 (part only)	10
Field 25 South	National Park/Mine Lease	ML 139	11
ML 107	Mine Lease	ML 107	12
Field 17 North	National Park/Mine Lease	ML 101	13
LB7 North	Mine Lease	ML 132	14
Field 26	National Park/Mine Lease	ML 140	15
LB1	Mine Lease	ML 123	16
LB2A	Mine Lease/vacant crown land	ML 130	17
RH1 and RH2	Mine Lease	ML 121 and 124	18

[Note: The following sites and priorities have been selected under the CIRRP. The fields mentioned are indicated in Figure 4 in “A Description of Christmas Island and the National Park”].

8. Terrestrial and Anchialine Animals

8.1 Background

The current status of the conservation of native animals on Christmas Island has been determined principally by five types of human activity – settlement, mining, hunting, fishing and the introduction of exotics. Mining resulted in the loss of approximately a quarter of the primary rainforest habitat, which was accompanied by corresponding declines in the populations of many forest animals in those areas. No further clearing of primary native vegetation that would result in habitat loss will be allowed, and cleared areas are being revegetated so that habitat loss no longer threatens long-term conservation.

Although sea birds were hunted in the early years, this no longer occurs. Islanders in the recent past habitually took certain terrestrial animals for food, principally imperial pigeons, flying foxes, blue crabs and robber crabs. Red crabs were used as chicken feed. Rapid depletion in imperial pigeon numbers due to hunting caused concern as early as 1904 (Crome 1978). As far back as 1949 it was reported that imperial pigeons had become uncommon and were virtually non-existent in the vicinity of the settlements (House of Representatives Standing Committee on Environment and Conservation 1974). Their numbers only increased once the species was protected. Local residents observed a depletion in numbers of blue crabs before harvesting was prohibited, probably because this species has a very limited natural distribution. All accessible species of seabirds such as Brown Boobies, Red-footed Boobies and Frigatebirds were hunted extensively. While habitat destruction through settlement and mining would have greatly affected seabird populations, this would have been exacerbated by extensive hunting.

The red crab (*Gecarcoidea natalis*) is by far the most obvious of the land crabs found on Christmas Island. At the beginning of the wet season (usually October/November), most adult red crabs suddenly begin a spectacular migration from the forest to the coast, to breed and the females release

eggs into the sea. Breeding is usually synchronised island wide. Masses of crabs gather into broad “streams” as they move toward the coast, climbing down high inland cliff faces, and over or around all obstacles in their way, following routes used year after year for both downward and return migrations. Thousands of adults and young are crushed by vehicles while crossing roads.

To raise awareness about red crab protection and to reduce the number of crabs killed by vehicles during the red crab migration, a Red Crab Migration Management Plan has been developed by Parks Australia in liaison with key local stakeholders. Specifically designed ‘crab crossings’ have been constructed (with more planned) in roads which cross main crab migration paths. In addition, some roads are closed at peak migration times. Community education, liaison and monitoring are key features of the Red Crab Migration Management Plan.

On 16 October 1992 Part 3 of the National Parks and Wildlife Regulations came into operation and provided for the protection of all native animals and plants in Christmas Island and the territorial sea (12 nautical miles) around the Island, outside the Park, subject to any declaration made by the Minister declaring a species to be unprotected. Part 9 of the EPBC Regulations (which have replaced Part 3 of the National Parks and Wildlife Regulations) protects species that are specified in Schedule 12 to the Regulations, outside the Park. Under Part 9 all native terrestrial animals, except the robber crab when it is taken in certain very restricted circumstances, are protected outside the Park.

Introduced animals

The most insidious threat to the long-term conservation of native animals is that posed by the introduction, both inadvertently and deliberately, of exotic plants (see under *Weed Management* in section 8 above) and animals. Animals whose invasion of the island is thought to be directly linked with human occupation since 1860 include ants, two snakes, two geckoes, a skink, two sparrows, two rodents, a freshwater fish and a snail (see Table 3). Two domestic animals – chickens and cats – have gone feral.

The greatest current threat to the island ecosystem by an exotic is from the invasive ant species *Anoplolepis gracilipes*, commonly called the ‘yellow crazy ant’. It is a ‘tramp ant’ species that was accidentally introduced to the island some time between 1915 and 1934. These ants have the ability to form multi-queened supercolonies, in which the ants occur at very high densities. Dramatic increases in supercolony formation began in the mid-late 1990s at several widespread locations. The ant sustains high population densities on all available surfaces and red crabs, robber crabs, blue crabs, reptiles and leaf litter fauna are severely impacted, sometimes to the point of local extinction in areas where supercolonies become established. The long-term effects are difficult to predict, but the absence of the land crabs in some areas has already begun to change the vegetation profile of the forest. Following an island-wide ant survey conducted May-August 2001, it is estimated that 24.4% of the natural forest area has been infested with crazy ants to supercolony density. Red crab burrows were also counted during the survey. From this data, it is estimated that the red crab population is currently in the range 40-50 million. The species' former population is not known with any great degree of certainty, but a decline of 25% in the red crab population is considered conservative, and may be as high as 40-50%, as a direct result of the establishment and spread of the yellow crazy ant over the last six years.

The population decline of other land crab species, ground dwelling reptiles and leaf litter fauna has not been quantified however their absence from infested areas is clearly noticeable. Parks Australia, in association with the Centre for the Analysis and Management of Biological Invasions (CAMBI) at Monash University, have jointly undertaken a research and control program to better understand the ecology of the ants, and develop, trial and implement suitable control techniques to manage crazy ant populations. The black rat or ship rat (*Rattus rattus*) is thought to be a severe threat to native animals, including young birds and reptiles. It is a highly adaptable species and has invaded all island habitats.

Feral cats (*Felis catus*) are widespread across all terrestrial island habitats. Although few quantitative data exist on their impact on native species, cats are believed to pose a severe threat as they prey on a wide range of animals including insects, reptiles, birds and bats. They also prey on other introduced species. An ongoing integrated program of control involving Parks Australia, SOCI and the Christmas Island Administration would be desirable. Since 1997 a de-sexing program for dogs and cats has been conducted by visiting veterinarians. Recently this program has been formalised and a contracted veterinarian will visit the island twice yearly to conduct animal clinics. This program is funded and supported by Parks Australia, the Christmas Island Administration and SOCI.

The South-East Asian wolf snake (*Lycodon aulicus capucinus*) was accidentally introduced to the island around 1987 in cargo from the north, and densities in the built up areas were relatively high until about 1993. Since then anecdotal evidence suggests that their densities have declined. However, they now occur on the fringes of primary rainforest and in the Central Plateau area. The increase in the range of the wolf snake may have contributed to the decline in numbers of some of the native reptiles and the pipistrelle bat. Further research is required to understand its potential impact and possible control.

The introduced giant African snail (*Achatina fulica*) which has been observed feeding on a wide variety of plants on the island, has spread into the Park and may have moved into the rainforest. Although its impact is unknown, scientists have expressed concern about the potential environmental damage it could cause. The presence of land crabs appears to restrict the distribution and abundance of the snails but now that the yellow crazy ant has removed crabs from some areas the potential for this animal to expand its range now exists.

In Table 3 below, exotic wild and feral domestic animals are rated according to their perceived danger to native animals. This listing is provisional and is intended as a starting point for long-term studies to assess the feasibility of eradicating one or more of these pests.

Table 3. Threat rating of Exotic Wild and Feral Domestic Animals

Animal	Perceived level of threat	Action (at Feb 2002)
<i>Exotic wild animals</i>		
yellow crazy ant (and all introduced ants)	extreme	baiting, monitoring, research
black rat	severe	none at present
house mouse	mild	none at present
Java Sparrow	mild	none at present
Tree Sparrow	mild	none at present
parrots (individuals)	none	none at present
wolf snake	severe	none at present
blind snake	none	none at present
house gecko	mild	none at present
barking gecko	mild	none at present
skink	mild	none at present
giant African snail	potentially severe	monitoring, research
terrapins	to be determined	none at present
aquatic vertebrates	to be determined	none at present
<i>Feral domestic animals</i>		
cat	severe	shooting, trapping

chicken	mild	shooting, trapping
dog	to be determined	shooting, trapping

[**Note:** Research project priorities on introduced animals are listed in section 15]

Quarantine

The control and eradication of existing exotic wildlife is difficult and expensive, and further introductions are probable. An effective quarantine program helps to prevent unwanted introductions of exotic species to the island.

A quarantine officer has been operating on the island since July 1994. This position is funded by the Department of Transport and Regional Services (DOTARS) through the Western Australian Quarantine and Inspection Service (WAQIS). DOTARS and WAQIS are currently reviewing the existing quarantine arrangements.

Formal quarantine procedures are in place to control the import of exotic animals, plants, and diseases. Parks Australia co-operates with WAQIS, Australian Customs and the Christmas Island Administration to help prevent the accidental introduction of pest species, through checking imported goods and disposing of potentially harmful animals, and will continue to provide ongoing support where required.

Anchialine Systems

The anchialine system on Christmas Island is of great significance and, owing to the location of the best known area, potentially vulnerable to future developments. The known number of anchialine sites on Christmas Island is small and the number in the National Park is unknown. The incorporation of a small part of this area (around Runaway Cave to the coast road) into the National Park would be warranted.

Perennially Wet Areas

Although small in number, these areas are habitat for a number of species and are integral to the island's ecology. Further work is required to assess the dynamics of these areas and to determine the complete range of species present.

Wildlife Management

Aspects of the conservation of native animals requiring action, other than routine management, to meet the Parks Australia's conservation obligations includes:

- restoration of habitat lost as the result of human activity;
- eradication where possible, or control (to an acceptable level) of introduced or feral animals;
- the prevention of further animal introductions; and
- the implementation of recovery plans, threat abatement plans and wildlife conservation plans.

8.2 Objectives

The objectives for the management of terrestrial animals are to:

- (a) protect all native animals inside the Park and to perpetuate the natural functioning of the ecosystems of which they are a part;
- (b) restore habitat damaged by human activity;

- (c) eradicate or control feral domestic and introduced wild animals and to prevent further introductions; and
- (d) protect wildlife and wildlife habitat outside the Park in accordance with the EPBC Act and Regulations.

8.3 Prescriptions

The following management actions are prescribed to meet the objectives in subsection 8.2.

Protection of native animals

- (a) Routine surveillance and public education shall be the principal actions taken to prevent native animals being killed or disturbed.
- (b) Recovery plans for listed threatened species and ecological communities under the EPBC Act shall be implemented.
- (c) The Red Crab Migration Management Plan shall be implemented during the annual migration, and its effectiveness reviewed.
- (d) Crab tunnels will continue to be installed at high density crab/road crossing points as resources permit.
- (e) Research shall be carried out to determine the cause of the apparent recent decline in the Christmas Island pipistrelle bat, and reptiles such as the blue-tailed skink (*Cryptoblepharus egeriae*) and the Christmas Island gecko or tree gecko (*Lepidodactylus listeri*).
- (f) During the life of this Plan, wildlife conservation plans may be prepared for submission to the Minister under s.285 of the EPBC Act, for species considered to be conservation-dependent species. They shall address issues such as wildlife distribution; habitats; life histories and ecology; wildlife population assessments and analysis; current knowledge on wildlife conservation status; threats to wildlife; obligations of Australia under international agreements to protect wildlife; monitoring and assessment of the impacts of any such undertaking; conservation management and research objectives; and the actions and prescriptions needed to achieve the objectives.

Habitat Restoration

- (f) Habitat restoration as prescribed in subsection 7.3 shall be continued, in co-operation with SOCI and the Christmas Island Administration.

Control of Introduced and Feral Animals

- (g) Additional measures may be developed and implemented to control and monitor non-native animals as resources permit.
- (h) A program to research, control, manage and monitor the impacts of the yellow crazy ant *Anoplolepis gracilipes* will continue as a high priority.
- (i) Collaboration with SOCI and the Christmas Island Administration on control of feral cats and exotic rodents will continue.
- (j) Parks Australia shall continue to provide support for quarantine initiatives and projects on the island to help reduce the risk of introduction of exotic pests.
- (k) Animals will not be allowed to be brought into or remain in the Park, with the exception of a guide dog used by a blind person or a hearing dog used by a deaf person in accordance with Regulation 12.19 of the EPBC Regulations.

Anchialine Systems

- (l) Additional or appropriate material for taxonomic work will be provided (very few specimens are available and those that are, are often immature).
- (m) Assistance will be provided for the documentation of the diversity of the anchialine fauna.
- (n) Research into the physico-chemical conditions and energetics of anchialine systems will be supported.

9. Marine Zone

9.1 Background

The marine zone of the Park was established when the Park was extended in 1989. Approximately 42 kilometres (63%) of the island shoreline that is contiguous with the terrestrial zone of the Park, extending 50 metres seaward of the low water mark, is included in the Park. This covers an area of 2.1 square kilometres.

The local community has expressed a desire to continue to fish in the marine zone of the Park. Since habitation of the island members of the Malay and Chinese communities in particular have fished for food and they consider fishing to be part of their cultural lifestyle rather than a recreational pursuit. The Director and Parks Australia supports the development of management objectives which reflect broad community interests in the recreational and cultural use of the Park, as far as these are consistent with the EPBC Act.

With a view to regulating fishing in all of the (12 nautical mile) territorial sea around Christmas Island in a consistent way (allowing for on-going non-commercial fishing in the Park) an Integrated Marine Management Program (IMMP) was drafted while the *National Parks and Wildlife Conservation Act 1975* and National Parks and Wildlife Regulations were in force, and has been extensively discussed over the last few years by many people in the community. It is anticipated that it will be introduced under the EPBC Act and EPBC Regulations during the life of this Management Plan.

Heavy seas for much of the year make access to the south and east coasts difficult and hazardous. The north and west coasts are protected from the prevailing south-east trade winds and are the most frequented areas. These natural constraints and the comparatively light fishing effort in relation to stocks, means that current catches of all harvested species are believed to be sustainable, although some caution needs to be adopted regarding several of the more popular deep reef species. Any increase in visitors to the island and the resident population is likely to increase the fishing effort which will in turn increase the impact on marine resources. Indirect impacts from an increase in tourists, for example increased commercial supply of marine resources for the tourism restaurant market, would also put further pressure on marine resources. A planned additional boat ramp on the north-east coast will increase boating and fishing activities along the eastern and southern shores of the island during the monsoon season. This activity will impact on marine resources in these areas. Currently these areas are accessed minimally as there is no boat launching facility other than a ramp at Flying Fish Cove.

In order to prevent such impacts developing in the long term, Parks Australia has adopted a precautionary approach to resource use within Park waters. The limited extent of fringing reef around the island, combined with the relative lack of scientific knowledge about the marine zone and the potential impacts of increases in exploitation, reinforce the need for application of the precautionary principle in relation to marine resource management.

The marine zone is also used by residents and visitors for beach going, swimming, scuba diving, snorkelling and boating. Commercial tour operators conduct boating, snorkelling and diving tours within Park waters.

9.2 Objectives

The objectives for the management of the marine zone are to:

- (a) protect all marine organisms, and habitats in as near a natural state as possible;
- (b) allow recreational fishing subject to specified conditions; and
- (c) manage recreational activities, particularly fishing, boating and diving, so as to minimise physical or biological damage to habitats and wildlife, and physical damage to wrecks or other artefacts.

9.3 Prescriptions

The following management actions are prescribed to meet the objectives in subsection 9.2.

Protection of unexploited natural ecosystems

- (a) Routine surveillance and public information, education and awareness are the principal management actions that shall be taken to protect and conserve the marine zone.
- (b) The Director may prohibit recreational fishing in an area of water in the Park pursuant to Regulation 12.35 of the EPBC Regulations in order to:
 - protect representative habitats, or
 - protect habitats considered to be at risk, or
 - protect individual species considered to be at risk.

Conservation of exploited ecosystems

- (c) Commercial fishing, or the taking of any organism or object for sale or barter, shall not be allowed in the Park.
- (d) Recreational fishing (ie fishing other than commercial fishing) shall be allowed subject to conditions determined by the Director under Regulation 12.35 of the EPBC Regulations.
- (e) A data collection system (a 'creel survey') has been developed and will be undertaken periodically to help evaluate the impact of harvesting on fish and crustacean stocks and determine from time to time what controls, if any, may have to be introduced.
- (f) Parks Australia shall continue to liaise closely with the community or appropriate representative bodies, on matters related to management of the marine zone.

Other recreational pursuits

- (g) Recreational pursuits such as water skiing, parasailing and the use of jet skis are prohibited by Regulation 12.56 of the EPBC Regulations if in contravention of a determination by the Director. The Director will consider making such a determination under Regulations 12.23 or 12.56.
- (h) The Western Australian Department of Transport '*Boating Guide*' and the Professional Association of Diving Instructors (PADI) / National Association of Scuba Diving Schools (NASDS) Safe Diving Codes shall be promoted to enhance the safety of Park users and to encourage environmentally sympathetic practices.
- (i) The moorings which have been installed for the use of boat operators in the marine zone shall be maintained. Other sites where the installation of moorings would protect corals from damage and benefit the boating public shall be evaluated and additional moorings may be installed.

10. Access

10.1 Background

Roads

The road and vehicular track network was originally developed for mining purposes. As the mining activities contracted and the area of the National Park increased, use of roads changed from being primarily used for haulage to being access roads to visitor destinations in the Park. These roads and tracks are of three standards: major, minor and tracks. Those roads still used for haulage are major roads and are primarily maintained by CI Phosphates and the Central Road Authority with input from Parks Australia. The access roads and tracks to major visitor destinations within the Park are the responsibility of Parks Australia to maintain.

Parks Australia, Christmas Island Phosphates and SOCI liaise with respect to day-to-day maintenance of roads and tracks. The Shire and the Christmas Island Administration have signed an MOU to establish a Central Road Authority with Commonwealth Government funding, to undertake road management and maintenance. The respective bodies, responsibilities for roads and tracks will be determined as the Authority is developed.

Forest tracks

During the 1960s, parallel survey tracks 400 feet apart were bulldozed over almost the entire plateau area and some of the terraces. Most are disused and overgrown but some were kept open for Abbott's Booby surveys and other management work. As this program has scaled down the number of tracks kept open has decreased. It would require a high level of funding and maintenance to keep the whole network of forest tracks open for general public use. Parks Australia recognises the recreational value of keeping a selection of the forest tracks maintained for recreational uses.

Walking tracks

A variety of walking tracks within the Park range from short well developed tracks such as to the Dales to less developed, more rugged tracks such as to Winifred Beach, West White Beach and Dolly Beach. All of these tracks are marked with international standard reflective directional arrows and are maintained regularly. Many of the forest tracks and four wheel drive access roads are also used as walking tracks.

Caves

Caves are a particularly localised and sensitive environment requiring special measures to protect their natural values.

Sea

Boats may be used to reach beaches, diving and fishing sites. No recreational boating restrictions are currently required but boat users will be encouraged, through suitable interpretation and education material, to avoid damaging coral by careless anchoring. Boat moorings have been provided at Winifred Beach, West White Beach, Boat Cave, Thunder Cliff and Million Dollar Bommie, following liaison with dive tour operators, to protect coral.

Air

There are no airfields in the Park and air access to the Park is possible only by helicopter or VTOL aircraft.

10.2 Objectives

The objectives for the management of access are to:

- (a) maintain and, in some cases, upgrade Park access roads for the benefit of visitors and to enable essential management and approved activities such as research and monitoring;
- (b) limit development of new roads and tracks to those deemed necessary to achieve management goals, benefit visitors, and those which will have low environmental impact;
- (c) continue to allow access to the marine zone from the sea and consider additional sites for the installation of moorings; and
- (d) minimise environmental impact on Park values, especially on seabird nesting, roosting and reproductive success.

10.3 Prescriptions

The following management actions are prescribed to meet the objectives in subsection 10.2.

- (a) Parks Australia shall work in liaison with the Central Road Authority and Christmas Island Phosphates.
- (b) Roads that are required for management purposes, for visitors and other users such as researchers shall be monitored, maintained and upgraded as funds become available.
- (c) Sections of the Dales, Blowholes, Dolly and Greta Beaches and Winifred Beach access tracks shall remain designated as suitable for four wheel drive only.
- (d) Sections of roads within the Park shall be closed as required during red crab migrations by determination of the Director under Regulation 12.42(3) of the EPBC Regulations.
- (e) Tracks will be checked for tree falls and maintained regularly.
- (f) Development of any new roads and tracks to meet management or other needs shall require thorough justification and environmental impact assessment.
- (g) Regulation 12.58 of the EPBC Regulations prohibits the landing or taking-off of aircraft in the Park. This does not prohibit landing or taking-off when reasonably necessary to deal with an emergency involving a serious threat to human life or property (Regulation 12.06) or when engaged in Park management activities.

11. Tourism

11.1 Background

The island's natural environment, much of which is now protected within the Park, is a major feature of interest to island visitors. The Park therefore has the potential to play a key role in the economic development of the island as an eco-tourism destination. Reflecting this role, Park staff are involved in a range of tourism related initiatives on the island. Parks Australia is actively involved in the Christmas Island Tourism Association (CITA). This was established in 1993 by SOCI, to encourage and promote the development of tourism, in a manner that minimises constraints and protects the inherent cultural and environmental qualities of the island.

A number of other recent initiatives have also occurred as a result of the growing tourism focus on the island. In early 1994 CITA established the Christmas Island Visitor Centre, in which Parks Australia also plays an active role. CITA contributes significantly to island marketing and attends trade shows on behalf of its members. CITA has prepared a regional Tourism Strategy covering both Christmas and Cocos Islands. Parks Australia will maintain its integral involvement in tourism development and management. Parks Australia will work with CITA in accordance with these Plans to create a framework for the future of tourism on the island. There is some marketing of the island by commercial operators as a visitor destination to Asian as well as Australian target audiences.

The Park currently attracts a small number of visitors. Their activities currently pose few management problems, but the situation could change if numbers increase greatly. Tourism requires management action to provide access and information, prevent littering, and damage to the landscape, and minimise conflicting activities. At present the land areas of the Park are used by tourists for camping, walking, running, sightseeing and the enjoyment of wildlife. The coastal areas are used for boating, beach going, swimming, diving and angling. There are, however, physical restraints on many of the previously stated activities due to the difficult terrain, the climate and sea conditions. Professional photographers and film makers regularly visit to produce wildlife publications and films. Cultural and historical artefacts such as the Chinese temples and the remaining phosphate mining infrastructure are also visited.

The greatest use of the Park to date has been for sightseeing, and most visitors are local residents, and their families and friends.

Parks Australia actively supports the development of tour operations within the Park. Whilst there is a current tour operators manual, it requires updating, and cooperation is required with CITA to undertake further tour operator training.

Parks Australia's policy towards tourism is to preserve the unspoilt character of the landscape whilst providing opportunities for the enjoyment of the island's natural and cultural attributes. The visitor facilities that have been provided to date include the viewing platforms at the Blowholes, Margaret Knoll and Martin Point, gazebos at the Research Station and LB4, boardwalks and walking tracks at the Dales and the Research Station and the ladder at Winifred Beach.

The Act requires that this Plan has regard for the encouragement and regulation of the appropriate use, appreciation and enjoyment of the Park by the public, including taking all necessary steps to prevent injury to visitors. The obligation on Parks Australia to provide a duty of care may necessitate the erection of safety structures or the closure of areas of the Park, as well as the provision of safety information for Park visitors.

In the recent past, visitor numbers have fluctuated with the opening and closing of the Christmas Island Resort and the resident population. The Resort may reopen during the life of this Plan and coupled with the effect of other planned private infrastructure development there could be a steady growth in residents and tourism. Potentially, tourism could become the principal management activity

in terms of the demand on resources. It could also eventually provide significant income towards management of the Park if entry and/or permit fees are charged.

Under Regulation 12.28 camping is prohibited except in a camping area or camping site described in a determination made by the Director. No such determinations have been made for the Park.

The objectives for the management of the effects of tourism have been framed around these general considerations.

11.2 Objectives

The objectives for the management of tourism are to:

- (a) promote the Park's values and enhance the visitor experience without compromising the Park's cultural or natural heritage or management of the Park.
- (b) present the Park to visitors as an almost intact example of a natural ecosystem containing unique elements and providing exceptional opportunities to observe and enjoy nature;
- (c) preserve cultural or historical artefacts, and present these for appropriate visitor observation and enjoyment;
- (d) restrict access or constrain certain activities, where necessary, to prevent damage to the Park or protect visitors or other users from danger;
- (e) develop and maintain infrastructure and services for tourism consistent with reasonable, safe access and with minimal impact on the Park;
- (f) promote the use of the Park for the observation, study or enjoyment of nature, cultural and historical artefacts, and appropriate leisure, cultural and religious activities;
- (g) encourage and train tour operators to offer well-informed guidance to visitors;
- (h) seek ways and means of applying an appropriate proportion of island tourist revenues to the cost of managing tourism in the Park;
- (i) participate actively with the Christmas Island Tourist Association on all matters relating to tourism in the Park, and
- (j) participate in and if appropriate undertake tourism assessment planning, development and monitoring in order to provide a range of visitor opportunities and protect the Park's natural and cultural values.

11.3 Prescriptions

The following management actions are prescribed to meet the objectives in subsection 11.2.

Preservation of the natural and artificial features of the landscape

- (a) Visitors shall be encouraged via the Interpretive Plan referred to in subsection 12.3(a) of this Plan to respect the values of the Park, and act in a safe and environmentally responsible manner while in the Park.

Management of Visitor Access

- (b) The introduction of a Park use charge for non-residents will be investigated during the life of this Plan and, subject to the approval of the Minister, may be implemented by the Director.
- (c) Subject to the approval of the Minister the Director may determine and impose charges under s.356A of the EPBC Act for the conduct of Park tours by Parks Australia staff.
- (d) Visitor access will generally only be restricted to protect exceptionally vulnerable natural features, to protect or conserve biodiversity or heritage, to protect research and monitoring activities and for visitor safety.

- (e) Parks Australia will assess actual and potential impacts of tourist visitation on different sites, and may develop area management plans for popular visitor destinations.
- (f) Parks Australia will provide further low key visitor facilities and infrastructure if necessary and appropriate, although no substantial modifications will be made to the landscape.
- (g) As no camping areas have been established in the Park and camping is generally prohibited by the EPBC Regulations, prospective campers must obtain a permit to camp in the Park. Permits will be issued subject to conditions that will include conditions to protect the Park and wildlife.
- (h) Parks Australia will develop a policy on camping at Dolly Beach to address issues such as a booking scheme, a limit to duration of stay, number of persons per group, prescriptions for minimal impact camping, and how the booking procedure shall be implemented.
- (i) Intending campers will be advised to bring all their own equipment and supplies except for water which may be taken from streams where available. Parks Australia will generally advise that water quality cannot be guaranteed.
- (j) Campers shall not be allowed to use portable generators.

Guided tours

- (k) A permit from the Director is required to conduct commercial tours (or any other commercial activity) in the Park. Parks Australia shall continue to facilitate tour operator training workshops and provide tour operator manuals for tour operators who conduct tours in the Park. In conjunction with the CITA, a process of tour operator accreditation will be developed and implemented.

Caving

- (l) In cooperation with the Christmas Island Administration, Parks Australia shall develop a Cave Management Plan during the life of this Plan to address issues such as protection of ecological features, cave access, visitor safety, licensing of use, interpretation and research requirements. Access to certain caves may be restricted or prohibited if visitor safety and environmental impact cannot be appropriately managed.

Fishing

- (m) Recreational fishing in the marine zone of the Park is allowed in accordance with subsection 9.3 of this Plan.

Walking and running

- (n) Walkers and runners are required by Regulation 12.55 of the EPBC Regulations to use only roads or tracks that are available for public use or tracks provided by the Director in a Commonwealth reserve. Walkers and runners shall be encouraged to use existing roads and tracks in the Park. Designated walking tracks shall be maintained regularly and promoted through Park brochures. [Note: Walkers and runners shall be encouraged to leave details of their intentions with someone responsible before entering the Park.]

Cultural and historical sites

- (o) Visitors shall be allowed access to the Chinese temples in the Park, provided such is approved by the relevant Temple Association and provided that they respect the wishes of the Temple Committees concerning conduct within and in the vicinity of the temples, and comply with any signs and instructions provided.
[Note: Persons intending to enter a Chinese temple are expected to remove their shoes.]

Commercial operations

- (p) Permits to undertake commercial activities, including tours and filming and photography (and other recording of images of the Park) may be granted by the Director if the proposed activity is consistent with the Park's IUCN category II status, this Management Plan, the protection of the Park and its wildlife and the appropriate use, appreciation and enjoyment of the Park.
- (q) Applications for and the issuing of permits will be subject to fees in accordance with the EPBC Regulations.
- (r) Parks Australia shall develop, in liaison with the CITA and the Civil Aviation Authority, a Fly Neighbourly Agreement (FNA). The objective of the FNA is to encourage self regulatory control of airspace, by asking airspace users to adhere to particular flight paths and heights and to avoid particular areas. The conditions on flight paths and heights and areas are to ensure visitors on the ground are not disturbed by aircraft noise, to avoid disturbance to birds and bats, and for safety (See also 10.3(d)).
- (s) Major new accommodation facilities or other major tourist infrastructure will not be permitted in the Park.

Infrastructure and services

- (t) Infrastructure to assist with improving visitor safety, access and amenity (such as viewing platforms, walkways, gazebos, picnic facilities, shelters, access ladders and toilets) will be considered and installed as resources permit to meet anticipated visitor levels and environmental needs during the life of this Plan. They will be developed to minimise visitor impact, and will consider visitor safety and appropriate access to sites of interest.
- (u) The development of any new roads and tracks for visitor access will be limited to those deemed essential for meeting management objectives outlined in 11.2. All developments shall be subject to environmental assessment and approval processes described in subsection 14.1 of this Plan and as prescribed by subsection 14.3(e).
- (v) Parks Australia will develop a Track Management Plan which will identify those tracks to be kept open and the maintenance required for them, and provide the rationale for closing certain tracks. Subject to safety and environmental considerations, the forest tracks in the Hanitch Hill area will be maintained to allow for visitor and management access to this area of plateau rainforest contained within the Park.

Other Park uses

- (w) The Director will consider requests to conduct activities in the Park not specified in this Plan, and may issue permits for such activity if in the Director's judgement such activities are not inconsistent with the purpose of the Park and the IUCN Reserve Management Principles. To protect Park values, the Director may impose conditions on these activities.
- (x) Proposals to stage public gatherings, stunts, festivals, ceremonies or other events inconsistent with subsection 11.2 of the Plan will not be approved.

[Note: The Director may authorise official ceremonies or functions in the Park that are related to the normal operation of the Park.]

- (y) Requests for advertising in the Park will be dealt with in accordance with the EPBC Act and the EPBC Regulations.

Christmas Island Tourist Association (CITA)

- (z) The Government Conservator shall represent the Director on the Christmas Island Tourist Association and participate fully or delegate staff participation in the Association activities that promote environmentally sustainable tourism.

Tourism planning

- (aa) As part of an ongoing planning program, Parks Australia shall undertake assessment of the existing and potential impacts of visitors on different sites within the Park and develop Area Visitor Management Plans. The Plans shall address issues such as the degree of development and limits of acceptable change for particular visitor destinations, development of appropriate access and facilities, meeting a diversity of visitor demands through the application of the recreational opportunity spectrum, management prescriptions and monitoring of impacts (see also subsections 11.1 and 12.2).

12. Interpretation

12.1 Background

Interpretation is the communication, education and information process to facilitate visitor enjoyment and safety, providing visitor information and orientation, minimising user damage to Park environments, and developing community and visitor understanding of and support for Park values and regulations.

Since the establishment of the Park a range of interpretation materials and services has been developed. Since 1982 the Parks office at Drumsite has served as the primary information source about the Park and its wildlife. It contains photographic and natural history displays. In 1994, the Christmas Island Tourism Association established the Christmas Island Visitor Centre at Settlement. Parks Australia assisted in the establishment of the display and has provided photographic and other static material, with a view to this Centre now being the primary destination of visitors seeking information about the island flora and fauna.

Direction signs on Park roads are maintained and progressively upgraded. An interpretive sign system and Park infrastructure are in place at the Dales. The previously existing basic viewing platforms at the Blowholes and Margaret Knoll have been replaced with new, more functional and extensive structures. An additional viewing platform of similar design has been erected at Martin Point.

At each of the viewing platforms interpretive signs depicting natural features and processes have been installed.

A short self guided nature trail with boardwalks has been constructed at the Research Station. Other facilities, such as a BBQ and picnic shelter, have been built and are available for use by the public (see also 11.1). Further requirement for interpretive sites or visitor facilities will be addressed in a Local Area Master Plan for the Research Station and Grants Well precinct. Being relatively flat, this site is one of the few in the Park suitable for passive and environmentally-friendly recreational activities, particularly for young children and the elderly. This Plan will consider current and future uses for the area, management options and preservation of sites listed on the Register of the National Estate.

Discussions have been initiated with CIP for the possible interpretation of mining activities and infrastructure remaining in the Park.

Parks Australia has produced a new more comprehensive island-wide tourist map which replaces the previous Park visitor guide. Parks Australia brochures, about the Christmas Island Rainforest Rehabilitation Program, red crabs and crazy ants, have been produced. An interim brochure for the Pink House nature trail has been produced with a view to being superseded by on site interpretive signs.

Current environmental and Park Management issues are publicised through local radio and articles in the local newsletter.

Over the period of the last Plan, Parks Australia withdrew from providing conducted Park tours for visitors, to enable locally-established tour operators to start commercial tour operations. Parks Australia also assisted in providing tour operator workshops as conducted in other parks on the mainland. Parks Australia still provides guided tours for visiting officials and dignitaries as required.

Parks Australia jointly financed the compilation and printing of the second edition of *Christmas Island Naturally* with the Christmas Island Natural History Association in 1995.

As discussed in section 11, tourism is an important focus for development on the island, and tourist facilities and services are being developed and promoted. There is an expectation from the Christmas Island community that Parks Australia will increase and upgrade its interpretation services, facilities and materials, to inform visitors and residents of the island's natural values, to promote appropriate visitor behaviour and to ensure visitor safety.

Interpretive materials can help Parks Australia increase community understanding of the importance of the island's natural and cultural features, the rationale for conservation regulations and the reasons for environmentally sensitive behaviour. Environmental education through the Christmas Island District High School is an important activity for Parks Australia, as this will help instil environmental understanding and conservation ethics in the younger members of the local community. Parks Australia will work closely with the school during the life of this Plan to upgrade the schools environmental curriculum and increase its relevance to the island.

The multi-cultural nature of the island's residents and tourists means that Parks Australia must take into account different cultural perspectives when developing interpretive materials and provide interpretive materials in languages other than English, such as Bahasa Malay and Chinese (Mandarin).

As world scientific and public attention on the island increases and as it becomes more widely recognised as a place of international conservation significance, it becomes crucial for Parks Australia to interpret and educate people about this significance and the need to protect it. Parks Australia staff have assisted and provided information to journalists, film and television crews, professional photographers, researchers and visitors from Australia and overseas.

In 1994 the Christmas Island Interpretive Plan was produced. However, budget constraints have limited the number of recommendations being implemented. It is now intended to revise the timeframe and continue to undertake the prescriptions detailed in the Interpretive Plan. This includes filling the need for essential interpretive materials and services such as maps, signs, displays, brochures, Park notes, other publications, education programs and community activities.

12.2 Objectives

The objectives for the interpretation of Park management issues are to:

- (a) assemble and disseminate scientific, descriptive, cultural and historical information about the Park and its surroundings that include Chinese and Malay translations;
- (b) explain and promote the purpose of the Park and the island and the Park's contribution to the conservation of species, locally and regionally and internationally;
- (c) assist visitors to find and safely enjoy the Park's special features;
- (d) encourage all Park users to adopt an appropriate code of behaviour while in the Park; and
- (e) inform visitors of the natural hazards of the Park, particularly those associated with the sea, caves, cliffs and rugged terrain.

12.3 Prescriptions

The following management actions are prescribed to meet the objectives in subsection 12.2.

Interpretive Plan

- (a) The timeframe of the 1994 Interpretive Plan will be reviewed and the prescriptions detailed therein will continue to be undertaken. The Interpretive Plan will be revised within the lifetime of this Plan.

Local Area Plan

- (b) A Local Area Master Plan will be prepared for the Grants Well and Research Station precinct to describe the values of the area, noting the special natural and cultural heritage features present (eg the former railway fettlers quarters), to set out future management arrangements to protect these features and to provide for appropriate visitor use.

Provision of information

- (c) Information materials shall be produced in English, Chinese and Malay to inform visitors about walking trails, marine activities, cultural and historical features and other aspects of the Park.
- (d) Interpretive and safety signs shall continue to be installed and maintained at visitor destinations throughout the Park, as appropriate.
- (e) Interpretive sites relating to the plateau rainforest and fauna will be installed along the nature trail at the Research Station.
- (f) Liaison shall continue with the Christmas Island Natural History Association on future publications and nature conservation activities of the Association that are consistent with this Plan will be supported as resources allow.
- (g) The local radio and newspaper shall be used to reach the widest possible island audience with information about the Park and nature conservation issues.
- (h) Displays illustrating Park features, Parks Australia operations, wildlife protection matters and other environmental matters shall be developed as the need is identified and resources permit.
- (i) Use of the Christmas Island Research and Education Station by students from the Christmas Island District High School shall be encouraged and promoted in liaison with the school staff.
- (j) Induction courses about the Christmas Island natural environment for people coming to live and work on the island shall be provided if requested.
- (k) Signposting on internal Park roads shall be maintained and upgraded as required.
- (l) Maps, trail head interpretive signs, trail markers and on-site interpretative materials shall be used to guide people visiting the Park.
- (m) Assistance in tour operator training shall be offered by Parks Australia to tour operators permitted to conduct tours in the Park. A fee may be charged for this service.
- (n) Park staff may be available to give talks and guided tours to special nature study groups. Subject to the approval of the Minister the Director may determine and impose a charge for this service under s.356A of the EPBC Act.
- (o) Parks Australia shall liaise and work with the Christmas Island Tourist Association on interpretation and visitor information for the island and continue to support the Christmas Island Visitor Centre.

Visitor safety in the marine part of the Park

- (p) Brochures, signs and notices for fishing, boating and diving activities in the marine part of the Park shall be developed and other methods also used as appropriate, to promote safe and environmentally responsible activities in this area.

Visitor safety on land

- (q) Interpretive materials such as signs and brochures shall be produced to advise visitors to be exceptionally careful when traversing loose or steep terrain, sight-seeing along the coastal cliffs or rock platforms and carrying out any activity in isolated areas.

13. Research

13.1 Background

Parks Australia's office in Darwin administers a research and mapping program for protected areas including the Park. The program includes research and investigations relevant to the establishment and management of the Park and the protection, conservation and management of its wildlife. While Parks Australia staff participate in research from time to time, projects are normally commissioned from external organisations and individuals.

Several cartographic projects to produce topographic and thematic maps have also been carried out including the continued development and maintenance of the Christmas Island Geographic Information System (GIS).

A Research and Education Station ('The Pink House') providing accommodation and working space for visiting scientists and school groups is maintained in the Park.

Research projects completed during the term of the previous Plan or currently underway are listed below:

Table 4. Research Projects Completed or Initiated During the Term of the Previous Plan

- Status, impact and recommendations for management of the crazy ant
 - Field survey and updating of topographic map
 - Biology, ecology and population status of the Christmas Island Hawk-owl
 - Systematics of the Christmas Island Hawk-owl
 - Christmas Island Hawk-owl draft recovery plan
 - Abbott's Booby recovery plan
 - Christmas Island Frigatebird draft recovery plan
 - Christmas Island Goshawk draft recovery plan
 - Effects of red crabs on forest regeneration (underway)
 - Studies of red, blue and robber crabs
 - Feral pest (cat and rat) assessment and control (underway)
 - Survey of the South-east Asian wolf snake
 - Assessment of the effectiveness of rainforest rehabilitation
 - Environmental weed survey and assessment
 - Cave assessment – geotechnical hazards
 - Cave assessment – natural values and recommendations for management options
 - Cave assessment – ecological values
 - Monitoring impact of recreational fishing on fish stocks (ongoing)
 - Pipistrelle bat survey
 - Shrew survey
 - Reptile surveys
 - Seabird survey
 - Goshawk taxonomy
 - Aerial photography update (incomplete)
-

Parks Australia recognises the scope for broader research projects which consider the regional and global context and significance of the island and its biota. Specific areas of interest include the trophic links between the island's seabirds and the surrounding seas where they feed; the effects of impacts on the marine zone on the avifauna; and the effects of sea surface temperature changes on Abbott's Booby nesting success. In particular, long-term monitoring studies are needed to assess the impact of global or local change on the island's ecosystem. Methods of regularly monitoring populations of threatened and protected species need to be developed that are statistically sound and achievable within the likely available resources. Some research issues relevant to the regional context are expected to arise from the Integrated Marine Management Plan for the Territory waters and the possible 'twinning' of Christmas Island National Park with a park in nearby Java, Indonesia.

In addition to funds from the Research and Mapping Program, Parks Australia also seeks research funds from other sources. Recovery Plans are required to be prepared for six of the endemic animals that are listed on the national list of threatened vertebrate fauna. Some funding for this work has been received from Environment Australia's national Endangered Species Program. Funding for tourism studies, marine studies and other scientific research may be sourced from relevant funding bodies.

Under Regulation 12.10 a permit from the Director is required to carry out research in the Park.

13.2 Objectives

The objectives for the management of research are to:

- (a) increase knowledge of the distribution, abundance and status of the flora and fauna, and of the ecological processes of Christmas Island, to achieve best practice standards of ecosystem management and to protect species of conservation significance and their habitats; and
- (b) facilitate where possible conservation-oriented research, by outside individuals and organisations.

13.3 Prescriptions

The following management actions are prescribed to meet the objectives in subsection 13.2.

- (a) Project briefs and lists of potential consultants shall be prepared to facilitate invitations to tender for the relevant research projects of the Research and Mapping Program.
- (b) Appropriate staff shall be appointed as specific project liaison officers charged with overseeing the satisfactory performance of the relevant consultants.
- (c) Parks Australia staff will routinely enter newly-acquired data into the island's Geographic Information System (GIS). Consultants will be required to provide relevant research data in a form to facilitate this.
- (d) New projects for inclusion in the Research and Mapping Program shall be identified and submitted for funding as and when the need arises.
- (e) The facilities of the Research Station will be maintained, may be expanded and its appropriate use encouraged. Improvements shall include building fabric repairs and upgrade, as well as reference and interpretive materials.
- (f) Subject to the approval of the Minister the Director may determine and impose a charge for use of the Research Station under s.356A of the EPBC Act.
- (g) Research activities require a permit from the Director, which shall specify the observations and associated activities which may be carried out in the area in question, and any conditions on the conduct and management of the research and its reporting.
- (h) The development of the research program and the consideration of management implications arising from research will be discussed with CINPAC.

[Note: Refer to sections on specific topics such as Terrestrial Vegetation, Terrestrial Animals and the Marine Zone for further discussion and details on research needs and prescriptions.]

Current research priorities are as follows, however, these priorities may change during the term of this Plan. Implementation of research priorities shall be dependent on availability of funds.

Table 5. Research Priorities during the Life of this Plan

Project	Priority
• Dynamics, impact and control of the crazy ant	Highest
• Integrated seabird and threatened species monitoring plan	High
• Implement Abbott's Booby recovery plan	High
• Implement Christmas Island Frigatebird recovery plan	High
• Assess the status of rare or threatened Christmas Island plants	High
• Implement the Christmas Island Goshawk recovery plan	High
• Prepare and implement a recovery plan for Christmas Island reptiles	High
• Effects of red, blue and robber crabs on forest regeneration	High
• Implement the Hawk-owl recovery plan	High
• Prepare and implement a recovery plan for the pipistrelle bat	High
• Development of 'model' rainforest rehabilitation plans	High
• Integrated feral animal management program	Medium
• Impact of coral bleaching and affect of sea temperature on reef dynamics	Medium
• Further investigation and studies of the anchialine system	Medium

14. Administration

14.1 Background

Staff

In 2002 Parks Australia staffing on Christmas Island included the following positions:

- Government Conservator;
- Natural Resources Manager;
- Park Manager;
- Senior Ranger;
- Ranger;
- Project Officer (Natural Resources);
- Project Officer (Rehabilitation);
- Nursery Manager; and
- Administration Officer

In addition to the above, four rehabilitation officers are employed under a contractual agreement with the phosphate mining company, although this may change in the life of this Plan.

Other casual staff members are employed under contract to carry out short-term, labour-intensive work such as field work assistance. Contracts have been let for projects such as the construction of board walks, road maintenance and asset maintenance.

Parks Australia has in the past been contracted by DOTARS to assist and advise on conservation and environmental protection requirements for Christmas Island generally.

Apart from National Park administration the most time consuming administrative duties are the Christmas Island Rainforest Rehabilitation Program (CIRRP); advice to DOTARS, (SOCI), Asia Pacific Space Centre (APSC) and others on environmental protection matters.

The above activities will all continue, however, significant changes in the distribution of this workload are anticipated during the life of this Plan:

- (i) increased emphasis on interpretation and education;
- (ii) intensified control of exotic plants and animals (especially yellow crazy ants);
- (iii) increased assistance to, and liaison with, DOTARS, the SOCI and possibly other Commonwealth or State Departments or Authorities via service delivery agreements;
- (iv) more efficient and effective management and implementation of the CIRRP.

Other administrative commitments that will demand varying amounts of staff time are the island rebuilding program, the development and administration of a wildlife management program on land outside the Park, and the expansion of tourism.

Environmental impact assessment

As noted in section 5.3 of this Plan actions that could have a significant environmental impact on the Park may “trigger” the assessment and approval provisions of the EPBC Act and may be “controlled actions”.

Where the Director considers that a proposed action may be a controlled action in relation to the Park, the Director may refer the proposal to the Minister for the Environment and Heritage under section 71 of the EPBC Act for a decision whether or not the action is a controlled action.

Proposed actions in the Park that are not controlled actions under the EPBC Act may still be subject to environmental assessment by the Director and Park staff in accordance with the following guidelines and prescriptions.

Guidelines for environmental assessment requirements

The following guidelines define the evaluation and assessment requirements for park management activities and proposals in the Park:

Category 1

Category 1 includes those activities that produce little or no impact on the natural and cultural heritage of the Park. These include routine maintenance; repair and replacement of existing structures in their present form; improvements to mitigate environmental damage; installation of signs; and similar activities. Activities in this category are unlikely to require a formal environmental assessment to be carried out.

Category 2

Category 2 includes those activities that have an impact on the natural and cultural heritage of the Park at a local level. These include the establishment of new facilities; walking tracks and car parks; the upgrading of facilities; the realignment of existing roads; minor upgrading of roads; any activity in endangered species habitat; some commercial activities; and activities which may result in changes to local water flow and environmental systems. Activities in this category require a formal

environmental assessment to be carried out and may require the approval of the Director. Generally, such assessments will be carried out by Park staff.

Category 3

Category 3 includes those activities that would be likely to produce a major impact on the natural and cultural heritage of the Park, and/or significantly alter visitor use, and/or are a major departure from the existing facilities or services in the Park. Included in this category are: major realignment of existing roads or tracks; establishment of major infrastructure; construction of new roads and services; and establishment of new types of commercial activities (see also section 11, particularly subsection 11.3(p), of this Plan for discussion of commercial activities). Detailed environmental assessment is required for all activities in this category. This assessment is to be completed prior to work being tendered or commencing. Activities in this category will require the approval of the Director.

Infrastructure and equipment

In 2002 there were two staff houses owned by Parks Australia in Silver City and one at Drumsite near the Park office. During the currency of the previous Plan two houses in Settlement were sold in accordance with Government directives and leased back to the Director for a period of 3 years with an option to renew the lease for a further period of 2 years. An office, storage shed and the reforestation nursery complex are located at Drumsite and there are some buildings at Grants Well. A Research Station is maintained in the Grants Well/Jedda Cave area. There were also nine vehicles, one dinghy, one patrol/work boat and sundry other plant and equipment. A list of existing and proposed buildings is at Appendix A.

14.2 Objectives

The objectives for the administration of this Plan are to:

- (a) maintain staff resources sufficient to carry out the management prescriptions in this Management Plan;
- (b) maintain staff resources sufficient to meet agreed arrangements with the DOTARS, SOCI and other government departments or authorities as necessary;
- (c) employ and train island residents;
- (d) apply an appropriate environmental assessment procedure to all development proposals;
- (e) develop and deliver an internal capital works program; and
- (f) execute a level of surveillance adequate to ensure that the EPBC Act and the EPBC Regulations are respected by Park users.

14.3 Prescriptions

The following management actions are prescribed to meet the objectives in subsection 14.2.

Staff resources

- (a) An Internal Staff Work Plan shall be prepared and reviewed annually.

[Note: This Staff Work Plan will be designed to realise, on an annual basis, the overall objectives and management actions set out in this Plan.]

Opportunities for island residents

- (b) In keeping with the overall policy of involving the community in all possible aspects of the management of the Park, casual employment and works contracts shall be offered to local residents whenever possible and within financial resources.
- (c) As resources permit, training will be offered to residents in park management, administration, environmental protection and/or rainforest rehabilitation skills and research field assistance.

Staff training

- (d) An ongoing program of in-service and external training, focussing on skill and career development, shall be facilitated for Parks Australia staff.

Environmental assessment

- (e) All proposed developments in the Park shall be subject to environmental assessment prior to approval.
- (f) Actions and developments in the Park that do not trigger the EPBC Act will be considered under the guidelines for environmental assessment requirements and, if necessary, formally assessed.

Infrastructure and equipment

- (g) A capital works program shall be developed and reviewed annually and amended as required.
- (h) As far as possible, works contracts shall be let to island-based enterprises with regular regard to value for money considerations.

Surveillance and law enforcement

- (i) Surveillance shall be aimed principally at monitoring Park use and discouraging illegal activities and those prohibited by this Plan and the EPBC Act and EPBC Regulations.
- (j) A field staff roster shall be maintained to cater for regular patrols, random evening and night patrols and to ensure that at least one staff member is on duty on weekends and public holidays.
- (k) Efforts shall be made to dissuade and advise offenders acting out of ignorance before considering formal charges under the EPBC Act and EPBC Regulations.
- (l) Malicious, deliberate and persistent offenders shall be prosecuted.
- (m) Staff shall liaise and work closely with the police force and other relevant agencies and authorities on law enforcement applicable to Parks Australia's responsibilities.
[Note: Australian Federal Police officers are wardens *ex-officio* under the EPBC Act.]
- (n) Education and extension materials and activities related to Park regulations shall be developed to help improve compliance with the EPBC Act and EPBC Regulations.

15. Occupancies

15.1 Background

The following areas within the Park were being used or occupied by other persons and agencies for non-Park purposes at the time the Park was declared:

- the Jedda Cave, Jane-Up pumping stations and Jedda Cave-Settlement waterlines and Ross Hill Gardens waterline;
- the Christmas Island Power Authority's power line;
- two Chinese temples; and
- a residential occupation at Grants Well.

The Jedda Cave, Jane-Up and Ross Hill Gardens pumping stations and waterlines are part of the industrial and domestic water reticulation to the community. The Administration's powerlines carry electricity from the generating station to Grants Well, Jedda Cave, the Research Station and the Central Area Workshop. The two Chinese temples are used regularly and are maintained by the Shaolin Temple Association. A residence has been occupied at Grants Well for approximately the last 15 years.

A licence has been granted by the Director to the occupiers at Grants Well to formalise on-going use and occupation of this area. Licences for the public utilities and temples have not been formalised, but would include the conditions outlined in schedules 1 to 3 of this Plan. There may be a need for new occupancies such as an upgrade of services to the Central Area Workshop (CAW), and new services to the proposed Asia Pacific Space Centre (APSC) site at South Point where they pass through the Park.

Mining is prohibited in the Park by the EPBC Act except with the approval of the Governor-General and in accordance with a management plan. To date mining has not been allowed in the Park.

15.2 Objectives

The objectives for the management of occupancies are to:

- (a) ensure that any damage to the Park as a result of the occupants' activities is minimal and that such activities are compatible with other Park objectives.

15.3 Prescriptions

The following management actions are prescribed to meet the objectives in subsection 15.2.

- (a) Further licences for use and occupation of land in the Park will not generally be granted. Licences may be granted for essential public service infrastructure, or for water supply from Jedda Cave in connection with the Asia Pacific Space Centre, or in other exceptional circumstances. All proposals for additional use and occupation of land in the Park will be subject to environmental assessment by Parks Australia and may trigger the provisions of the EPBC Act.

16. Park Extensions

16.1 Background

Before the Park was extended in 1986 and 1989, the public was asked to comment on the proposals. On both occasions, a majority of respondents (mostly non-residents) not only endorsed the proposed extensions but urged that further areas be included. Of more than 1000 representations in 1989, approximately 90% urged the inclusion of additional areas. As the result of this strong endorsement the Director was instructed by the Minister to prepare a proposal to extend the Park.

Two areas have been identified as desirable extensions to the Park:

- (a) An area on the east side of the island which incorporates: an area south-east of Hanitch Hill on the western side of the North South Baseline extending south of a straight line from the Hanitch Hill sector to the Hosnie's Spring sector; and an area east of the North South Baseline between Hosnie's Spring and Ross Hill sectors of the Park: and
- (b) An area on the eastern side of South Point extending south of the Ross Hill sector round the South Point coast to join the existing Park, which includes the primary forest areas of South Point (but excluding mining fields) that extend west to the Park boundary along the old railway alignment and north to the Ross Hill sector.

16.2 Objectives

The objectives of proposals to extend the Park are to:

- (a) incorporate wildlife, habitat or distinctive natural features which would benefit from protection;
- (b) enhance the protection and management of already rehabilitated mining fields by inclusion in the Park; and
- (c) rationalise the Park boundaries to improve management and enhance public appreciation of their location.

16.3 Prescriptions

The following management actions are prescribed to meet the objectives in subsection 16.2.

- (a) In consultation with CINPAC, the Christmas Island Administration and SOCI, Parks Australia shall determine the exact boundaries of the two areas detailed in subsection 16.1, and any other areas which may be further identified, to assess any advantages and consequences to the Park of their inclusion in the Park.
- (b) Should any new areas be added to the existing area of the Park these additional areas shall be managed in accordance with the objectives and prescribed management actions of this Plan.

ADDITIONAL MANAGEMENT PROVISIONS

17. Environment Protection and Biodiversity Conservation Act 1999 and Regulations

As noted in subsection 6.3 of this Plan, Hosnie's Spring in the Park is a Ramsar wetland (see section 20 below). As required by the EPBC Act Australia's obligations under the Convention were taken into account in preparing this Plan, which is consistent with the Australian Ramsar management principles made under the EPBC Act and set out in Schedule 6 to the EPBC Regulations:

- the site's ecological character and characteristics are described in a Ramsar Information Sheet (RIS – see Appendix B);
- the site's character is maintained by isolation (it is a difficult site to access) and sustainable use and potential impacts are dealt with in the same context as the rest of the National Park;
- no site restoration or rehabilitation is presently required;
- the site is periodically monitored by Parks Australia staff;
- public consultation occurs through the Management Plan planning process; and
- the Management Plan will be reviewed in 7 years.

Section 334 of the EPBC Act also requires the Director to take reasonable steps to manage the Park consistently with the Ramsar Convention and the Australian Ramsar management principles.

If any part of the Park were to be included in:

- the World Heritage List under the Convention for the Protection of the World Cultural and Natural Heritage; or
 - a Biosphere Reserve under the UNESCO Man and the Biosphere Programme,
- the Director would be required by the EPBC Act (ss.322, 323 and 339) to take reasonable steps to manage the Park consistently with the World Heritage Convention and Australian World Heritage management principles (set out in Schedule 5 to the EPBC Regulations), or the Australian Biosphere management principles (set out in Schedule 7 to the Regulations).

As noted in section 4 of this Plan, Parts 13 and 13A of the EPBC Act may also be relevant to management of the Park.

Part 13 of EPBC Act provides for protection of:

- threatened species and communities included in lists established under Part 13;
- migratory species listed under Part 13, being species listed under JAMBA, CAMBA, the Bonn Convention (see section 20) or other international agreements approved by the Minister;
- cetaceans (members of the sub-order Mysticeti or Odontoceti of the Order Cetacea); and,
- marine species included in the list established under Part 13.

Environment Australia maintains a current list of these species at <http://www.ea.gov.au/biodiversity/threatened/species/index.html>

Part 13A of the EPBC Act (which replaced the *Wildlife Protection (Regulation of Exports and Imports) Act 1982* on 11 January 2002) regulates the export and import of wildlife for Australia and its external territories and gives effect to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) to which Australia is a signatory (see section 20 of this Plan).

18. Other legislation

In addition to legislation referred to elsewhere in this Plan the following Commonwealth Acts and Ordinances of the Territory of Christmas Island are relevant either directly or indirectly to the management of the Park:

- *Migratory Birds Ordinance 1980* – gives effect to agreements between the Government of Australia and other Governments for the protection of migratory birds (see section 20)
- *Australian Heritage Commission Act 1975* – Establishes a Register of the National Estate and requires Commonwealth Ministers and authorities not to take action that will have an adverse effect on registered places, as part of the National Estate, unless there is no feasible and prudent alternative. The Park and the ocean and sea floor surrounding Christmas Island within 500m of Low Water Mark on the island, were listed in the Register on 15 May 1990
- *Fisheries Management Act 1991* – regulates fishing in the Australian Fishing Zone (the waters within the outer limits of the 200 nautical mile exclusive economic zone adjacent to the coast of Australia and each external Territory, excluding the 3 nautical mile coastal waters adjacent to the Australian States and the Northern Territory):
- *Administration Ordinance 1968*;
- *Casino Control Ordinance 1988*;
- *Customs Ordinance 1993*;
- *Importation of Dogs and Cats Ordinance 1973*;
- *Lands Ordinance 1987*; and
- *Quarantine and Prevention of Disease Ordinance*.

Western Australian laws are applied to Christmas Island under the amended *Christmas Island Act 1958* as the result of the law reform process begun in 1992. The applied laws include the following Acts:

- *Agriculture and Related Resources Protection Act 1976* – provides for agricultural and quarantine matters;
- *Dog Act 1976* – provides for the control of dogs;

- *Environmental Protection Act 1986* – provides for the protection, control and abatement of environmental pollution;
- *Health Act 1911* – provides for the protection of human health;
- *Firearms Act 1973* – regulates the ownership and control of firearms;
- *Litter Act 1979* – provides for the abatement of litter;
- *Marine and Harbours Act 1981* which regulates boating;
- *Mining Act 1978*;
- *Plant Diseases Act 1914*;
- *Prevention of Cruelty to Animals Act 1920*;
- *Road Traffic Act 1974*;
- *Soil and Land Conservation Act 1945*; and
- *Spear-guns Control Act 1955*.

19. International Migratory Species Agreements

As noted earlier in this Plan (see sections 4 and 17) Part 13 of the EPBC Act provides for the protection of “listed migratory species”, and Appendix 3 of “A Description of Christmas Island and the National Park” includes a list of species listed under migratory bird agreements. Significant agreements which apply to or affect Christmas Island or the operation of the Park either directly or indirectly are listed below.

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 (JAMBA) provides for co-operation between the governments of Australia and Japan to protect birds which migrate between the two countries, to protect birds in danger of extinction, and to protect their environment.

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 (CAMBA) promotes co-operative measures which may include: controlling the taking, and the trade or exchange of, migratory birds and their eggs; establishing sanctuaries and other facilities for the management and protection of migratory birds and their habitat; and undertaking joint research and exchanging information and publications on migratory birds.

The Convention on the Conservation of Migratory Species of Wild Animals, also known as the Bonn Convention, aims to conserve terrestrial, marine and avian migratory species throughout their range. It is one of a small number of intergovernmental treaties concerned with the conservation of wildlife and wildlife habitats on a global scale.

20. Convention on Wetlands of International Importance

As noted earlier in this Plan (subsection 6.3 and section 17) the Hosnie’s Spring area is included in the List of Wetlands of International Importance under the Convention on Wetlands of International Importance especially as Waterfowl Habitat, commonly referred to as the Ramsar Convention. The Ramsar Convention aims to maintain the ecological character of listed wetlands (i.e. the structure and inter-relationships between the biological, chemical, and physical components) through conservation including, where appropriate, wise use. Wise use is defined as the sustainable use of wetlands for the benefit of humankind in a way that is compatible with the maintenance of the natural properties of the ecosystem.

Wetlands are designated as Ramsar sites on the basis of their ecological, botanical, zoological, limnological or hydrological values. The Hosnie's Spring site was listed because it consists of a stand of mangroves including *Brugiera gymnorhiza* and *B. sexangula*, located approximately 30 metres above sea level and 120 metres inland of the seaward cliff.

This stand is considered remarkable for three reasons: it occurs up to 37 metres above sea level and on an inclined surface; the mangroves are among the largest of their species ever recorded; and conditions favourable for mangrove establishment do not appear to have existed since the Interglacial period, therefore the stand has probably persisted in this location for up to 120,000 years. The stand is maintained by a permanent freshwater spring.

Hosnie's Spring wetland is in a relatively pristine condition because of its isolation. Under the Plan the wetland will be managed to ensure that development and recreational activities do not impede or inhibit regeneration of the mangroves.

A Ramsar Information Sheet (RIS) has been prepared for Hosnie's Spring, and is available through Environment Australia or can be downloaded from:

http://www.wetlands.agro.nl/ramsar_database/Ramsar_Dir/Australia_pt2/Contents.asp

A more comprehensive description is provided at (Appendix B) to this Plan.

During the life of this Plan, Parks Australia may recommend to the Commonwealth Government that 'The Dales' area be designated by the Commonwealth under the Ramsar Convention for inclusion in the List of Wetlands of International Importance in recognition of its unique qualities. The Dales includes significant karst features, surface water (streams and a waterfall), ecological assemblages containing populations of blue crabs, red crabs, robber crabs and stands of Tahitian chestnuts, and a series of dales (a low gorge or gully) occurring between ocean cliffs resulting in small beaches and rock pools.

Management of the Dales involves site monitoring by Parks Australia staff, management of visitor impacts, the erection and maintenance of interpretive signs and installation of above-ground boardwalks.

21. Other International Agreements

Australia is a signatory to the Convention for the Protection of the World Cultural and Natural Heritage (World Heritage Convention), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and the Convention on the Conservation of Nature in the South Pacific (Apia Convention). Parks Australia staff support the Christmas Island quarantine service in searches and seizure of items prohibited by CITES.

22. Leases

Mining Lease

The lease between the Commonwealth of Australia and Phosphate Resources Limited sets out the terms and conditions agreed between the parties for the mining, stockpiling, transporting, processing and export of phosphate on Christmas Island.

Christmas Island Resort Lease

The lease between the Commonwealth of Australia and Christmas Island Resort Pty Ltd sets out the requirement for the lessee, in consultation with the Commonwealth, to develop and implement adequate measures to protect the environment of Christmas Island in relation to any proposed development associated with the resort.

23. Rainforest Protection

In 1988 the Commonwealth Government announced that there would be no further clearing of rainforest (a moratorium) on Christmas Island and that a program would re-establish rainforest habitat in former phosphate mining fields. The moratorium is still in effect.

Appendix A - Excavations, Buildings and Other Structures and Works

Subsection 354(1) of the EPBC Act provides that a person, including the Director, may only carry on an excavation, erect a building or other structure, or carry out works, in a Commonwealth reserve, in accordance with a management plan for the reserve. The following is list of such actions that are required to be, or may be taken, during the life of this Plan.

Developments by Parks Australia, proposed or potential within the life of this Plan:

- overall upgrade of roads and access
- crab crossings on red crab migration routes
- two toilets, one at the Blowholes carpark and in the vicinity of Martins Point
- interpretive signs at Pink House Nature Trail
- miscellaneous bench seats and other furniture on walking tracks
- trailhead interpretive signs
- rainforest canopy walk
- continued upgrading of Hugh's Dale waterfall access
- upgrade of workshop/storage/laboratory facilities at Drumsite Headquarters and nursery.

Developments by other bodies or joint ventures

- The Director will consider requests to conduct activities in the Park not specified in this Plan and may issue permits for such activity if in the Director's judgement such activities are not inconsistent with the purpose of the Park and the IUCN Reserve Management Principles. To protect Park values, the Director may impose conditions on these activities.

Appendix B - Ramsar Information Sheet from Directory of Wetlands of International Importance

Site: Hosnie's Spring		Designation date: 11/12/1990	
Coordinates: 10°28'S 105°41'E	Elevation: 24-37 m		Area: 0.33 ha
Location: Hosnie's Spring lies on Christmas Island, in the Indian Ocean west of Australia.			
Criteria: 1d, 2a, 2d Hosnie's Spring is an example of a highly unusual wetland type, unique to Christmas Island and perhaps unique world-wide. The site encompasses a unique stand of mangroves of the genus <i>Bruguiera</i> . It is the only stand of mangrove on this island, and comprises between 300 and 600 <i>Bruguiera</i> trees, including some of the largest ever recorded. Its age is estimated at 120,000 years. It is unlike most tidal <i>Bruguiera</i> forests. The probability of such a small stand of trees successfully regenerating at one site for this great length of time, without propagules from outside, is very small indeed. The site supports an assemblage of flora that is restricted to just one location, and additionally several endemic and vulnerable species. Globally threatened robber crabs <i>Birgus latro</i> and blue crabs <i>Cardisoma hirtipes</i> are found. The blue crab is totally protected on the island. Endemic species include many birds, like pigeon <i>Ducula whartoni</i> , dove <i>Chalcophaps indica natalis</i> , goshawk <i>Accipiter fasciatus natalis</i> , hawk-owl <i>Ninox natalis</i> , thrush <i>Turdus poliocephalus erythroleurus</i> , and white-eye <i>Zosterops natalis</i> .			
Wetland Types: Xf, M, Y The wetland consists of a stand of mangroves <i>Bruguiera gymnorhiza</i> and <i>B. sexangula</i> located approximately 30 metres above sea level and 120 metres inland of a seaward cliff. It encompasses an area of shallow freshwater streams and seepages. The mangrove stand is maintained by a permanent freshwater spring.			
Biological/Ecological notes: The margins of the wetland are discrete; to the north and west there are limestone cliffs and fallen blocks, to the south the transition to <i>Hibiscus</i> and <i>Pandanus</i> is abrupt, while to the east there is a gap of 8-10 m between the stand and a <i>Barringtonia</i> , <i>Pandanus</i> and <i>Ficus</i> forest. The mangroves within the stand are regenerating. The present structure comprises few enormous individuals and abundant saplings and seedlings. The stand is particularly susceptible to extinction due to storm or lightning damage or total senescence. The most conspicuous element of the fauna in the mangroves is the ubiquitous crabs which reach extraordinary densities on the island. The red crab <i>Gecarcoidea natalis</i> , which is restricted to Christmas Island and the Cocos Islands, is the most abundant.			
Hydrological/Physical notes: Christmas Island is an uplifted island of 135 square kilometres rising to 361 metres above sealevel. Prominent around the coast of the island are limestone terraces backed by inland cliffs. Hosnie's Spring lays atop gravel and phosphatic soil. The actual spring is one of a limited number of permanent springs on Christmas Island. Flow rates in the spring are very low.			
Human Uses: The principal industry on Christmas Island is phosphate mining although this activity is pursued on a reduced scale since 1988. It is restricted to removal of previously stockpiled ore and re-mining of existing quarries. The Australian Government is encouraging development of a tourism industry on the island. No specific research is currently being carried on at Hosnie's Spring. However, there is a research and education station on the island, which would greatly facilitate future research on the site.			
Conservation Measures: Hosnie's Spring was incorporated within Christmas Island National Park on 20 December 1989 and is managed by the Australian National Parks and Wildlife Service (now Parks Australia). The isolation of the wetland means that it is in relatively pristine condition. Protective measures have been introduced under a Plan of Management for the National Park, so that development and recreational activities on the island do not impede or inhibit regeneration of the mangroves.			
Adverse Factors: Although not currently important, Hosnie's Spring is a potential tourist attraction, especially with the new tourist resort that has been built on the east coast. However, tourism is still regarded a minor threat due to the relative isolation of Hosnie's Spring.			
Most recent Ramsar Information Sheet/datasheet: 1998; Please see Introduction for more details.			

Appendix C - Main Risks to Human Health and Safety and Conservation of Natural and Cultural Heritage Considered in this Plan

This Appendix to the Management Plan lists some of the main risks to human health and safety and to conservation that are considered in the Plan and some of the most relevant prescriptions that address these risks. The list is not comprehensive and further information on management of a range of risks in Christmas Island National Park is found in the Plan.

Risks to human health and safety

Type of risk	Prescriptions in Management Plan
Injury to or death of people through accidents while in park	<ul style="list-style-type: none"> • 9.3: g, h • 10.3: b, e, g, h • 11.3: a, d, l, n, t, v • 12.3: c, d, p, q

Risks to conservation of natural and cultural heritage

Type of risk	Prescriptions in Management Plan
Loss of native vegetation due to clearing in the park	<ul style="list-style-type: none"> • 7.3: a
Loss of native biodiversity due to insufficient or ineffective rehabilitation of minefields and other cleared areas	<ul style="list-style-type: none"> • 7.3: b, h • 8.3: f
Reduced native biodiversity due to infestation by weeds	<ul style="list-style-type: none"> • 7.3: c, d, f
Reduced biodiversity and adverse impacts on threatened species due to Crazy Ant infestation	<ul style="list-style-type: none"> • 8.3: h
Reduced biodiversity and adverse impacts on threatened species due to other introduced animals (see Table 3 for threat ratings of species)	<ul style="list-style-type: none"> • 8.3: i, j, k
Adverse impacts on red crabs due to road kills during migration	<ul style="list-style-type: none"> • 8.3: c, d
Reduced abundance of species due to illegal activities	<ul style="list-style-type: none"> • 8.3: a • 9.3: a • 14.3: i – n
Reduced abundance of marine species due to over-fishing	<ul style="list-style-type: none"> • 9.3: b, c, d, e, f
Declines in abundance of rare or threatened species due to failure to implement research programs or recovery plans	<ul style="list-style-type: none"> • 7.3: e • 8.3: b, e, l, m, n • 13.3: a – h
Adverse environmental impacts due to developments in the park	<ul style="list-style-type: none"> • 14.3: e, f • 15.3: a

SCHEDULE 1

Conditions of the licence issued to the Christmas Island Water Corporation to operate the water pumping stations at Jane Up, Jedda Cave and Grants Well and their associated easements

1. No primary rainforest shall be cleared.
2. No further building construction or renovation shall be carried out without the permission of Parks Australia.
3. Public access along easements shall be the responsibility of the licensee.
4. Clearing of tree falls, secondary growth and individual trees on the existing alignments and occupations shall be the responsibility of the licensee and permitted only after consultation with Parks Australia.
5. Cleared vegetation shall not be pushed into primary rainforest.
6. Ground shall not be cleared to bare earth. A slashed ground cover shall be maintained.
7. Weed control is the responsibility of the licensee and may only be carried out in consultation with, and with the permission of, Parks Australia.

SCHEDULE 2

Conditions of the licence issued to the Administration (Christmas Island Power Authority) for the use of easements through the Park to operate electric power lines

1. No primary rainforest shall be cleared.
2. Public access along easements shall be the responsibility of the licensee.
3. Clearing of tree falls and secondary growth on the existing alignments and occupations shall be the responsibility of the licensee and permitted only after consultation with Parks Australia.
4. Cleared vegetation shall not be pushed into primary rainforest.
5. Ground shall not be cleared to bare earth. A slashed ground cover shall be maintained.
6. Weed control as assessed and determined by Parks Australia shall be the responsibility of the licensee.
7. No further building construction or renovation shall be carried out without the permission of Parks Australia.

SCHEDULE 3

Conditions of the licence issued to the Shaolin Temple Association for the use of Park land for the operation of two temples

1. The licence shall not be transferable.
2. No vegetation shall be cleared without permission from Parks Australia.
3. Sites shall be kept neat and tidy and all rubbish removed from the Park.
4. Fires are permitted in designated places only.
5. No building or renovation shall be carried out without the permission of Parks Australia.

SCHEDULE 4

Conditions of the licence for the domestic occupancy of Grants Well Refer to 12.1 12.3(b) and 15.3(g) in this Plan

1. The licence shall not be transferable and cannot be passed onto heirs and successors.
2. Continuation of occupancy provisions shall apply i.e. the licence shall be forfeited if the area is unoccupied for a specified time or licence conditions are not met.
3. No clearing of rainforest shall be permitted.
4. A schedule of environmental conditions shall apply.
5. Restrictions on commercial activities may apply.
6. Controls on domestic animals shall apply.
7. The area must be kept neat and tidy.
8. The occupant shall be responsible for the maintenance of the building and surrounds.
9. Weed control as assessed and determined by Parks Australia shall be the responsibility of the licensee.
10. No further building or renovation shall be carried out without the permission of Parks Australia.

SCHEDULE 5

Quarantine list of prohibited animals and plants

TERRITORY OF CHRISTMAS ISLAND

CHRISTMAS ISLAND QUARANTINE SERVICE

Definition of Diseases in relation to Animals

Item (1)

Animal diseases as per section 5(1) of the Commonwealth Quarantine Act 1908 for the purpose of that section to be referred to as section 6 of the Christmas Island (C.I.) Quarantine Ordinance.

- (a) Proclamation No. (151A) of the Quarantine Act of 1908 dated 15 / 12 / 93 to be used in preference to Proclamation No. (152A) as (151A) has more animal diseases listed. Most of the listed diseases in (151A) are not relevant to (C.I.) but should be kept in case a particular industry was to establish. Diseases listed in schedule 2 to be declared as a Quarantine disease. Insects and parasites affecting animals to be declared as a disease of animals.

Section (1a) Prohibited the importation into the Territory of Christmas Island all live animals including: insects, aquatic and marine, from all countries including Australia, as listed in schedule (2)

(1aa) Exceptions to section (1a) as in schedule (1) restricted animals.

Schedule (1) Restricted animals for the purpose of this section to be live fresh water fish (as in aquarium) from all countries, live chickens (as in poultry) from Australia only. The above are subject to import permit and conditions.

Schedule (2) Declared Animal Quarantine Diseases

Aedes sp	Mosquitoes	Haemorrhagic enteritis virus
Avian	Encephalomyelitis	Newcastle disease
Avian	Haemagglutinating adenovirus	
Avian	Herpesvirus infection	
Avian	Infectious bronchitis	
Avian	Infectious laryngotracheitis	
Avian	Malaria	
Avian	Papovavirus infection	
Avian	Paramyxovirus infection	
Avian	Poxvirus infection	
Avian	Reovirus infection	
Avian	Tuberculosis	
Avian	Arthritis	
Chicken	Anaemia agent	
Coronavirus	Enteritis and hepatitis of poultry	
Fowl	Cholera	
Fowl	Plague (avian influenza)	
Fowl	Pox	
Fowl	Typhoid	

Aquatic (fresh water) and Marine Diseases

Branchiomycosis
Capillaria spp.
Carp pox
Channel catfish virus
Chum salmon virus
Crayfish plague
Edwardsiella tarda infection
Edwardsiellosis
Eel papillomatosis
Epizootic ulcerative syndrome
European eel virus
Gill disease virus infection
Goldfish ulsa disease
Grey patch disease of turtles
Herpes virus infection
Infectious pancreatic necrosis
Infectious haematopoietic necrosis
Lumpy skin disease
Mud blister of oysters
Myobolosis (whirling disease)
Nocardiosis of fish and shell fish
Velar virus of shell fish
Per kinsus marinus infection of shell fish
Proliferative kidney disease of fish
Pullorum disease (*Salmonella pullorum*)

Rhabdovirus infection of fish
Rosy barb agent
Salmon blood spot, pox
Septicaemic cutaneous ulcerative disease of turtles

Schedules

Schedule (1) Plant diseases

There is a lack of knowledge of plant diseases present on Christmas Island and it is difficult to secure any specific information on potential imported disease or disease threat specific to the island's vegetation. As a result, it is not possible to develop a comprehensive declared list of plant diseases. Once a comprehensive assessment of plant disease has been established then the appropriate proclamations can be submitted.

Because of the current lack of knowledge, a generalised declaration has been made to prohibit the introduction into the Territory of Christmas Island any disease, germ, microbe, disease agent, culture virus, pathogen virus, fungi, schizomycetes, bacteria, actinomycetes, slime and moulds including:

<i>Phytophthora cinnamomii</i>	Cinnamon fungus
<i>Phytophthora</i> sp	Fungus
Red top	Fungus
Core rot	Fungus
Palm rust	Fungus
<i>Gleosporium palmarum</i>	Palm leaf blight
<i>Pestalotiopsis</i> spp	Palm leaf spot
<i>Bipolaris incurvata</i>	Palm ring spot
Sooty mould	Fungus
<i>Phytoplasma</i>	Lethal Yellow Disease
Nematode sp	Head drop of coconuts

Schedule (2) Plant Pests

<i>Acarina</i>	Mites and ticks
<i>Agonoxena phoenicia</i>	Palm moth
<i>Agromyzidae</i>	Leaf and stem miners
<i>Aleurodidae</i>	White flies
<i>Anadastus</i>	Palm beetle
<i>Anobiidae</i>	Timber and stored products beetle
<i>Anthomyidae</i>	Root maggot flies
<i>Bemesia tabaci</i>	Poinsettia white fly
<i>Blastobasis sarcophaga</i>	Palm moth
<i>Bostrychidae</i>	Tree borers
<i>Buprestidae</i>	Tree and timber borers
<i>Bruchidae</i> spp	Palm seed borer
<i>Brontspa longissima</i>	Palm leaf beetle
<i>Cephalidae</i>	Stem boring saw flies
<i>Cephrenes trichopepla/ augiade</i>	Yellow & orange palm dart moth
<i>Cerambycida</i>	Tree borers
<i>Ceroplastes rubens</i>	Pink wax scale
<i>Chryeomphalus aonidum</i>	Circular black scale
<i>Chrysomelidae</i>	Leaf eating beetle
<i>Coccidae</i>	Scale insects and meal bugs
<i>Coccus hesperidum</i>	Soft brown scale
<i>Coleoptera</i>	Beetles, borers
<i>Cerambycidae</i>	
<i>Cossidae</i>	Wood boring moth
<i>Curulionidae</i>	Weevils
<i>Delphacidae</i>	Leaf hoppers
<i>Deudorix epijarbas dido</i>	Palm butterflies

<i>Ephestia</i>	Tobacco and stored food moth
<i>Eriophyes hibisdi</i>	Leaf crumpling mite
<i>Eucalymnalus tessellatus</i>	Flat brown scale
<i>Eumerus</i>	Bulb flies
<i>Eurytomidae</i>	Grass and seed wasp
<i>Formicidae</i>	Ants
<i>Gelechiidae</i>	Twig, leaf and seed moth
<i>Hemipeplus australasicus</i>	Palm beetle
<i>Hylotrupes bajulus</i>	European house borer
<i>Hymenoptera</i>	Wasp, ants
<i>Hepialiadae</i>	Wood boring moth
<i>Ips grandicollis</i>	Five spined bark beetle
<i>Isoptera</i>	Termites or white ants
<i>Iassidae</i>	Leaf hopper
<i>Icerya purchasi</i>	Cottony cushion scale
<i>Lyclidae</i>	Powder post beetle
<i>Parlatoria proteus</i>	Palm scale
<i>Paratetranychus pilosus</i>	European red mite
<i>Pinnaspis spp</i>	Fern or coconut scale
<i>Platypodinae</i>	Palm seed borer
<i>Popillia japonica</i>	Japanese beetle
<i>Portheria dispar</i>	Gypsy moth
<i>Pironoplus reticulatus</i>	Huhu Huhu beetle
<i>Pseudococcus sp</i>	Mealy bugs
<i>Pyralidae</i>	Leaf roller
<i>Saissetia nigra</i>	Nigra scale
<i>Scaradaeidae</i>	White grub beetle
<i>Scolytidae</i>	Bark beetle
<i>Smultistriatus</i>	Bark beetle
<i>Siricidae</i>	Wood wasp
<i>Sirex noctilio</i>	Sirex wasp
<i>Stirastoma</i>	Cacao beetle
<i>Thysanoptera</i>	Thrips
<i>Tortriciae</i>	Leaf / fruit moths

Schedule (3) Noxious plants

Any species of the genus <i>Cenchrus</i> that has burrs	
<i>Abrus precatorius</i>	Crabs eye
<i>Acacia</i>	Wattles
<i>Acanthospermum</i>	Starburr
<i>Acroptilon repens</i>	Creeping knapweed
<i>Aegilops species</i>	Goat grasses
<i>Agave spp</i>	
<i>Ageratina adenophorum</i>	Crofton weed
<i>Ageratina riparium</i>	Mistflower
<i>Albizzia spp.</i>	
<i>Alhagi pseudalhagi</i>	Camelthorn
<i>Allium vineale</i>	Crow garlic
<i>Aloe spp.</i>	
<i>Alternanthera philoxeroides</i>	Alligator weed
<i>Alternanthera pungens</i>	Khaki weed
<i>Ambrosia spp.</i>	Rag weed
<i>Amsinckia spp.</i>	Yellow burr weed
<i>Anredera spp.</i>	

<i>Araujia</i>	
<i>Arenga</i> spp.	
<i>Argemone mexicana</i>	Mexican poppy
<i>Asparagus</i> (including <i>Protoasparagus/ Myriophyllum</i>) spp.	
<i>Baccharis halimifolia</i>	Groundsel bush
<i>Berberis</i>	Barberry
<i>Berkhaya rigida</i>	African thistle
<i>Brachiaria</i> spp.	
<i>Bryophyllum</i> (including <i>Kalanchoe</i>) spp.	
<i>Bromus commutatus</i>	Hairy chess
<i>Cabomba</i> spp.	Cabomba
<i>Calotropis procera</i>	Calotrope, i.e. rubber tree or rubber bush
<i>Cannabis sativa</i>	Indian hemp
<i>Cardia draba</i>	Hoarycress/white weed
<i>Cardiospermum</i> spp.	
<i>Carduus nutans</i>	Nodding thistle
<i>Carthamus glaucus</i>	Glaucous star thistle
<i>Carthamus lanatus</i>	Saffron thistle
<i>Carthamus leucicaulos</i>	Glaucous star, distaff thistle
<i>Cassia</i> spp.	
<i>Celtis – exotic</i> spp.	
<i>Cenchrus gracillmus</i>	
<i>Centaurea calcitrapa</i>	Star thistle
<i>Centaurea solstitialis</i>	St Barnaby's thistle
<i>Cestrum perqui</i>	Green cestrum or green poisonberry
<i>Chondrilla juncea</i>	Skeleton weed
<i>Chromolaena</i> spp.	
<i>Chrysanthemoides monilifera</i>	Boneseed
<i>Cinnamomum exotic</i> spp.	
<i>Cirsium arvense</i>	Perennial, Californian creeping thistle
<i>Clerodendrum</i> spp.	
<i>Clidemia</i> spp.	
<i>Coccinia</i> spp	
<i>Conium species</i>	Hemlocks
<i>Convolvulus</i>	Field bindweed
<i>Cortaderia judata hispidum</i>	
<i>Cortaderia richardii</i>	
<i>Cryptostegia</i> spp.	
<i>Cuscuta</i> spp.	Dodder
<i>Cynara</i>	Artichoke thistle
<i>Cyperus aromaticus</i>	
<i>Datura</i> spp.	Thorneapple
<i>Dinebra retroflexa</i>	Dinebra
<i>Diplotaxis tenuifolia</i>	Sand rocket
<i>Dipsacus sylvestris</i>	Wildeasel
<i>Echium italicum</i>	Italian Bugloss
<i>Echium plantagineum</i>	Patterson curse
<i>Egeria densa</i>	Leafy elodea water
<i>Elodea</i> spp.	Pond weed
<i>Emex australis</i>	Doublegee
<i>Emex spinosa</i>	Lesser Jack
<i>Eremocarpus setiger</i>	Dove weed
<i>Eurocereus martinii</i>	Harrisia cactu
<i>Eucalyptus</i> spp.	
<i>Eupatorium</i> spp.	

<i>Euphorbia lathyris</i>	Caper spurge
<i>Euphorbia paralias</i>	Sea spurge
<i>Euphorbia segetalis</i>	Shortstem carnation
<i>Euphorbia terracina</i>	Geraldton carnation
<i>Furcraea</i> spp.	
<i>Gaura</i> spp.	Clock weeds
<i>Gleditsia</i> spp.	
<i>Gmelina asiatica</i>	Badara bush
<i>Gomphocarpus fruticosus</i>	Cotton bush
<i>Gorteria personata</i>	Gorteria
<i>Halogeton glomeratus</i>	Halogeton
<i>Harrisia</i> spp	
<i>Harungana</i> spp	
<i>Helenium species</i>	Sneeze weeds
<i>Helianthus ciliaris</i>	Texas blueweed
<i>Heliotropium</i> spp.	Heliotrope
<i>Homeria</i> spp.	Cape tulips
<i>Hypericum perforatum</i>	St Johns wort
<i>Hyptis capitata</i>	Knobweed
<i>Hyptis suaveolens</i>	Hyptis
<i>Hydrocotyle</i> spp.	
<i>Ibicella lutea</i>	Devils claw
<i>Ipomoea purpurea</i>	Morning glory
<i>Iva axillaris</i>	Poverty weed
<i>Jacaranda</i> spp.	
<i>Jatropha</i> spp.	
<i>Lactuca pulchella</i>	Blue lettuce
<i>Lantana</i> spp.	Lantana
<i>Largosiphon major</i>	Largosiphon
<i>Ligustrum exotic</i> spp.	
<i>Linaria dalmatica</i>	Dalmation toadflax
<i>Macfadyena</i> spp.	
<i>Malachra fasciata</i>	Malachra
<i>Mahonia</i>	
<i>Marrubium vulgare</i>	Horehound
<i>Martynia annua</i>	Devils claw
<i>Mentha pulegium</i>	Penny royal
<i>Merremia</i> spp.	
<i>Mikania</i> spp	
<i>Mimosa</i> spp.	Sensitive plants
<i>Myagrurn perfoliatum</i>	Musk weed
<i>Myrica</i> spp	
<i>Myriophyllum aquaticum</i>	Brazilian water milfoil/parrots feather
<i>Myriophyllum spicatum</i>	
<i>Nassella trichotoma</i>	Serrated tussock
<i>Ochna</i> spp.	
<i>Onopordum acanthium</i>	Cotton thistle
<i>Onopordum acaulon</i>	Stemless thistle
<i>Opuntia species</i>	Prickly pear
<i>Orobanche species</i>	Broomrape
<i>Oryza rufipogon</i>	Red or wild rice
<i>Oxalis</i> spp.	Sourgrass, bulbous, tuberous spp
<i>Papaver somniferum</i>	Opium poppy
<i>Parkinsonia aculeata</i>	Parkinsonia
<i>Parthenium hysterophorus</i>	White top

<i>Passiflora</i> spp.	
<i>Peganum harmala</i>	African rue
<i>Pennisetum macrourum</i>	African feather grass
<i>Pennisetum pedicellatum</i>	Pennisetum
<i>Pentzia suffruticosa</i>	Calomba daisy
<i>Phragmites</i> spp.	
<i>Physalis viscosa</i>	Sticky cape gooseberry
<i>Phytolacca</i> spp.	
<i>Picnomon acarna</i>	Soldier Thistle
<i>Pistia stratiotes</i>	Water lettuce
<i>Proboscidea louisianica</i>	Devils claw
<i>Prosopis</i> spp.	Mesquites
<i>Rorippa austriaca</i>	Austrian field grass
<i>Rivinia</i> spp.	
<i>Rubus</i> spp.	
<i>Sagittaria graminea</i>	Sagittaria aquatic
<i>Sagittaria montevidensis</i>	Arrowhead aquatic
<i>Salvia aethiopsis</i>	Mediterranean sage
<i>Salvia reflexa</i>	Mintweed
<i>Salvinia</i> spp.	Salvinias
<i>Schinus</i> spp.	
<i>Scolymus hispanicus</i>	Golden thistle
<i>Scolymus maculatus</i>	Spotted thistle
<i>Selaginella</i> spp.	
<i>Senecio jacobaea</i>	Rugwort
<i>Senecia pterophorus</i>	African daisy
<i>Senna</i> spp	
<i>Setaria faberi</i>	Giant foxtail
<i>Sida acuta</i>	Spinyhead sida
<i>Sida cordifolia</i>	Flannel weed
<i>Sida leprosa</i>	Alkali sida
<i>Silybum marianum</i>	Variiegated thistle
<i>Sinapis arvensis</i>	Charlock
<i>Solanum carolinense</i>	Carolina horse thistle
<i>Solanum elaeagnifolium</i>	Silverleaf nightshade, Silvertail nightshade or white horse nettle
<i>Solanum hermannii</i>	Apple of Sodom
<i>Sonchus arvensis</i>	Corn sowthistle
<i>Sorghum alnum</i>	Columbus grass
<i>Sorghum halepense</i>	Johnson grass
<i>Stachytarpheta jamaicensis</i>	Jamaica snakeweed
<i>Stachytarpheta urticifolia</i>	Snake weed
<i>Stipa brachyaeta</i>	Espartillo
<i>Stratiotes aloides</i>	
<i>Striga species</i>	Witch weed
<i>Stylosanthes</i> spp.	
<i>Taeniatherum caput-medusae</i>	Medusa head
<i>Tagetes</i> spp.	
<i>Themeda quadrivalis</i>	Grader grass
<i>Thevetia</i> spp.	
<i>Thunbergia</i> spp.	
<i>Toxicodendron radicans</i>	Poison ivy
<i>Trapa</i>	
<i>Tribulus terrestris</i>	Caltrop
<i>Typha</i>	

Ulex europaeus
Wedelia glauca
Xanthium spp.
Zantedeschia aethiopica
Ziziphus spp.

Gorse
Pascalia weed
Burr thistle
Arum lily

GLOSSARY

<i>Anchialine</i>	Anchialine habitats consist of bodies of haline waters, usually with a restricted exposure to open air, always with more or less extensive subterranean connections to the sea, and showing noticeable marine as well as terrestrial influences (Stock et al.1986). They typically occur in volcanic or limestone bedrock.
<i>Assemblage</i>	A collection of individuals, usually of different types
<i>Beach</i>	Intertidal beaches (sand, gravel, stone, coral, rubble)
<i>Chemoautotroph</i>	Any organism using inorganic sources of carbon, nitrogen etc. as starting materials for biosynthesis, and an inorganic chemical energy source
<i>Community</i>	Any group of organisms belonging to a number of different species that co-occur in the same area and interact through trophic and spatial relationships
<i>Diversity</i>	Variety, often expressed as a function of a number of species in a sample, sometimes modified by their relative abundances
<i>Echinoderm</i>	A phylum of marine coelomate animals (eg starfish, sea urchins, sea cucumbers)
<i>Ecosystem</i>	A dynamic complex of plant, animal, fungal and micro-organism communities and the associated non-living environment acting as an ecological unit
<i>El Nino</i>	A particular pattern of the ocean-atmosphere system in the Tropical Pacific having important consequences for weather and climate around the globe
<i>Endemic</i>	Restricted to a certain region or part of region
<i>Exotic</i>	A foreign plant, animal or organism not from that region
<i>Fringing Reef</i>	A reef that fringes an oceanic island, a continental island or a continental mainland. It typically consists of an inner intertidal flat, and outer intertidal flat and an outer slope.
<i>Genus</i>	A category including closely related species. Interbreeding between organisms within the same category can occur
<i>Habitats</i>	The biophysical medium or media: (a) occupied (continuously, periodically or occasionally) by an organism or group of organisms; or (b) once occupied (continuously, periodically or occasionally) by an organism, or group of organisms, and into which organisms of that kind have the potential to be reintroduced.
<i>Hydrology</i>	The scientific study of the nature, distribution and behaviour of water
<i>Invertebrates</i>	A general term for all animals without backbones

<i>Karst</i>	Includes surface and subterrean landscape features formed in water-soluble carbonate rocks, for example limestone or dolomite
<i>Kraznozem Soils</i>	Falling within the Soil Order 'Ferrosoils' according to the Australian Soil Classification (Isbell 1996), these soils commonly form from basic igneous rocks under conditions of strong leaching. They are characterised by a strong red colour, increasing clay content with depth and lack of clear boundaries between horizons
<i>Leeward</i>	Side protected from the wind
<i>Limnology</i>	The study of the physical properties (including biological) and other aspects of lakes and other standing waters.
<i>Monitoring</i>	Repeated observation of a system, usually to detect change
<i>Overburden</i>	Soil materials, both organic and mineral, and weathered unmineralised rock of no economic value which have to be removed to allow access to the economically exploitable mineral resource below
<i>Perennial</i>	Plant which persists for more than two years
<i>Population</i>	All individuals of one or more species within a prescribed Area
<i>Primary Native Vegetation</i>	Vegetation where there is no significant changes in species composition or number over time. Small changes in plant numbers and species may occur, but they are not cumulative in their effect and result merely in fluctuations about some long-term mean
<i>Pristine</i>	Natural, uncorrupted state
<i>Qualitative</i>	Descriptive, non-numerical, assessment
<i>Quantitative</i>	Numerical; based on accounts, measurements or other values
<i>Reafforestation</i>	Establishment of a tree-based ecosystem similar in characteristics to the forest ecosystem naturally established on the site prior to mining or other forms of development which led to tree clearing
<i>Rehabilitation</i>	Treatment of a site post-development which results in the establishment of a self sustaining ecosystem and associated land use that is in accord with the applicable legal requirements and with the agreement of the stakeholders
<i>SCUBA</i>	Self-Contained Underwater Breathing Apparatus
<i>Species</i>	A classification of related organisms that can freely interbreed
<i>Speleology</i>	The exploration, description and scientific study of caves and related phenomena
<i>Subterranean</i>	Existing or occurring under the earth's surface; underground
<i>Symbiosis</i>	The close association of two or more dissimilar organisms where both receive an advantage from the association

<i>Taxa</i>	Of taxon, i.e. any defined unit (e.g. species, genus, family) in the classification of living organisms
<i>Tectonic Plates</i>	Large segments of the outer part of the earth which move relative to one another
<i>Terra Rossa Soils</i>	Reddish residual clay soil developed on limestone
<i>Terrestrial</i>	Living or found on land, as opposed to in rivers, lakes or oceans, or in the atmosphere
<i>Trophic (Group)</i>	Individuals grouped by the way in which they obtain food; similar relative position in the food chain
<i>Vertebrates</i>	Animals possessing a well-formed bony or cartilaginous vertebral column or backbone enclosing the spinal cord
<i>Water Column</i>	A volume of water between the surface and the bottom
<i>Windward</i>	Side exposed to the wind

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