



## PART 2

# Christmas Island National Park Management Plan

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# 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 The plan will cease to have effect seven years after commencement, unless it has already been revoked or replaced with a new plan.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* (NPWC Act) 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;

**SOCI** 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 NPWC 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/](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/](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 comprising 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 per cent 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 of 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 per cent) 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 unrehabilitated 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.

**Table 1: Areas requiring rehabilitation and work completed**

Mining Fields	Area of Field (ha)	Area Rehabilitated (ha)	Date of Rehabilitation	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.

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, 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.

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. *molucanna*, *Adenanthera 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 north east 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 bestride 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 CIRR. 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 per cent 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 per cent in the red crab population is considered conservative, and may be as high as 40–50 per cent, 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.

#### 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

**Table 3: Threat rating of Exotic Wild and Feral Domestic Animals**

<b>Animal</b>	<b>Perceived level of threat</b>	<b>Action (at Feb 2002)</b>
<b>EXOTIC WILD ANIMALS</b>		
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
terrapians	to be determined	none at present
aquatic vertebrates	to be determined	none at present
<b>FERAL DOMESTIC ANIMALS</b>		
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

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.

#### PERENNIALY 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;
- (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

- (g) 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

- (h) Additional measures may be developed and implemented to control and monitor non-native animals as resources permit.
- (i) A program to research, control, manage and monitor the impacts of the yellow crazy ant (*Anoplolepis gracilipes*) will continue as a high priority.
- (j) Collaboration with SOCI and the Christmas Island Administration on control of feral cats and exotic rodents will continue.
- (k) 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.

- (l) 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

- (m) Additional or appropriate material for taxonomic work will be provided (very few specimens are available and those that are, are often immature).
- (n) Assistance will be provided for the documentation of the diversity of the anchialine fauna.
- (o) 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 per cent) 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 CIP 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, CIP 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 EPBC 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. 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 Australian 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 Australia 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 in Table 4.

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.

**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)

### **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; and
- (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 legislation 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 per cent 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 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 37m 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](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 *Bruguiera*. It is the only stand of mangrove on this island, and comprises between 300 and 600 *Bruguiera* trees, including some of the largest ever recorded. Its age is estimated at 120,000 years. It is unlike most tidal *Bruguiera* 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 *Birgus latro* and blue crabs *Cardisoma hirtipes* are found. The blue crab is totally protected on the island. Endemic species include many birds, like pigeon *Ducula whartoni*, dove *Chalcophaps indica natalis*, goshawk *Accipiter fasciatus natalis*, hawk-owl *Ninox natalis*, thrush *Turdus poliocephalus erythropleurus*, and white-eye *Zosterops natalis*.

**Wetland Types:** Xf, M, Y

The wetland consists of a stand of mangroves *Bruguiera gymnorhiza* and *B. sexangula* 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 *Hibiscus* and *Pandanus* is abrupt, while to the

Ramsar Information Sheet from Directory of Wetlands of International Importance *continued*

east there is a gap of 8–10m between the stand and a *Barringtonia*, *Pandanus* and *Ficus* 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 *Gecarcoidea natalis*, 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 <b>accidents</b> while in park	<ul style="list-style-type: none"> <li>• 9.3: g, h</li> <li>• 10.3: b, e, g, h</li> <li>• 11.3: a, d, l, n, t, v</li> <li>• 12.3: c, d, p, q</li> </ul>
Risks to conservation of natural and cultural heritage	
Loss of native vegetation due to <b>clearing</b> in the park	• 7.3: a
Loss of native biodiversity due to insufficient or ineffective <b>rehabilitation</b> of minefields and other cleared areas	<ul style="list-style-type: none"> <li>• 7.3: b, h</li> <li>• 8.3: f</li> </ul>
Reduced native biodiversity due to infestation by <b>weeds</b>	• 7.3: c, d, f
Reduced biodiversity and adverse impacts on threatened species due to <b>Crazy Ant</b> infestation	• 8.3: h
Reduced biodiversity and adverse impacts on threatened species due to other <b>introduced animals</b> (see Table 3 for threat ratings of species)	• 8.3: i, j, k
Adverse impacts on red crabs due to <b>road kills</b> during migration	• 8.3: c, d
Reduced abundance of species due to <b>illegal activities</b>	<ul style="list-style-type: none"> <li>• 8.3: a</li> <li>• 9.3: a</li> <li>• 14.3: i – n</li> </ul>
Reduced abundance of marine species due to <b>over-fishing</b>	• 9.3: b, c, d, e, f
Declines in abundance of <b>rare or threatened species</b> due to failure to implement research programs or recovery plans	<ul style="list-style-type: none"> <li>• 7.3: e</li> <li>• 8.3: b, e, l, m, n</li> <li>• 13.3: a – h</li> </ul>
Adverse environmental impacts due to <b>developments</b> in the park	<ul style="list-style-type: none"> <li>• 7.3: e</li> <li>• 14.3: e, f</li> <li>• 15.3: a</li> </ul>



## Schedule 1

### Conditions of the licence issued to the Christmas Island Water Corporation

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)**

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

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

#### Item (1) – Definition of Diseases in relation to Animals

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.

## Item (2) – Definition of diseases in relation to plants

### Plant Diseases, Pests and Noxious Plants

Diseases of plants and pests of plants or a noxious plant to be a disease affecting plants, including aquatic and marine plants and pests and diseases of aquatic and marine plants, 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 Quarantine Ordinance.

#### Section (1)

Prohibit the importation into the Territory of Christmas Island plant diseases, pests of plants and noxious plants and seeds from noxious plants, as listed in schedules 1, 2 & 3.

#### (1a)

All plants are prohibited from all countries except Australia. Plants not listed in schedule (3) are restricted and require and import permit conditions apply.

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	Myobolosis (whirling disease)
Capillaria spp.	Nocardiosis of fish and shell fish
Carp pox	Velar virus of shell fish
Channel catfish virus	<i>Per kinsus marinus</i> infection of shell fish
Chum salmon virus	Proliferative kidney disease of fish
Crayfish plague	Pullorum disease ( <i>Salmonella pullorum</i> )
<i>Edwardsiella tarda</i> infection	Rhabdovirus infection of fish
Edwardsiellosis	Rosy barb agent
Eel papillomatosis	Salmon blood spot, pox
Epizootic ulcerative syndrome	Septicaemic cutaneous ulcerative disease of turtles
European eel virus	Shell diseases
Gill disease virus infection	Spring viraemia of carp
Goldfish ulsa disease	Prawn reovirus infection
Grey patch disease of turtles	Ulcer disease of fish
Herpes virus infection	Ulcerative shell disease
Infectious pancreatic necrosis	Viral haemorrhagic septicaemia of fish
Infectious haematopoietic necrosis	
Lumpy skin disease	
Mud blister of oysters	

### Bacteria

<i>Yersinia ruckeri</i>	<i>Streptococcus</i> spp.
<i>Aeromonas salmonicida</i>	<i>Mycobacterium</i> spp.
<i>Pasteurella piscicida</i>	<i>Renibacterium salmoninarum</i>
<i>Haemophilus piscium</i>	<i>Aeromonas hydrophila</i>
<i>Lactobacillus piscicola</i>	

### Animals in general

<i>Aedes</i> spp. Mosquitoes
Pancreas disease in reptiles
Rabies
Screwworm infection ( <i>Cochliomya hominivorax/Chrysomya bezziana</i> )

### 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:

Schedule (1) Plant Diseases	
<i>Phytophthora cinnamomii</i>	Cinnamon fungus
<i>Phytophthora</i> spp.	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 spp.	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

Schedule (2) Plant Pests *continued*

<i>Bruchidae</i> spp	Palm seed borer
<i>Brontspa longissima</i>	Palm leaf beetle
Cephalidae	Stem boring saw flies
<i>Cephrenes trichopepla/ugiade</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
Coccidae	Scale insects and meal bugs
<i>Coccus hesperidum</i>	Soft brown scale
Coleoptera	Beetles, borers
<i>Cerambycidae</i>	
Cossidae	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</i> spp	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</i> sp	Mealy bugs
<i>Pyralidae</i>	Leaf roller
<i>Saissetia nigra</i>	Nigra scale

### Schedule (2) Plant Pests *continued*

<i>Scarabaeidae</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</i> spp	
<i>Ageratina adenophorum</i>	Crofton weed
<i>Ageratina riparium</i>	Mistflower
<i>Albizzia</i> spp.	
<i>Alhagi pseudalhagi</i>	Camelthorn
<i>Allium vineale</i>	Crow garlic
<i>Aloe</i> spp.	
<i>Alternanthera philoxeroides</i>	Alligator weed
<i>Alternanthera pungens</i>	Khaki weed
<i>Ambrosia</i> spp.	Rag weed
<i>Amsinckia</i> spp.	Yellow burr weed
<i>Anredera</i> spp.	
<i>Araujia</i>	
<i>Argemone</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.	

**Schedule (3) Noxious plants** *continued*

<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>Chrimolaena</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</i> spp.	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>	Leafyelodeawater
<i>Elodea</i> spp.	Pond weed
<i>Emex australis</i>	Doublegee

Schedule (3) Noxious plants *continued*

<i>Emex spinosa</i>	Lesser Jack
<i>Eremocarpus setiger</i>	Dove weed
<i>Eirocereus 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</i> spp.	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

Schedule (3) Noxious plants *continued*

<i>Merremia</i> spp.	
<i>Mikania</i> spp.	
<i>Mimosa</i> spp.	Sensitive plants
<i>Myagrum 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</i> spp.	Prickly pear
<i>Orobanche</i> spp.	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>Picnoman 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 aethiops</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.	

Schedule (3) Noxious plants *continued*

<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>	Variegated 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 almum</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>	
<i>Ulex europaeus</i>	Gorse
<i>Wedelia glauca</i>	Pascalina weed
<i>Xanthium</i> spp.	Burr thistle
<i>Zantedeschia aethiopica</i>	Arum lily
<i>Ziziphus</i> spp.	



## Glossary

- Anchialine** 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.
- Assemblage** A collection of individuals, usually of different types.
- Beach** Intertidal beaches (sand, gravel, stone, coral, rubble).
- Chemoautotroph** Any organism using inorganic sources of carbon, nitrogen etc. as starting materials for biosynthesis, and an inorganic chemical energy source.
- Community** 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.
- Diversity** Variety, often expressed as a function of a number of species in a sample, sometimes modified by their relative abundances.
- Echinoderm** A phylum of marine coelomate animals (eg starfish, sea urchins, sea cucumbers).
- Ecosystem** A dynamic complex of plant, animal, fungal and micro-organism communities and the associated non-living environment acting as an ecological unit.
- El Niño** A particular pattern of the ocean-atmosphere system in the Tropical Pacific having important consequences for weather and climate around the globe.
- Endemic** Restricted to a certain region or part of region.
- Exotic** A foreign plant, animal or organism not from that region.
- Fringing Reef** 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.
<b>Genus</b>	A category including closely related species. Interbreeding between organisms within the same category can occur.
<b>Habitats</b>	The biophysical medium or media: <ul style="list-style-type: none"> <li>(a) occupied (continuously, periodically or occasionally) by an organism or group of organisms; or</li> <li>(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.</li> </ul>
<b>Hydrology</b>	The scientific study of the nature, distribution and behaviour of water.
<b>Invertebrates</b>	A general term for all animals without backbones.
<b>Karst</b>	Includes surface and subterrean landscape features formed in water-soluble carbonate rocks, for example limestone or dolomite.
<b>Kraznozem Soils</b>	Falling within the Soil Order 'Ferrosols' 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.
<b>Leeward</b>	Side protected from the wind.
<b>Limnology</b>	The study of the physical properties (including biological) and other aspects of lakes and other standing waters.
<b>Monitoring</b>	Repeated observation of a system, usually to detect change
<b>Overburden</b>	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.
<b>Perennial</b>	Plant which persists for more than two years.

<b>Population</b>	All individuals of one or more species within a prescribed area.
<b>Primary Native Vegetation</b>	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.
<b>Pristine</b>	Natural, uncorrupted state.
<b>Qualitative</b>	Descriptive, non-numerical, assessment.
<b>Quantitative</b>	Numerical; based on accounts, measurements or other values.
<b>Reafforestation</b>	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.
<b>Rehabilitation</b>	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.
<b>SCUBA</b>	Self-Contained Underwater Breathing Apparatus.
<b>Species</b>	A classification of related organisms that can freely interbreed.
<b>Speleology</b>	The exploration, description and scientific study of caves and related phenomena.
<b>Subterranean</b>	Existing or occurring under the earth's surface; underground.
<b>Symbiosis</b>	The close association of two or more dissimilar organisms where both receive an advantage from the association.
<b>Taxa</b>	Of taxon, ie. any defined unit (e.g. species, genus, family) in the classification of living organisms.
<b>Tectonic Plates</b>	Large segments of the outer part of the earth which move relative to one another.

<b>Terra Rossa Soils</b>	Reddish residual clay soil developed on limestone.
<b>Terrestrial</b>	Living or found on land, as opposed to in rivers, lakes or oceans, or in the atmosphere.
<b>Trophic (Group)</b>	Individuals grouped by the way in which they obtain food; similar relative position in the food chain.
<b>Vertebrates</b>	Animals possessing a well-formed bony or cartilaginous vertebral column or backbone enclosing the spinal cord.
<b>Water Column</b>	A volume of water between the surface and the bottom.
<b>Windward</b>	Side exposed to the wind.



## Bibliography and further reading

- Adamczewska, A.M. and Morris, S. (1994) *Exercise in the Terrestrial Christmas Island Red Crab Gecarcoidea natalis I. Blood Gas Transport*. Journal of Experimental Biology 188, pp 235–256.
- Adamczewska, A.M. and Morris, S. (1994) *Exercise in the Terrestrial Christmas Island Red Crab Gecarcoidea natalis II. Energetics of Locomotion*. Journal of Experimental Biology 188, pp 257–274.
- Adamczewska, A.M. and Morris, S. (1996) *The Respiratory Gas Transport, Acid-based State, Ion and Metabolite Status of the Christmas Island Blue Crab, Cardisoma hirtipes (Dana) Assessed in situ with Respect to Immersion*. Physiological Zoology 69, pp 67–92.
- Allen, G.R. (1979) *The Fishes of Christmas Island, Indian Ocean*, Special Publication (2), ANPWS, Canberra.
- Allen, G.R. (1986) *Marine Biological Survey of Christmas Island, Indian Ocean*, Commissioned by the Christmas Island Assembly and the Christmas Island Administration, Christmas Island.
- Allen, G.R. and Steene, R.C. (1988) *Fishes of Christmas Island, Indian Ocean*, Christmas Island Natural History Association, Christmas Island.
- Altevogt, R. (1982) *The Coconut Crab and its Need of Conservation*. Fish and Fishery, Special Issue, pp 37–44.
- Andrews, C.W. (1899) *A Description of Christmas Island (Indian Ocean)*, Geogr. J., 13, pp 17–35.
- Andrews, C.W. (1900) *A Monograph of Christmas Island (Indian Ocean)*, British Museum (Natural History), London.
- Andrews, C.W. (1900) *On the Marine Fauna of Christmas Island (Indian Ocean), Introductory Note*, Proc. Zool. Soc. London, pp 115–117.
- Andrews, C.W. (1909) *On the Fauna of Christmas Island*, Proc. Zool. Soc. London, 1 pp 101–103.
- Andrews, C.W. (1909) *On the Robber Crab, (Birgus latro)*, Proc Zool Soc. London, pp 887–889.
- Australian Biological Resources Study (1993) *Oceanic Islands 2, Flora of Australia*, Volume 50, AGPS, Canberra.
- Australian Bureau of Statistics, (1982) *Census of Population and Housing 30 June 1981*, AGPS, Canberra.
- Australian National Parks and Wildlife Service (1976) *Annual report*. Abbott's Booby Monitoring Program Expert Panel, ANPWS, Canberra.

- Australian National Parks and Wildlife Service (1984) *Christmas Island Environment Book*, ANPWS, ANPWS, Canberra.
- Australian National Parks and Wildlife Service (1985) *(1st) Christmas Island National Park Plan of Management*, Canberra.
- Australian National Parks and Wildlife Service (1986–1987) *Annual report. Abbott's Booby Monitoring Program*, ANPWS, Canberra.
- Australian National Parks and Wildlife Service (1991) *A Directory of Important Wetlands in Australia*. ANPWS, Canberra, pp 9–11.
- Australian Nature Conservation Agency (1994) *(2nd) Christmas Island National Park Plan of Management*, ANCA, Canberra.
- Barrett, P.J. (1973) *Phosphates on Christmas Island: A Guide to the Origin, Occurrence and Distribution of Christmas Island Phosphates*, British Phosphate Commissioners, Christmas Island.
- Barrett, P.J. (1985) *Christmas Island Water Resources*, Summary Report Feb.1985 (unpublished).
- Barrie, J. (1967) *The Geology of Christmas Island*, Bureau of Mineral Resources, Geology and Geophysics, Department of National Development, Canberra.
- Barrie, J. (1967) *The Geology of Christmas Island: Part 1*, Bureau of Mineral Resources, Geology and Geophysics, Record: 1967/37, Department of National Development, Canberra.
- Beng, F.C. (1966) *The Red Crabs – A Christmas Island Phenomena*, Aust. Territories, 6 (1), pp 20–23.
- Berry, P.F. (1988) *Survey of the Marine Fauna of Christmas Island, Indian Ocean*, Western Australian Museum, Report to ANPWS, Canberra.
- Bishop, R. (1964) Local Cave Exploration, *Christmas Island Bulletin*, Edition 33, April 1964.
- Boulenger, G.A. (1889) *On the Reptiles of Christmas Island*, Proc. Zool. Soc. London 1888, pp 534–536.
- Brett, D. (1989) *Seabirds in the Trees*, Ecos 61, pp 4–8.
- British Phosphate Commissioners (1978) *Christmas Island Phosphate Study*, British Phosphate Commissioners, Melbourne (unpublished).
- Butler, A.G. (1889) *On the Lepidoptera of Christmas Island*, Proc. Zool. Soc. London 1888, pp 542–545.

- Campbell, A.C. Goodrick, G.N. Gillison, A. N. and Bell, B. D. (1976) *Christmas Island Environment and Conservation*, Report by the Environment Reconnaissance Team to the Secretary, Dept. of Administrative Services, Canberra.
- Carew-Reid, J. (1987) *Rehabilitation of Mined Clearings on Christmas Island, Indian Ocean*, ANPWS, Canberra.
- Carlquist, S. (1965) *Island Life: a Natural History of the islands of the World*. Natural History Press, Garden City, New York.
- Caton, A. Mc Loughlin, K. and Staples, D. (eds) (1998) *Fishery Status Reports 1998: Resource assessments of Australian Commonwealth Fisheries*. Bureau of Rural Sciences, Canberra, pp145–146
- Chasen, F.N. and Boden Kloss, C. (1924) *Some Birds of Christmas Island (Indian Ocean)*, J.Malayan Branch Roy. Asiatic Soc., Records of the Raffles Museum, Singapore 2(4) pp 65–68.
- Chasen, F.N. (1933) *Notes on the Birds of Christmas Island, Indian Ocean*, Bull. Raffles Mus. 8, pp 55–87
- Christidis, L. (1997) *Molecular Assessment of the Taxonomic and Genetic Status of the Christmas Island Hawk Owl*. Final Report to Parks Australia Christmas Island from the Museum of Victoria. Unpub.
- Christmas Island Phosphate Commission (n.d.) *Christmas Island Phosphates* brochure.
- Cogger, H. Sadlier, R. and Cameron, E. (1983) *The Terrestrial Reptiles of Australia's Island Territories*, Special Publication 11, ANPWS, Canberra.
- Cogger, H. (1979) *Christmas Island Reptiles*, Unpublished Report to ANPWS, Canberra.
- Cogger, H. and Sadlier, R. (1999) *Current conservation status of the reptiles of Christmas Island*. Unpublished report to Parks Australia North.
- Crome, F.H.J. (1978) *Report on the Christmas Island Imperial Pigeon*, CSIRO Division of Wildlife Research, Report to ANPWS, Canberra.
- CSIRO Division of Entomology (1990) *CSIRO Entomological Survey of Christmas Island*, Report to ANPWS, Canberra.
- CSIRO, Minesite Rehabilitation Research Branch (1996) *Technical Assessment of the Christmas Island Rainforest Rehabilitation Program and Review of the Strategic and Economic Factors Affecting the Management of the Christmas Island Rainforest Rehabilitation Program*, Final Report for Parks Australia North.
- Dampier, W. (1967) *A New Voyage Round the World*, Reprint, London 1927.
- Davey, B. (1984) *A Report on the Properties of Some Soil Samples from Christmas Island*, Department of Soil Science, University of Sydney.

- Day, D. (1981) *The Doomsday Book of Animals: A Natural History of Vanished Species*. The Viking Press.
- Dela-Cruz, J. and Morris, S. (1997) *Respiratory, Acid-based, and Metabolic Responses of the Christmas Island Blue Crab, Cardisoma hirtipes (Dana), to Simulated Immersion*. *Physio. Zool.*, 70(1) pp 100–115
- De Mann, J.G. (1905) *On Species of Crustacea of the Genera Ptychognathus Stimps and Palaemon Fabr. from Christmas Island*, *Proc. Zool. Soc. London*, pp 537–550.
- Department of Home Affairs and Environment (1981) *Christmas Island Annual Report 1980–81*, AGPS, Canberra.
- Dobson, G.E. (1887) In (MR) Thomas, O. (1888), *On the mammals of Christmas Island*. *Proc. Zool. Soc. London*.
- Dunlop, J.N. (1985) *PMCI: Conservation Section Bulletin No.1*, Phosphate Mining Company Incorporated.
- Dunlop, J.N. and Stewart, J.E. (1985) *The Implications of Deferred Verses Concurrent or Sequential Quarry Rehabilitation on Phosphate Quarries on Christmas Island*.
- Dunlop, J.N. (1987) *Moult and breeding in the Common Noddy Anous stolidus on Christmas Island, Indian Ocean*. *Corella* 11,15–19.
- Dunlop, J.N. Cheshire, N.G. and Woller, R.D. (1988) *Observations on the Marine distribution of Tropicbirds (Genus: Phaethon) in the Eastern Indian Ocean*, Report to ANPWS, Canberra.
- Dunlop, J.N. Cheshire, N.G. and Woller, R.D. (1988) *The Status and Biology of the Golden Bosunbird Phaethon lepturus fulvus*, Report to ANPWS, Canberra.
- DuPuy, D.J. (1988) *Mapping of Christmas Island Native and Endemic Plants with Limited Distributions*, Royal Botanic Gardens, Kew, England.
- DuPuy, D.J. and DuPuy, B.P. (1989), *An extraordinary population of Corymborkis veratrifolia on Christmas Island, Indian Ocean*. *The Orchid Review*: 163–166.
- Environment Australia (1998) *Christmas Island Shrew Recovery Plan*, *Crocidura attenuata trichura*, Canberra.
- Falkland, A. (1986) *Christmas Island (Indian Ocean) Water Resources. Study in Relation to a Proposed Development at Waterfall*. Hydrology and Water Resources Unit, Water Supply, Sewerage and Stormwater Branch of Transport and Works Division for the Department of Territories, HWR 86/19, Canberra.
- Farrelly, C.A. and Greenaway, P. (1992) *Morphology and Ultrastructure of the Gills of Terrestrial Crabs (Gecarcinidae and Grapsidae): Adaptations for Air-breathing*. *Zoomorphology* 12, pp 39–49.

- Farrelly, C.A. and Greenaway, P. (1993) *Land Crabs with Smooth Lungs: Grapsidae, Gecarcinidae and Sundathelphusidae: Ultrastructure and Vasculature*. *Journal of Morphology* 215, pp 245–260.
- Farrelly, C.A. and Greenaway, P. (1994) *Gas Exchange in Air-breathing Crabs: Lungs Versus Gills*. *Journal of Experimental Biology* 187, pp 113–130.
- Flannery, T. (1990) *The Rats of Christmas Past*, *Australian Natural History* 23, pp 394–400.
- Forman, L.L. (1983) *Flowering Plants of Christmas Island*, Royal Botanic Gardens, Kew, England, (unpublished).
- Fritts, T.H. (1993) *The Common Wolf Snake, Lycodon aulicus capucinus, a Recent Colonist of Christmas Island in the Indian Ocean*, *Wildl. Res.* 20 pp 261–266.
- Gahan, G.J. (1889) *On the Coleoptera of Christmas Island*, *Proc. Zool. Soc. London* 1888, pp 538– 541.
- George, R.W. (1978) *The Land and Freshwater Crabs of Christmas Island*, Report to ANPWS, Canberra.
- Gibson-Hill, C.A. (1947) *Contributions to the Natural History of Christmas Island in the Indian Ocean*, *Bulletin of Raffles Museum, Singapore* 18, pp 6–17.
- Gibson-Hill, C.A. (1947) *The Echinodermata; Field notes on Terrestrial Crabs; Isoptera; Lepidoptera (Rhopalocera); The Terrestrial Reptiles; Notes on the Birds of Christmas Island; A Note on the Mammals of Christmas Island*, *Bulletin of the Raffles Museum, Singapore* 18 pp 18 22–26; 43–52; 56–57; 74–80; 81–86; 87–165; 166–167.
- Gibson-Hill, C.A. (1949) *The Early History of Christmas Island in the Indian Ocean*, *Journal of Malayan Branch of Royal Asiatic Society*, xxii(1), pp 67–93.
- Gillison, A.N. (1976) *Report of the Conservation of Vegetation on Christmas Island – Indian Ocean*, Unpublished Report, part of a report by the 1976 Environment Reconnaissance Team.
- Gray, H.S. and Clark R. (1995) *Christmas Island – Naturally*, (second edition) Christmas Island Natural History Association.
- Green, P.T. O’Dowd, D.J. and Lake, P.S. (1993), *The Role of Red Land Crabs (Gecarcoidea natalis (Pocock, 1888): Brachyura, Gecarcinidae) in Structuring Rain Forest on Christmas Island, Indian Ocean*, Report to ANCA, Department of Ecology and Evolutionary Biology, Monash University, Clayton, Victoria.
- Green, P.T. (1996) *Canopy Gaps in Rain Forest on Christmas Island, Indian Ocean: Size Distribution and Measurement*. *Journal of Tropical Ecology* 12, pp 427–434.

- Green, P.T. (1997) *Red Crabs in Rain Forest on Christmas Island, Indian Ocean: Patterns of Activity, Density and Biomass*. *Journal of Tropical Ecology* 13, pp 17–38.
- Green, P.T. O’Dowd, D.J. and Lake, P.S. (1997) *Control of Seedling Recruitment by Land Crabs in Rain Forest on a Remote Oceanic Island*. *Ecology* 78, pp 2474–2486.
- Green, P.T. (1998) *Litterfall in Rain Forest on Christmas Island, Indian Ocean: Quantity, Seasonality and Composition*. *Biotropica* 30, pp 671–676.
- Green, P.T. (1999) *Greta’s Garbo: Stranded Seeds and Fruits from Greta Beach, Christmas Island, Indian Ocean*. *Journal of Biogeography* 26: 937–946.
- Green, P.T. Hart, R. Jamil bin Jantan, Metcalfe, D.J. O’Dowd, D.J. and Lake, P.S. (1999) *Red Crabs in Rain Forest on Christmas Island, Indian Ocean: No Effect on the Soil Seed Bank*. *Australian Journal of Ecology* 24, pp 90–94.
- Green, P.T. Lake, P.S. and O’Dowd, D.J. (1999) *Monopolization of Litter Processing by a Dominant Land Crab on a Tropical Oceanic Island*. *Oecologia* 119: 435–444.
- Green, P.T. O’Dowd, D.J. and Lake, P.S. (1999) *Alien Ant Invasion and Ecosystem Collapse on Christmas Island, Indian Ocean*. *Aliens*, 9, pp 2–4.
- Greenaway, P. (1985) *Calcium Balance and Moulting in the Crustacea*. *Biol. Rev.* 60, pp 425– 454.
- Greenaway, P. (1988) *Ion and Water Balance*. In (eds) Burggren, W. W. and McMahon, B. R., *Biology of the Land Crabs*. Cambridge University Press, Cambridge, pp 211–248.
- Greenaway, P. Morris, S. and McMahon, B.R. (1988) *Adaptations to the Terrestrial Existence by the Robber Crab Birgus latro*. II. *In Vivo Respiratory Gas Exchange and Transport*. *Journal of Experimental Biology* 140, pp 493–509.
- Greenaway, P. (1989) *Sodium Balance and Adaptation to Fresh Water in the Amphibious Crab, Cardisoma hirtipes*. *Physiological Zoology* 62, pp 639–653.
- Greenaway, P. and Morris, S. (1989) *Adaptations to a Terrestrial Existence by the Robber Crab Birgus latro*. III. *Nitrogenous Excretion*. *Journal of Experimental Biology* 143, pp 333–346.
- Greenaway, P. Taylor, H.H. and Morris, S. (1990) *Adaptations to a Terrestrial Existence by the Robber Crab Birgus latro*. VI. *The Role of the Excretory System in Fluid Balance*. *Journal of Experimental Biology* 152, pp 505–519.
- Greenaway, P. and Farrelly, C. (1990) *Vasculature of the Gas-exchange Organs in Air-breathing Brachyurans*. *Physiological Zoology* 63, pp 117–139.
- Greenaway, P. (1991) *Nitrogenous Excretion in Aquatic and Terrestrial Crustacea*. *Memoirs of the Queensland Museum* 31, pp 215–227.

- Greenaway, P. and Nakamura, T. (1991) *Nitrogenous Excretion in Two Terrestrial Crabs* (*Gecarcoidea natalis* and *Geograpsus grayi*). *Physiological Zoology* 64, pp 767–786.
- Greenaway, P. (1993) *Calcium and Magnesium Balance during Moulting in Land Crabs*. *Journal of Crustacean Biology* 13, pp 191–197.
- Greenaway, P. (1994) *Salt and Water Balance in Field Populations of the Terrestrial Crab* *Gecarcoidea natalis*. *Journal of Crustacean Biology* 14, pp 438–453.
- Greenaway, P. and Linton, S.M. (1995) *Dietary Assimilation and Food Retention Time in a Herbivorous Terrestrial Crab* *Gecarcoidea natalis*. *Physiological Zoology* 68, pp 1006–1028.
- Greenaway, P. and Raghaven, S. (1998) *Digestive Strategies in Two Species of Leaf Eating Land Crabs* (Brachyura: Gecarcinidae) *in the Rain Forest*. *Physiological Zoology* 71: 36–44.
- Guppy, H.B. (1919) *The Island and the Continent*, *Journal of Ecology* 7, pp 1–4.
- Harms, J.W. (1932) *Lebensablauf und Stammesgeschichte des Birgus latro L. von der Weihnachtsinsel, (Life Cycle and Evolution of Birgus latro L. on Christmas Island)*, *Jena. Z. Naturw* 71, pp 1–34.
- Hart, R. (1991) *Propagation of Christmas Island Trees*, ANPWS, Canberra.
- Hart, R. (1998) *Environmental Weeds of Christmas Island – A Management Plan*. Parks Australia North, Christmas Island, (unpub).
- Harvey, M.S. and West, P.L.J. (1998) *New species of Charon* (Amblypygi, Charontidae) *from northern Australia and Christmas Island*. *Journal of Arachnology* 26, pp 273–284.
- Hemsley, W. B. (1890) *Report on the Botanical Collections from Christmas Island, Indian Ocean, made by Captain J.P. Maclear, Mr J.J. Lister, and the Officers of the H.M.S. 'Egeria'*, *J. Linn. Soc., Zoology* 1890, pp 351–361.
- Hicks, J. (1982) *A Visit to Christmas Island National Park*, *Habitat* 10 (6), pp 15–19.
- Hicks, J. (1983) *When Red Crabs March*, *Geo*, 5 (2), pp 41–51.
- Hicks, J. and Powell, D. (1983) *Forest Margin Survey: Abbott's Booby Site Protection*, ANPWS/PMCI Report.
- Hicks, J. Rumpff, H. and Yorkston, H. (1984) *Christmas Crabs, Christmas Island Natural History Association*, Christmas Island.
- Hicks, J. (1985), *The Breeding Behaviour and Migrations of the Terrestrial Crab* *Gecarcoidea natalis* (Decapoda: Brachyura). *Australian Journal of Zoology* 33, pp 127–142.
- Hill, F.A.R. (1996) *The Christmas Island Hawk-Owl. Its Distribution, an Estimate of Density, Population Size and its Conservation Status*. Final report to the Australian Nature Conservation Agency by the Royal Australasian Ornithologists Union, Victoria

- Hill, F.A.R. (1997) *The Christmas Island Goshawk Recovery Plan*, *Accipiter fasciatus natalis*. Unpublished report for Environment Australia by Birds Australia, Australia
- Hill, F.A.R. (1997) *The Christmas Island Hawk Owl Recovery Plan*, *Ninox natalis*. Unpublished report for Environment Australia by Birds Australia, Australia
- Hill, F.A.R. and Lill, A. (1998) *Density and total population estimates for the threatened Christmas Island Hawk-Owl* *Ninox natalis*. *Emu* 98, pp 209–220
- Hill, F.A.R. and Lill, A. (1998) *Vocalisations of the Christmas Island Hawk-Owl* *Ninox natalis: individual variation in advertisement calls*. *Emu* 98, pp 225–226
- Hill, F. A.R. and Lill, A. (1998) *Diet and roost characteristics of the Christmas Island Hawk-Owl* *Ninox natalis*. *Emu* 98, pp 227–233
- Holenhaus R. and Meek, P.D. (1998) *The March of the Red Crab*, Wildlife Australia, Autumn, pp 16–20
- House of Representatives Standing Committee on Environment and Conservation (1974) *Conservation of Endangered Species on Christmas Island*, AGPS, Canberra
- Humphreys, W.F. (2000) *The hypogean fauna of the Cape Range peninsula and Barrow Island, north-west Australia*. In H. Wilkens, D. C. Culver and W. F. Humphreys (eds), *Ecosystems of the World*, Vol. 30. Subterranean Ecosystems. Elsevier, Amsterdam
- Humphreys, W.F. and Eberhard, S.M. (1998) *Assessment of the Ecological Values and Management Options for Cave Use on Christmas Island: Project 97/002*. A report prepared for Parks Australia North – Christmas Island, Western Australian Museum. Unpublished
- Humphreys W.F. (1999) *Physico-chemical profile and energy fixation in Bundera Sinkhole, an anchialine remiped habitat in north-western Australia*. *Journal of the Royal Society of Western Australia* 82, pp 89–98
- Humphreys W.F., Poole A, Eberhard S.M. & Warren D. (1999) *Effects of research diving on the physico-chemical profile of Bundera Sinkhole, an anchialine remiped habitat at Cape Range, Western Australia*. *Journal of the Royal Society of Western Australia* 82, pp 99–108
- Hutchinson (1950) *Ancient Phosphatisation on an Elevated Coral Island*, *Bulletin American Museum (Natural History)* 96, pp 285–287
- IUCN Commission on National Parks and Protected Areas (1994) *Guidelines for Protected Area Management Categories*. Cambridge UK and Gland Switzerland, pp 261
- Jenkins, P.D. (1976) *Variation in Eurasian Shrews of the Genus Crocidura* (Insectivora: Soricidae), *Bulletin of the British Museum (Natural History)* 30 (7), pp 271–309

- Jenkins, P.D. (1982) *A Discussion of Malayan and Indonesian Shrews of the Genus Crocidura* (Insectivora: Soricidae), Zoologische Mededelingen 56, pp 267–279
- Jepson, D. and Inglis, K. (eds) (1997), *Birding Indonesia – A Bird-watchers Guide to the World's Largest Archipelago*, Periplus Edition (HK) Ltd, pp 45–82
- King, B. Woodcock, M. and Dickson, E.C. (1975) *A Field Guide to the Birds of South-East Asia*, Collins, London
- Kirby, W.F. (1889) *On the Insects (Exclusive of Coleoptera and Lepidoptera) of Christmas Island*, Proc. Zool. Soc. London 1888, pp 546–555
- Lake, P.S. and O'Dowd, D.J. (1991) *Red Crabs in Rainforest, Christmas Island: Biotic Resistance to invasion by an exotic snail*, Oikos 62, pp 25–29
- Lawrence, J.F. (1990) *Entomological Survey of Christmas Island*, Progress Report 1989, Final Report 1990, Report(s) to ANPWS, Canberra
- Leigh, J.H. and Briggs, J.D. (1992) *Threatened Australian Plants: Overview and Case Studies*, ANCA, Canberra
- Lincoln-Smith, M.P., Skilleter, G.A., Underwood, A.J., Smith, A.K., Hawes, P.M.H., Howitt, L., Stark, J. and Chapman, M.G. (1993) *Study of the Impact of Harvesting Marine Invertebrates and Reef Fish in the Christmas Island National Park*. ANCA, Canberra
- Linton, S.M. and Greenaway, P. (1997) *Intracellular Purine Deposits in the Gecarcinid Land Crab Gecarcoidea natalis*. Journal of Morphology 23 (1) pp 101–110
- Lister, J.J. (1889) *On the Natural History of Christmas Island in the Indian Ocean*, Proc. Zool. Soc. London 1888, pp 512–531
- Longley, R. (1986) *Christmas Island: Interim Master Plan for the Dog's Head Area*, Commissioned by the Christmas Island Services Corporation
- Lumsden, L. Silins, J. and Schulz, M. (1999) *Population Dynamics and Ecology of the Christmas Island Pipistrelle, Pipistrellus murrayi, on Christmas Island*. Unpublished report for Parks Australia North – Christmas Island, Arthur Rylah Institute for Environmental Research, Heidelberg, Victoria
- Mattiske, L. (1984) *Conservation and Rehabilitation on Christmas Island*, Phosphate Mining Company Incorporated
- MacArthur, R.H. (1967) *Island Biogeography*. Princeton University Press, Princeton N.J. pp 203
- Meek, P.D. (1997) *Protection of Abbott's Booby on Christmas Island*. Draft proceedings of a forum at the University of Canberra, Report for Environment Australia

- Meek, P.D. (2000) *The Decline and Current Status of the Christmas Island Shrew, Crocidura attenuata trichura, on Christmas Island, Indian Ocean*. Australian Mammalogy 22, pp 43–49
- Milne, A.R. Gillespie, D. Murray D.J., Lee, D. (1997) *Strategic Planning Workshop 'Environmental Management & Mining Field Rehabilitation Goals for Christmas Island' – Summary Report*. ERA Environmental Services Pty Ltd and TALLEGALLA Consultants Pty Ltd
- Mitchell, B.A. (1968) *A Forest Survey of Christmas Island, Indian Ocean*, Report to the British Phosphate Commissioners
- Mitchell, B.A. (1974) *The Forest Flora of Christmas Island, Commonwealth Forestry Review*, Commonwealth Forestry & Timber Bureau, Forest Research Institute, South Australia, 53, 1, pp 19–29
- Mitchell, B.A. (1985) *A Vegetation Survey of Christmas Island*, Report to ANPWS, Canberra
- Morris, S. and Adamczewska, A. (1998) *Red Crabs on the Run*, Nature Australia 26 pp 44–53
- Morris, S., Greenaway, P. and McMahon, B.R. (1988) *Adaptations to a Terrestrial Existence by the Robber Crab Birgus latro. I. An in vitro Investigation of Haemolymph Gas Transport*. Journal of Experimental Biology 140, pp 477–491
- Morris, S. and Greenaway, P. (1989) *Adaptations to a Terrestrial Existence by the Robber Crab Birgus latro. IV. L-lactate dehydrogenase function and L-lactate accumulation during exercise*. Comp. Biochem. Physiol. 94B, pp 59–64
- Morris, S. and Greenaway, P. (1990) *Adaptations to a Terrestrial Existence by the Robber Crab Birgus latro. V. The Activity of Carbonic Anhydrase in Gills and Lungs*. J. Comp. Physiol. 160B, pp 217–221
- Morris, S. Taylor, H.H. and Greenaway, P. (1991) *Adaptations to a Terrestrial Existence by the Robber Crab Birgus latro. VII. The Branchial Chamber and its Role in Urine Processing*. Journal of Experimental Biology 161, pp 315–331
- Morris, S. and Adamczewska, A.M. (1996) *Red Crabs and Town Site Development on Christmas Island*. Report DN44, ANCA, Darwin, pp 53
- Morris, S. and Adamczewska, A.M. (1996) *In-situ immersion of Cardisoma carnifex*. Marine Biology and Ecology 206: 149–164
- Nelson, J.B. (1971) *The Biology of Abbott's Booby Sula abbotti*, Ibis 113, pp 429–467
- Nelson, J.B. (1972) *The Biology of Seabirds of the Indian Ocean Christmas Island*. Journal of the Marine Biological Association of India 14, pp 643–662
- Nelson, J.B. (1974) *The Distribution of Abbott's Booby, Sula abbotti*, Ibis 116, pp 368–369

- Nelson, J.B. (1975) *Report on the Status and Prospects of Abbott's Booby (Sula abbotti) in Relation to Phosphate Mining on the Australian Territory of Christmas Island*, August 1974, Bull. Int. Council Bird Preservation 12, pp 131–140
- Nelson, J.B. (1975) *The Breeding Biology of Frigatebirds – A Comparative Review*. The Living Bird 14, pp 113–156
- Nelson, J.B. (1977) *Report on the Recommendations on the Status and Prospects of Abbott's booby in relation to the British Phosphates Commissioner's Mining and Conservation Policy*, Unpublished Report to British Phosphate Commissioners
- Nelson, J.B. (1978) *The Sulidae—Gannets and Boobies*. Oxford University Press
- Nelson, J.B. and Powell, D. (1986) *The Breeding Ecology of Abbott's Booby (Sula abbotti)*, Emu 86, pp 33–46
- New, T.R. (1985a) *A Revision of the Australian Myrmeleontidae (Insecta, Neuroptera). I. Introduction*, Myrmeleontini, Protoplectrini. Australian Journal of Zoology Supplement 104, pp 90 pages
- New, T.R. (1985b) *A Revision of the Australian Myrmeleontidae (Insecta, Neuroptera). III. Distoleontini and Acanthaclisinae*. Australian Journal of Zoology Supplement 106, pp 159 pages
- New, T.R. (1991) *Neuroptera from Christmas Island, Indian Ocean*. Neuroptera International 6, pp 133–136
- New, T.R. (1995) *The Order Zoraptera (Insecta) from Christmas Island, Indian Ocean*. Invertebrate Taxonomy 9, pp 243–246
- Norman, J.A. et al. (1998) *Molecular data confirms the species status of the Christmas Island Hawk-Owl Ninox natalis*. Emu, pp 197–208
- O'Dowd, D.J. and Lake, P.S. (1986) *The Role of Terrestrial Crabs in Structuring Rainforest Communities on Christmas Island*, Report to ANPWS, Canberra
- O'Dowd, D.J. and Lake, P.S. (1987) *The Role of the Terrestrial Crabs in the Dynamics of Rainforest on Christmas Island*, Department of Ecology and Evolutionary Biology, Monash University, Clayton, Victoria
- O'Dowd, D.J. Green, P. and Lake, P.S. (1999) *Status, Impact, and Recommendations for Research and Management of Exotic Invasive Ants in Christmas Island National Park*. Report to Environment Australia, by the Centre for the Analysis and Management of Biological Invasions, Monash University, Victoria
- O'Dowd, D.J. and Lake, P.S. (1989) *Red Crabs in Rainforest, Christmas Island: Removal and Relocation of Leaf Fall*, Journal of Tropical Ecology 5, pp 337–348
- O'Dowd, D.J. and Lake, P.S. (1990) *Red Crabs in the Rainforest, Christmas Island: Differential Herbivory of Seedlings*, Oikos, 58, pp 289–292

- O'Dowd, D.J. and Lake, P.S. (1991) *Red Crabs in Rainforest, Christmas Island: Removal and Fate of Fruits and Seeds*, Journal of Tropical Ecology 7, pp 113–122
- O'Dowd, D.J. and Lake, P.S. (1991) *Red Crabs in Rainforest, Christmas Island: Biotic Resistance to Invasion by an Exotic Snail*, Oikos 62, pp 25–29
- O'Toole, D. and Grimes, K. (1998) *Geotechnical Hazard Assessment of Caves on Christmas Island (Indian Ocean)*. Unpublished report to Parks Australia North – Christmas Island, Coffey Partners International Pty Ltd
- Ovington, J.D. Cullen, J.M. and Nelson, J.B. (1981) *Appraisal and Implications of a Survey (1979–80) of Abbott's Booby on Christmas Island*, ANPWS Report, Canberra
- Parks Australia North (1999) *Red Crab (Gecarcoidea natalis) Migration Management Plan*. Parks Australia North, Christmas Island, Unpublished
- Pendlebury, H.M. (1947) *Lepidoptera (Heterocera)*, Bulletin of the Raffles Museum, Singapore 18, pp 58–73
- Pettifer, G.R. and Polak, E.J. (1979) *Christmas Island (Indian Ocean) Geophysical Survey for Groundwater, 1976*, Bureau of Mineral Resources, Geology and Geophysics, Record 1979/33, Dept. of National Resources, Canberra
- Phillips, D.J. Olsen, P.D. Rentz, D.C.F. and Lawrence, J. (1991) *Observations on the Diet of the Christmas Island Hawk-Owl Ninox squamipila natalis*. Emu 91, pp 250–251
- Pickering, J. and Norris, C.A. (1996) *New evidence concerning the extinction of the endemic murid Rattus macleari (Thomas 1887), from Christmas Island, Indian Ocean*. Australian Mammalogy 19, pp 19–25
- Polak, E.J. (1976) *Christmas Island (Indian Ocean) Geophysical Survey for Groundwater*, Bureau of Mineral Resources, Geology and Geophysics, Record 1976/100, Dept. of National Resources, Canberra
- Powell, D. and Tranter, J. (1981) *The Distribution of Abbott's Booby; Christmas Island, 1979–1980*, British Phosphate Commissioners
- Powell, D. and Covacevich, J. (1983) *Lister's Palm, Arenga listeri, on Christmas Island: Rare or Vulnerable Species*, Principes, Vol.27 (2), pp 89–93
- Reville, B.J. Tranter, J. and Yorkston, H. (1987) *Monitoring the Endangered Abbott's Booby on Christmas Island: 1983–1986*, ANPWS Occasional Paper No.11, Canberra
- Reville, B.J. (1989) *A Visitor's Guide to the Birds of Christmas Island, Indian Ocean*, Christmas Island Natural History Association, Christmas Island
- Reville, B.J. Tranter, J. and Yorkston, H. (1990) *Conservation of the Endangered Seabird Abbott's Booby on Christmas Island, The Monitoring Program 1983–1989*, ANPWS Occasional Paper No. 20, ANCA, Canberra

- Reville, B.J. Tranter, J. and Yorkston, H. (1990) *Impact of Forest Clearing on the Endangered Seabird, Sula abbotti*, Biological Conservation 51, pp 23–38
- Reville, B.J. Tranter, J. and Yorkston, H. (1990) *Timing of Primary Moulting in the Tropical Seabird, Sula abbotti*, Emu 90, pp 266–268
- Ridley, H.N. (1905) *The Botany of Christmas Island*, J. Straits Branch R. Asiatic Soc. 45, pp 156 – 271
- Rivereau, J.C. (1965) *Notes on a Geomorphological Study of Christmas Island, Indian Ocean*, Bureau of Mineral Resources, Geology and Geophysics, Record 1965/116, Dept. of National Development, Canberra
- Roth, L.M. (1999) *New cockroach species, redescription, and records, mostly from Australia, and a description of Metanocticola christmasensis gen. nov., sp. nov., from Christmas Island (Blattaria)*. Records of the Western Australian Museum 19, pp 327–364
- Roth, L. (2000) *The cockroaches (Blattaria) of Christmas Island (Indian Ocean)*. Oriental Insects 34, pp 67-76
- Rumpff, H. (1986) *Freilanduntersuchungen zur Ethologie, Ökologie und Populationsbiologie des Palmendiebes, Birgus latro L. (paguridea, Crustacea, Decapoda) auf Christmas Island (Indischer Ozean)*, [Field studies on the Behaviour, Ecology and Population Biology of the Robber Crab, Birgus latro L. (Paguridea, Crustacea, Decapoda), on Christmas Island (Indian Ocean)], Ph.D. Thesis, Munster, Germany
- Rumpff, H. (1992) *Distribution, Population, Structure and Ecological Behaviour of the Introduced South-East Asian Wolf Snake (Lycodon aulicus capucinus) on Christmas Island, Indian Ocean*, Report to ANCA, Canberra
- Savory, T.H. (1947) *Arachnida*, Bulletin of Raffles Museum, Singapore 18, pp 53–55
- Schiller, C.B. (1988) *Spawning and Larval Recruitment in the Coconut Crab (Birgus latro) on Christmas Island, Indian Ocean* University of Queensland, Report to ANPWS, Canberra
- Senate Standing Committee on Science, Technology and the Environment (1983) *The Preservation of the Abbott's Booby on Christmas Island*. AGPS, Canberra
- Senate Hansard Standing Committee on Science, Technology and Environment, (1985), *Working Party on Future of Christmas Island*, pp 59–125.
- Senate Standing Committee on Science, Technology and the Environment (1986) *Christmas Island: Report on the examination of the Annual Reports for 1984–85 of the Australian National Parks and Wildlife Service (ANPWS) and the Department of Territories*. The Parliament of the Commonwealth of Australia Parliamentary Paper No. 176/1986.

- Short, J. and Meek, P.D. (2000) *New records of Macrobrachium* (Crustacea: Decapoda: Palaemonidae) *from Christmas Island, Indian Ocean*. *Transcripts of the WA Museum* 20, pp 81–86
- Smith, E.A. (1889) *On the Terrestrial Molluscs of Christmas Island*, *Proc. Zool. Soc. London* 1888, pp 536–538
- Smith, L.A. (1988) *Lycodon aulicus capucinus, a colubrid snake introduced to Christmas Island, Indian Ocean*, *Rec. West. Aust. Mus.* 1988, 14 (2), pp251–252
- Spate, A.P. and Webb, R. (1998) *Management Options for Cave Use on Christmas Island*. Unpublished report prepared for Parks Australia North – Christmas Island. Australasian Cave and Karst Management Association
- Stokes, A. (1988) *A Review of the Birds of Christmas Island*, Indian Ocean ANPWS Occasional Paper No. 16
- Swarbrick, J. T. (1997) *Environmental Weeds and Exotic Plants on Christmas Island, Indian Ocean*. A Report to Parks Australia
- Sweetland, W.W. (1980) *Inquiry into the Viability of Christmas Island Phosphate Industry*
- Sweetland, W.W. (Chairman) (1982) *Inquiry into the Long-term Future of Christmas Island*, AGPS, Canberra
- Tallegalla Consultants Pty. Ltd. and ERA Environmental Services Pty. Ltd. (1998) *Christmas Island Rainforest Rehabilitation Program*. Concept Plan, Discussion draft for Parks Australia
- Taylor, H.H., Greenaway, P. and Morris, S. (1993) *Adaptations to a Terrestrial Existence by the Robber Crab, Birgus latro. VIII. Osmotic and ionic Regulation on Freshwater and Saline Drinking Regimens*. *Journal of Experimental Biology* 179, pp 93–113
- Thomas, O. (1889) *On the Mammals of Christmas Island*, *Proc. Zool. Soc. London* 1888, pp 532–534
- Tidemann, C.R. (1985) *A Study of the Status, Habitat Requirements and Management of the Two Species of Bat on Christmas Island*, Report to ANPWS, Canberra
- Tidemann, C.R. (1987) *Notes on the flying fox, Pteropus natalis (Chiroptera: Pteropodidae) on Christmas Island, Indian Ocean*. *Australian Mammalogy* 10, pp 89–91
- Tidemann, C. R. (1988) *Survey of the Christmas Island Shrew and other Terrestrial Mammals*, Australian National University, Report to ANPWS, Canberra
- Tidemann, C.R. (1989) *Survey of the Terrestrial Mammals on Christmas Island (Indian Ocean)*, Report to ANPWS, Canberra

- Tidemann, C.R., Yorkston, H. and Russak, A.J. (1991) *Gifts from 100 Christmasses: Native and Feral Mammals of Christmas Island, Indian Ocean After a Century of Human Occupation*, Publication Draft 1991, Report to ANPWS, Canberra
- Tidemann, C.R. Yorkston, H.D. and Russack, A.J. (1994), *The diet of feral cats (Felis catus) on Christmas Island, Indian Ocean*. Wildlife Research 21, pp 279–286
- Tracy, J.G. (1991) *Review of Current Rehabilitation Techniques Aimed at Revegetation of Former Mined Areas on Christmas Island, Indian Ocean*.
- Trueman, N.A. (1965) *The Phosphate, Volcanic and Carbonate Rocks of Christmas Island (Indian Ocean)*, J. Geol. Soc. Australia Vol.12 (2), pp 261–283; pp 18–20
- Tweedie, M.W.F. (1947) *On the Brachyura of Christmas Island*, Bulletin of Raffles Museum 18, pp 27–42
- Van der Lee, G. and Jarman, P. (1996) *The Status of cats Felis catus and prospects for their control on Christmas Island*. Draft report to the Australian Nature Conservation Agency
- Van Steenis, C.G.G.J. (1984) *Three More Mangrove Trees Growing Locally in Nature in Freshwater*, Blumea 29, pp 395–397
- Van Tets, G.F. and Van Tets, P.A. (1967) *A Report on the Resident Birds of the Territory of Christmas Island*, The Emu Vol.66 (4), pp 309–319
- Van Tets, G.F. (1973) *A Report on the Status and Conservation of Birds at Christmas Island, Indian Ocean*, Unpublished Report
- Van Tets, G.F. (1974) *A Second Report on Potential Bird Hazards to Aircraft at Christmas Island*, Unpublished Report
- Varley, D.G. and Greenaway, P. (1994) *Nitrogenous Excretion in the Terrestrial Carnivorous Crab Geograpsus grayi. I. Site and Mechanism of Excretion*. Journal of Experimental Biology 190, pp 179–193
- Varne, R. (1988) *Report on the Geology of Christmas Island*, ANPWS Canberra
- Varne, R. (1992) *Report on the Geology of Christmas Island*, Geology Dept., University of Tasmania, (unpublished)
- Veeh, H.H. (1985) *Uranium-Series Dating Applied to Phosphate Deposits on Coral Reef Islands*, Proceedings of the Fifth Annual Coral Reef Conference, Tahiti, 1985, Vol. 3
- Vogel, P. (1972) *Beitrag zur Fortpflanzungsbiologie der Gattungen Sorex, Neomys und Crocidure (Soricidae)*. Verhdt. Naturf. Ges. Basel 82 (2) pp 165–192
- Western Australian Overseas Projects Authority (1985) *Christmas Island Land Use Study*, Commissioned by the Department of Territories and Local Government

- Wharton, W.J.L. (1888) *Account of Christmas Island, Indian Ocean*, Proceedings of the Royal Geographical Society 10, pp 613–624
- Woodroffe, C.D. (1988a) *Relic Mangrove Stand on the Last Interglacial Terrace, Christmas Island, Indian Ocean*, J Tropical Ecology 4, pp 1–17
- Woodroffe, C.D. (1988b) *Vertical Movement of Isolated Volcanic Islands at Plate Margins: Evidence from Emergent Reefs in Tonga (Pacific Ocean), Cayman Islands (Caribbean Sea) and Christmas Island (Indian Ocean)*, Z Geomorph. N.F. 69, pp 17–37
- Wells, F.E. Clayton, W.B. Clark, J.E. and Hansen, G.M. (1990) *Christmas Shells: The Marine Molluscs of Christmas Island (Indian Ocean)*, Christmas Island Natural History Association, Christmas Island
- Woehler, E.J. (1984) *Breeding Seabirds on the Shore Terraces Christmas Island, Indian Ocean*, Royal Australasian Ornithologists Union, Report to ANCA, Canberra
- Yager, J. and Humphreys, W. F. (1996) *Lasionectes exleyi, sp. nov., the first remiped crustacean recorded from Australia and the Indian Ocean, with a key to the world species*. Invertebrate Taxonomy, 10, pp 171–187
- Yorkston, H.D. (1992) *A Review of the Abbott's Booby (Sula abbotti) Monitoring Program on Christmas Island, Indian Ocean 1989–1992*
- Yorkston, H.D. and Green P.T. (1997) *The Breeding Distribution and Status of Abbott's Booby (Sulidae: Papasula) on Christmas Island, Indian Ocean*, Biological Conservation 79, pp 293–301
- Yorkston, H. Hart, R. and Dagleish, R. (1992) *Plant Survivorship in the Christmas Island Rainforest Rehabilitation Program*, ANCA, Canberra