



# Natural Heritage Trust

*Helping Communities Helping Australia*

An Australian Government Initiative

## **NATIONAL RECOVERY PLAN FOR THE CHRISTMAS ISLAND HAWK-OWL *Ninox natalis***

**Richard Hill  
Birds Australia**

Prepared by Richard Hill, Birds Australia, for the Australian Government Department of the Environment and Heritage

Published by the Commonwealth of Australia.

Made under the *Environment Protection and Biodiversity Conservation Act 1999*: August 2004

**ISBN 0 642 55010 7**

© Commonwealth of Australia

This publication is copyright. Apart from any use permitted under the *Copyright Act 1968*, no part may be reproduced by any process without prior written permission from the Commonwealth. Requests and inquiries regarding reproduction should be addressed to:

Assistant Secretary  
Natural Resource Management Policy Branch  
Department of the Environment and Heritage  
GPO Box 787  
CANBERRA ACT 2601

This plan should be cited as follows:

Hill, R. 2004. National Recovery Plan for the Christmas Island Hawk-Owl *Ninox natalis*.  
Commonwealth of Australia, Canberra.

**Disclaimer:**

This recovery plan sets out the actions necessary to stop the decline of, and support the recovery of, the listed threatened species or ecological community. The Australian Government is committed to acting in accordance with the plan and to implementing the plan as it applies to Commonwealth areas.

The plan has been developed with the involvement and cooperation of a broad range of stakeholders, but the making or adoption of this plan does not necessarily indicate the commitment of individual stakeholders to undertaking any specific actions. The attainment of objectives and the provision of funds may be subject to budgetary and other constraints affecting the parties involved. Proposed actions may be subject to modification over the life of the plan due to changes in knowledge..

Copies available from: <http://www.deh.gov.au/biodiversity/threatened/recovery/list-common.html>

### ***Executive Summary***

The Christmas Island Hawk-Owl is endemic to Christmas Island, and is currently listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). It's territories are found in all habitats, but especially Primary and Marginal rainforests and in some secondary regrowth vegetation. The total population size was estimated in 1995 to be  $562 \pm 105$  occupied territories (about 820-1200 birds). The total population size is primarily limited by the area of suitable habitat remaining on Christmas Island, especially intact mature rainforest with holes for nesting. Supercolonies of the introduced Crazy Ant potentially pose an extreme risk to this species. Actions for the conservation of this species outlined in this Recovery Plan aim to downgrade this species to Conservation Dependent primarily by implementing the Invasive Ants on Christmas Island Action Plan, protecting all habitat critical to the survival of this species, monitoring the population, and educating the Christmas Island community about this small, unique owl.

## ***Background Information***

### *Conservation Status*

The Christmas Island Hawk-Owl *Ninox natalis* is currently listed as Vulnerable under the EPBC Act due to its small population size. This was based on estimates provided by van Tets (1975) of 10 - 100 pairs and subsequently by Stokes (1988) of 100 pairs. Following the outbreak of Crazy Ant supercolonies, Garnett & Crowley (2000) recommended the Christmas Island Hawk-owl be upgraded to Critically Endangered.

Approximately 25% of the island's forests have been cleared since settlement and all but the small areas of regrowth vegetation are currently unsuitable and are unoccupied by Christmas Island Hawk-Owls. Hill & Lill (1998a) estimated that the island prior to settlement had a carrying capacity in the order of  $740 \pm 135$  owl territories. Between 1994-1996 Hill & Lill (1998a) estimated the population at  $556 \pm 101$  occupied owl territories in Primary Rainforest and  $6 \pm 4$  occupied owl territories in regrowth vegetation, and a total population size of  $562 \pm 105$  occupied territories. The total Christmas Island Hawk-Owl population has probably decreased by at least 25% since settlement (Stokes 1988, Hill & Lill 1998a).

### *Taxonomic status*

The Christmas Island Hawk-Owls is now considered a full species after Norman et al. (1998). Formerly a subspecies of *N. squamipila*, Norman et al. (1998) concluded, using molecular data, that the three subspecies for which material was available, including the Christmas Island Hawk-Owl, each represented separate species in the genus *Ninox*.

### *Distribution and location*

The Christmas Island Hawk-Owl is restricted to Christmas Island in the Indian Ocean (10°0'S; 105°40' E), approximately 1400km northwest of Australia. The nearest land is Java in the Republic of Indonesia, 360km to the north. Christmas Island is 135km<sup>2</sup> in area and 75% is covered with original vegetation. During 1994-1995, Christmas Island Hawk-Owls were widespread and occurred in all Primary, Marginal and secondary regrowth rainforests. The highest densities were found in Primary rainforests (Hill & Lill 1998a). Hill and Lill (1998a) concluded that the total population size was probably limited primarily by the area of remaining rainforest and that the observed owl densities within available habitat had probably not changed markedly since settlement (Hill & Lill 1998a). The lack of change in density of birds in the habitat available combined with the reduction in 25% of habitat area leads to the conclusion that the population has declined by 25%.

Using data from radio-tracking, territory mapping and census by playback of calls, Hill & Lill (1998a) found that owls were uniformly distributed throughout the two Primary and Marginal of rainforest at a density of  $5.5 \pm 1.0$  territories per square kilometre. They speculated that densities might be lower in some Marginal rainforests because of the more seasonal microclimates in areas exposed to the prevailing southeast winds. In regrowth vegetation they found that owls were present at significantly lower densities ( $1.7 \pm 1.1$  territories/km<sup>2</sup>).

Approximately 75% of Christmas Island is still covered with natural vegetation and 84% of this (63% of the island) is within National Park (Figure 1). "Primary Rainforests" (du Puy 1993) outside the park are currently protected from clearance by a Federal Government moratorium, and Primary rainforest, Marginal rainforest and second-growth rainforest or regrowth vegetation may be removed only within the constraints of the EPBC Act and EPBC Regulations.

Rainforest rehabilitation has been occurring on Christmas Island for several decades. Currently, the main aim is to revegetate mined areas adjacent to Abbott's Booby nesting habitat in an attempt to reduce wind turbulence caused by the clearings and implicated in reduced nesting success of the booby (Reville *et al.* 1990). There are approximately 70 clearings covering 3200ha or 24% of the island area (Carew-Reid 1987). It is not known how long it will take for rehabilitation plantings to develop into forest which can be used by Christmas Island Hawk-Owls: it would not be long before these areas might be used for foraging, however, it is likely to be centuries before mature trees with nesting holes are available.

### Ranging Habits

The ranging habits of adults in Primary rainforest have been studied by radio-tracking and territory mapping (Hill & Lill 1998a). Male and female pairs ranged within an apparently exclusive territory and two females radio-tracked used a smaller area than the two males tracked. One female of a pair occupied a smaller area that was wholly contained within that used by the male. Both females were preparing breeding at the time of being tracked and presumably range further when not breeding. Pairs defend their territory year round. Territorial boundaries appeared to be sharply delineated and crossings into neighbouring territories appeared to be rare. Territories appeared to be contiguous and were estimated to be 18ha in size on average. There is evidence that territories are contiguous in areas of Marginal rainforest (Hill & Lill 1998a). There are no data on the ranging habits of independent young.

### Diet

Christmas Island Hawk-Owls are primarily insectivorous eating a wide variety of medium to large insects, especially Orthoptera, Lepidoptera, and Coleoptera. They also are recorded eating a range of vertebrates including Black Rats *Rattus rattus*, geckos, and Christmas Island White-eyes *Zosterops natalis* (Hill & Lill 1998b).

### Habitat

Primary Rainforest (after Du Puy 1993) is restricted to the central plateau and is an evergreen closed forest 30 - 40 m high with emergent trees up to 45 m tall. Common canopy trees include *Syzygium nervosum*, *Planchonella nitida*, and *Hernandia ovigera*. The canopy formed by these trees is irregular, especially on the western side of the island where it is sheltered from strong southeast trade winds which blow throughout the dry season. The understorey comprises dense thickets of *Pandanus elatus* up to 4m tall, and more open areas which commonly include the plants *Aidia aff. racemosa*, *Arenga listeri*, *Leea angulata*, *Ochrosia ackeringae* and *Pisonia umbellifera* (Environment Australia 1994). Primary Rainforest can be further divided into two types after Mitchell (1974): Deep-soil Tall Closed Forest and Shallow-soil Closed Forest (Type I and II forests in Orchard *et al.* 2002) where the limestone is close to or at the surface. Hill (1996) censused Christmas Island Hawk-Owls in homogeneous areas of both these Primary Rainforest types.

Marginal Rainforest (after Du Puy 1993) grows on generally shallower soils on the coastal terraces and scree slopes surrounding the island. Many Marginal Rainforest trees lose their leaves in the dry season. This forest is generally lower than Primary Rainforest, often less than 30 m tall, and may include many vines. The canopy height and shape is variable, determined primarily by the degree of exposure to the southeast trade winds. Marginal Rainforest facing south and east has a smooth, wind-pruned canopy and tends to increase in height with increasing distance from the sea cliff. The inland cliffs and scree slopes may have no vegetation or carry a closed forest, depending on the degree of the slope. Trees such as *Ficus microcarpa* and *Dendrocnide sinuata* are common there.

Old stockpiles and cleared areas that have not been mined may support a low secondary growth closed forest of colonising trees such as *Macaranga tanarius* and *Claoxylon indicum* and an introduced tree *Leucaena leucocephala* generally less than 10m high. Previously mined areas tend to have very little remaining soil and on them grow dense herblands of a fern *Nephrolepis multiflora* to 2m high along with introduced scramblers and occasional low trees. Hill & Lill (1998a) did not record owls using old minefields at all, however, they did observe owls hunting in grassy clearings.

#### Habitat Critical to Survival

All four nests recorded for this species, three in Marginal Rainforest and one in Primary Rainforest, have been in tree hollows in *Syzygium nervosum* (Hill & Young 1995) and all nest sites are likely to be in tree hollows (Hill & Young 1995). *Syzygium nervosum* is a common emergent tree particularly in Primary Rainforest where it forms approximately 18% of the forest canopy and 30% of the emergent species (Du Puy 1993). It is commonly greater than 35m high, has abundant tree hollows, unlike most other tree species in Primary Rainforest. *Syzygium nervosum* is, therefore, a very important tree species for Christmas Island Hawk-Owls and if its abundance was to change in the future, this might lead to a shortage of nest sites. Marginal Rainforest appears to have more species of trees with hollows and may have more potential nest sites for Christmas Island Hawk-Owls. Additional monitoring may show that owls can nest in a number of tree species.

Based on the available information and applying the EPBC Act criteria, habitat critical to the survival of the Christmas Island Hawk-Owl is defined as all Primary and Marginal rainforest, and all secondary growth rainforest that provides suitable habitat. The boundaries of Primary and Marginal rainforest are mapped and provided in Figure 1. Secondary growth rainforest suitable for Christmas Island Hawk-Owls has not been mapped, as there is currently insufficient data on this.

#### International Obligations

The Hawk-Owl is not listed under any international agreements.

#### Affected Interests

Commonwealth Parks Australia North, Shire of Christmas Island, Christmas Island Phosphates, Union of Christmas Island Workers, the Asia Pacific Space Centre Pty. Ltd, the Department of Transport and Regional Services (DOTARS), Department of Immigration, Multicultural and Indigenous Affairs (DIMIA).

#### Role and interests of indigenous people

Not applicable. Christmas Island does not have an indigenous population.

#### Social and economic impacts

The actions in this plan may have positive and negative social and economic impacts.

Positive social impacts will arise from community education actions that will increase Christmas Islanders knowledge and interest in their own environment. The rainforest rehabilitation program provides on-island jobs, as could the hawk-owl monitoring program. Christmas Island endemic birds attract specialist bird watching groups each year that is high value, low-impact tourism.

Negative social and economic impacts arising from implementation of the plan could include greater restrictions due to review of the quarantine barrier. The EPBC Act already provides a regulatory framework for the protection of rainforest on Christmas Island, and one element of

this is assessing potential impacts of proposed developments on the listed threatened species. These provisions have the potential to impact on economic activity, for example by adding additional obligations for industry and other development on the island in order to minimise impacts on listed species. This arises from the listing of the species under the EPBC Act invoking a range of protective provisions and offences where a population is to be affected. The magnitude of this potential impact is unknown, as it will vary with the location, size and extent of the activity, proposed or current. However, the plan will aid in determining what could be significant impacts on the Christmas Island Hawk-owl (through defining habitat critical to survival and developing a management plan outside the national park).

### Biodiversity Benefits:

Protection of the habitat of the Christmas Island Hawk-Owl provides protection for numerous other listed species (Table 1). Community education targeted at this species will promote awareness of all the endemic forest birds and their conservation needs.

Table 1: Native species listed under the EPBC Act that will benefit from recovery actions listed in this plan (after Environment Australia 2002).

Taxon	National Status
<i>Tectaria devexa</i> var. <i>minor</i>	E
<i>Carmona retusa</i>	V
Christmas Island Pipistrelle (e) <i>Pipistrellus murrayi</i>	E
Christmas Island Shrew 1 (e) <i>Crocidura attenuata trichura</i>	E
Christmas Island Blind Snake (e) <i>Ramphotyphlops exocoeti</i>	V
Christmas Island Gecko <i>Lepidodactylus listeri</i>	V
Christmas Island Goshawk (e) <i>Accipiter fasciatus natalis</i>	E MF
Abbott 's Booby (e) <i>Papasula abbotti</i>	E M S J
Red-footed Booby <i>Sula sula rubripes</i>	M S C J
Christmas Island Frigatebird (e) <i>Fregata andrewsi</i>	V M S C J
Great Frigatebird <i>Fregata minor minor</i>	M S C J

Notes: (e)=species and subspecies endemic to the island

E Listed under the EPBC Act as Endangered

V Listed under the EPBC Act as Vulnerable

M Listed under the EPBC Act as a Migratory species

MF Within a family listed under the EPBC Act as Migratory

S Listed Marine species under the EPBC Act.

C Listed under China-Australia Migratory Bird Agreement

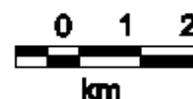
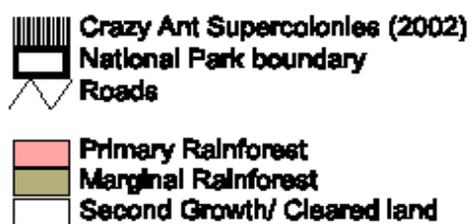
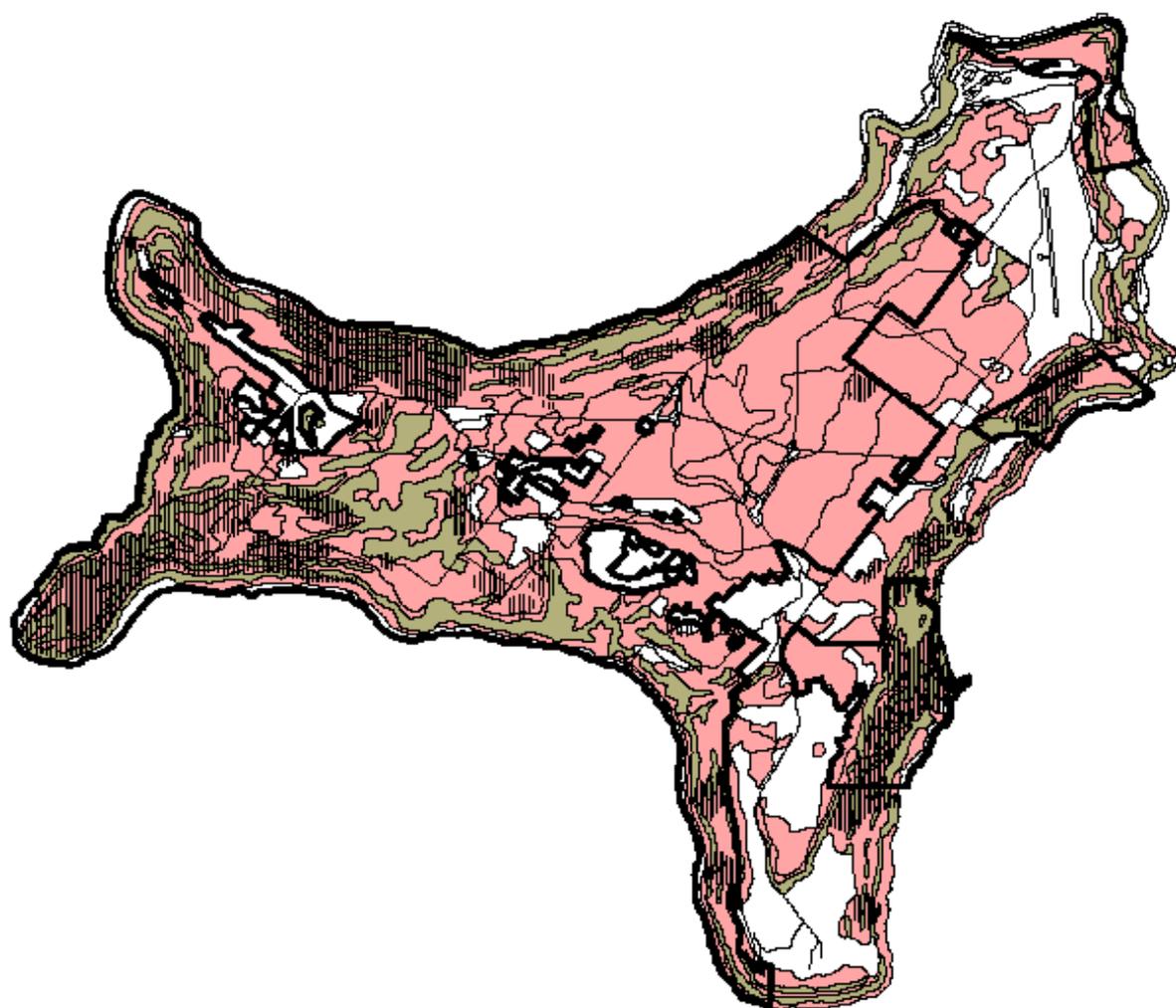
J Listed under Japan-Australia Migratory Bird Agreement

### Relationship to other plans

The Christmas Island National Park Management Plan is the strategic nature conservation document for the island. This recovery plan makes numerous recommendations in common with other recovery plans for Christmas Island threatened taxa. Opportunities for sharing resources and points shared in common with other recovery plans are identified in the implementation section of this plan.

### Recovery Team

The Christmas Island Hawk-Owl Recovery Team should comprise on-island Parks Australia North staff, Shire of Christmas Island, an environment consultant, Department of Transport and Regional Services, and other members as thought appropriate.



**Figure 1: Distribution of Primary Rainforest and Marginal Rainforest on Christmas Island and Crazy Ant supercolonies (after Orchard et al. 2002).**

## *Threats to the species*

### *Birds on Islands*

Island birds are particularly vulnerable to extinction and a very high number of island birds relative to continental species have become extinct in the past century (Diamond 1985, King 1985). This is because: (i) island birds tend to have smaller population sizes than continental species and small populations are more vulnerable to extinction (Lacy 1987); (ii) island birds have often evolved in the absence of many predators, diseases and competitors and they can be catastrophically affected by the introduction of one of these (King 1985); (iii) there are often no opportunities for dispersal and thus recolonisation on islands, and this factor also predisposes a population to extinction (Lacy 1987); and (iv) there is often less opportunity to make reserves on islands because land area is limited (Diamond 1985). Predators in general are often naturally rare because their prey, other animals, are less abundant than other food resources. Thus island raptors are a particularly vulnerable group of island birds.

### *Crazy Ants*

The exotic invasive yellow crazy ant (*Anoplolepis gracilipes*) arrived on Christmas Island more than 70 years ago, and is now widespread throughout rainforest (Orchard et al. 2002). The ants can form multi-queened 'super-colonies', in which they occur at very high densities. This has apparently been a relatively recent phenomenon, with the first supercolony discovered in 1989, with further dramatic increases probably beginning around the mid-1990s.

At supercolony densities, the ant is having a devastating impact on the island's ecosystems. Red crabs, robber crabs, blue crabs and most other ground dwelling animals such as reptiles, have been and are continuing to be severely impacted, sometimes to the point of local extinction in heavily infested areas. By eliminating local populations of red crabs, the ants are also having a marked effect on forest composition and structure, and litter dynamics. The feeding activities of the ants and their mutualistic scale insects can stress large trees to the point of death, and appear to be causing canopy dieback in areas of supercolony formation (Orchard et al. 2002). In addition groundings of birds in crazy ant supercolonies would most probably result in the death of the bird. Although research has shown that crazy ants have little impact on canopy insects, it is possible that the ants may reduce insect populations, the primary prey of the Hawk-Owl. In the recent Risk Watch List compiled for the Christmas Island National Park and Conservancy, the crazy ant invasion was rated as an *Extreme Risk* to biodiversity and conservation values, with catastrophic consequences of failure to implement effective control measures.

Parks Australia North field workers and assistants conducted an island-wide ant survey during the months May-August, 2001. This survey was designed by Centre for the Analysis and Management of Biological Invasions, Monash University (CAMBI). Of 972 sites surveyed; 741 surveyed points fell in natural forest. Crazy ants were recorded at 46.7% (346/741) of sites in natural forest. Super-colony densities were recorded at 22.7% (168/741) of sites in natural forest. Using these survey points as a representative sample of the forest, it was estimated that 2,379 hectares of the estimated 10,492 hectares of forest on the island was infested with crazy ants at super-colony densities (Orchard et al. 2002). Crazy Ants are more commonly found in Marginal Rainforests and less commonly found in Primary Rainforests. Primary Rainforests make up most of the natural forests on the island plateau and 31% of census sites in natural forest, but contained only 6.5% of supercolony records (Orchard et al. 2002).

In September 2002 an aerial baiting program was undertaken, with all known supercolonies treated with insecticide. Results so far indicate that the program was successful in controlling supercolonies over 2500 hectares of Christmas Island. Crazy ants are still present in low densities on Christmas Island. However it must be noted that despite this action, further high

densities of crazy ants may establish in the terrace forests without warning. PAN staff will continue to monitor any new supercolony formation and treat by hand baiting over the next few years.

### Disease

A serious threat to all island birds is the introduction of new disease. Island birds have often evolved in the absence of diseases common in continental bird faunas and the introduction of such diseases to island birds can be disastrous. An example of this is the introduction of avian malaria to Hawaii, which caused the extinction of almost the entire endemic bird fauna from below 600 m altitude, and was probably the main cause of the total extinction of several bird species (Hay 1986). The range of many surviving species was severely reduced and fragmented which in turn markedly increased their chances of extinction. Avian malaria arrived with the accidental introduction of a new species of mosquito (Hay 1986). Christmas Island is very vulnerable to the accidental introduction of new disease. In 1994 a quarantine barrier was established between the island and Indonesia and Australia and this has reduced that risk.

### Habitat Loss

Approximately 25% of the island's original forests have been cleared and replaced by shrublands of ferns on minefields, regrowth vegetation on stockpiles, and roads and housing (Environment Australia 1994). This has meant a loss of their preferred forested habitat and thus a decrease in the total population size of the Christmas Island Hawk-Owl. Regrowth vegetation growing along roadsides and on stockpiles may provide good feeding habitat for Christmas Island Hawk-Owls at least at some times of the year. These small areas of regrowth vegetation may have slightly offset the effect of habitat clearance.

Rainforests on Christmas Island have been fragmented in places by clearing and dissected by roads and old mining 'grid lines'. The grid line system, a series of parallel lines 120 m apart and a bulldozer blade in width, was installed in the 1970's to explore the island's phosphate resources. After 25 years these are mostly overgrown with dense stands of regrowth vegetation. Numerous large trees were undoubtedly knocked over when the grid lines were being put in, and this may have reduced the number of suitable nest sites for owls. It seems unlikely that any clearings are large enough to be a barrier to dispersal.

There are some major development proposals and associated infrastructure in particular the Immigration Centre, Satellite launching station, airport upgrade, and expansion of phosphate mining that have the potential to reduce the area of hawk-owl habitat. One development condition for the satellite launching facility is to develop and implement an environment management plan (EMP), which is currently underway. The EMP will address threatened fauna and their habitat on the sites. The immigration centre is exempt from assessment under the EPBC Act, however, the DEH is being consulted on environmental aspects of the development, including monitoring of habitat for potential impacts. The airport upgrade and phosphate mining expansion proposals are undergoing assessment for environmental impact under the EPBC Act. Survey and monitoring of the Christmas Island Hawk-owl will aid in determining potential impacts of these and future developments on hawk-owl habitat.

### Natural Catastrophes

The effect of climatic catastrophes such as cyclones are more severe on small populations. Cyclone frequency may increase with Greenhouse-induced climate change and it would be useful to understand the effects of cyclones on owl populations to help predict the impact of any increase.

### Weeds

Weeds, especially newly introduced invasive species, could impact on Christmas Island Hawk-Owl nest sites, for example by forming vine towers over nesting trees.

### Other Possible Threats

Road killed Christmas Island Hawk-Owls are occasionally reported. A substantial increase in vehicular traffic will be associated with the proposed satellite launching station and the new immigration, reception and processing centre. This will likely increase the number of roadkills in high traffic areas. Thus it is possible that collisions with cars will become an issue for the conservation of populations in high traffic areas.

Feral Cats *Felis catus* are widespread throughout the original and modified vegetation on the island. Owls are unaccustomed to predators and may roost very low to the ground and consequently may occasionally be at risk of being caught by cats. However, cats do not appear to be a significant threat to owls at present (Tidemann et al. 1994, Van der Lee and Jarman 1996).

## ***Recovery Objectives and Timelines***

### *Overall Objective*

To downgrade the conservation status of the Christmas Island Hawk-Owl to Conservation Dependent within 10 years.

### *Specific objectives*

To reduce the risk of extinction and improve the conservation status of the species by:

1. Maintaining (or increasing) extent of occurrence and total population size at 1994-96 levels.
2. Implementing threat abatement strategies.
3. Increasing community involvement in and awareness of the Christmas Island Hawk-Owl.
4. Implementing the Recovery Plan through a Recovery Team.

### ***Performance Criteria***

- Total population size not less than  $562 \pm 105$  occupied territories as measured by the monitoring program.
- Owls widespread on the island in all suitable habitats as measured by the monitoring program.
- Crazy Ants having a negligible impact on populations.
- Protection of all habitat critical to survival outside the national park.
- A continuing increase in suitable habitat through implementation of the Christmas Island Rainforest Rehabilitation program.
- Maintenance of effective quarantine against the introduction of all avian diseases.
- Demonstrated increase in community awareness and support for habitat protection.
- Demonstrated successful operation/implementation of the Recovery Team over five years.

### ***Actions***

---

*Specific Objective:* 1. Maintain extent of occurrence and total population size at 1994-96 levels.

*Criteria:* Owls widespread on the island in all suitable habitats  
Total population size not less than  $556 \pm 101$  occupied territories.

***Action:*** ***1. Monitor the Christmas Island Hawk-Owl population every two years to detect any significant change in the distribution or abundance***

The monitoring program will census owls in Primary Rainforest, Marginal Rainforest and regrowth vegetation and aims in Primary and Marginal Rainforest to identify a greater than 20% change in population size. In regrowth vegetation and rehabilitation areas the monitoring program may indicate trends, but due to the small sample size and small area of this habitat it is not feasible to identify significant trends. Monitoring data should also be used to determine habitat requirements, to refine the definition of habitat critical to survival

In Primary and Marginal Rainforest 18 sites should be censused five times each. In regrowth vegetation, three sites are censused five times each, and a Rehabilitation Area is censused five times. The minimum interval between censuses of a particular site is two weeks to avoid owls habituating to playback of their call. The method is described in detail in Hill (1996). If a significant population decline is detected the Recovery Team will need to: consider the effect of this increased risk to extinction and whether a captive population should be established; and establish a research program to investigate the causes of decline. This will require detailed planning and substantial funding and is beyond the scope of this current plan.

---

<i>Specific Objective:</i>	1. Maintain extent of occurrence and total population size at 1994-96 levels.
<i>Criteria:</i>	Protection of all habitat critical to survival outside the national park.
<i>Action:</i>	<b>2. Develop and implement a wildlife management plan for hawk-owl habitat outside the national park</b>
<i>Action:</i>	<b>3. Ensure protection of habitat critical to survival outside the national park</b>

Most forested land outside the National Park is publicly owned, by the Commonwealth. Parks Australia North (PAN) staff are routinely involved with other stakeholders in negotiations over development proposals. This is ongoing. Proposals can occur unexpectedly and, as there is no overall wildlife management plan outside the park, are assessed on an *ad hoc* basis. Consultation with other agencies and proponents on projects which may impact on listed threatened species is essential and ongoing (under the EPBC Act referrals process). However, achievement of long-term protection of species outside the park requires a more considered approach. The EPBC Regulations include that actions under an approved management plan are not considered offences in relation to protected species, and that a management plan must not, or not be likely to, adversely affect the conservation status of a protected species or a population of a protected species. The Hawk-Owl meets the definition of a protected species.

The plan should allow for input of relevant landholders and decision-makers, while facilitating greater certainty for environmentally sensitive developments. The plan should also allow for adaptive management as better information becomes available on the Christmas Island Hawk-Owl and other threatened species, in particular greater definition of the areas of habitat critical to survival.

---

<i>Specific Objective:</i>	1. Maintain extent of occurrence and total population size at 1994-96 levels.
<i>Criteria:</i>	A continuing increase in suitable habitat through implementation of the Christmas Island Rainforest Rehabilitation Program (CIRRP).
<i>Action:</i>	<b>4. Continue effective and long-term rainforest rehabilitation program managed by DOTARS, supported by PAN and the mining company</b>

In 2002, the Government decided to redirect payment of the conservation levy to the portfolio agency with responsibility for the mine lease (DOTARS). This program is critical to increase rainforest habitat to further protect a range of species including the hawk-owl. A MOU between PAN and DOTARS was signed in February 2004 to continue the CIRRP within Christmas Island National Park. The program is linked to the Christmas Island Phosphates (CIP) mine lease, and DOTARS should ensure lease conditions are adhered to, allowing effective and efficient rainforest rehabilitation.

---

<i>Specific Objective:</i>	2. Implement threat abatement strategies
<i>Criteria:</i>	Crazy Ants have a negligible impact on populations.
<i>Action:</i>	<b>5. Invasive Ants on Christmas Island Action Plan</b>

PAN is currently implementing an Invasive Ants on Christmas Island Action Plan, aiming to control and minimise Crazy Ant impacts across the island. This will require ongoing monitoring of Crazy Ant numbers and control as detected. The recovery team must ensure this control program does not have negative impacts on Christmas Island Hawk-Owls.

---

<i>Specific Objective:</i>	2. Implement threat abatement strategies
<i>Criteria:</i>	Maintenance of effective quarantine against the introduction of all avian diseases
<i>Action:</i>	<b>6. Maintenance [and regular review] of a quarantine barrier between Christmas Island and all other lands which minimises the risks of new avian diseases establishing on Christmas Island.</b>

As part of the regular review process of the Christmas Island Quarantine Service, the effectiveness of the quarantine barrier preventing the man-made introduction of avian diseases onto Christmas Island should be assessed. Review of the Christmas Island Quarantine Service is undertaken by the Australian Quarantine Inspection Service, with input from PAN and in consultation with DOTARS. There is no additional cost for this action.

---

<i>Specific Objective:</i>	3. Increasing community involvement in and awareness of the Christmas Island Hawk-Owl
<i>Criteria:</i>	Demonstrated increase in community awareness and support for habitat protection
<i>Action:</i>	<b>7. Community education program to raise awareness and interest in the conservation of Christmas Island Hawk-Owls.</b>

As part of the Christmas Island Education and Interpretation Plan, which has a key objective of increasing knowledge of and local support for habitat and species protection, develop a multi-lingual pamphlet on Christmas Island Hawk-Owls stressing their uniqueness and vulnerability, and talking more generally about life in the forest at night. This should be further supported by a conservation related curriculum unit for both primary and secondary school students that raises awareness of Christmas Island habitats and species generally.

---

<i>Specific Objective:</i>	4. To implement the Recovery Plan through a Recovery Team
<i>Criteria:</i>	Demonstrated successful operation of the Recovery Team over five years.
<i>Actions:</i>	<b>8. Establish a recovery team which meets regularly</b> <b>9. Carry out a major review of the recovery plan</b>

A recovery team shall be formed to implement this recovery plan. The team should comprise staff from PANCI, the Shire of Christmas Island and other affected Christmas Island interests, such as the Christmas Island Phosphates, Union of Christmas Island Workers, the Asia Pacific Space Centre Pty. Ltd, the Department of Transport and Regional Services (DOTARS), the Department of Immigration, Multicultural and Indigenous Affairs (DIMIA), and other specialists where necessary. Progress will be monitored and evaluated yearly by members of the recovery team through an annual review. The monitoring process will include: compiling information from resighting of banded birds, success of monitored nests, and assessing progress of all actions against the criteria and objectives of the recovery plan (data comparisons performed by participating biologist). A major review of this performance must be conducted at the end of the first five years of implementation, by an independent reviewer.

Specific Objective	Performance Criteria	Actions
1. Maintain (or increase) extent of occurrence and total population size at 1994-96 levels.	<ul style="list-style-type: none"> <li>• Total population size not less than <math>562 \pm 105</math> occupied territories as measured by the monitoring program.</li> <li>• Owls widespread on the island in all suitable habitats as measured by the monitoring program.</li> <li>• Protection of all habitat critical to survival outside the national park.</li> <li>• A continuing increase in suitable habitat through implementation of the Christmas Island Rainforest Rehabilitation program.</li> </ul>	<ol style="list-style-type: none"> <li>1. Monitor the Christmas Island Hawk-Owl population every two years to detect any significant change in the distribution or abundance</li> <li>2. Develop and implement a wildlife management plan for hawk-owl habitat outside the national park</li> <li>3. Ensure protection of habitat critical to survival outside the national park.</li> <li>4. Continue an effective and long-term rainforest rehabilitation program managed by DOTARS and supported by other government departments, PAN and the mining company.</li> </ol>
2. Implement threat abatement strategies	<ul style="list-style-type: none"> <li>• Crazy Ants having a negligible impact on Christmas Island Hawk-Owls populations.</li> <li>• Maintenance of effective quarantine against the introduction of all avian diseases</li> </ul>	<ol style="list-style-type: none"> <li>5. Implement the Invasive Ants on Christmas Island Action Plan</li> <li>6. Maintenance [and regular review] of a quarantine barrier between Christmas Island and all other lands which minimises the risks of new avian diseases establishing on Christmas Island.</li> </ol>
3. Increase community involvement in and awareness	<ul style="list-style-type: none"> <li>• Demonstrated increase in community awareness and support for habitat protection</li> </ul>	<ol style="list-style-type: none"> <li>7. Community education program to raise awareness and interest in the conservation of Christmas Island Hawk-Owls.</li> </ol>
4. Implement the Recovery Plan through a Recovery Team	<ul style="list-style-type: none"> <li>• Demonstrated successful operation of the Recovery Team over five years.</li> </ul>	<ol style="list-style-type: none"> <li>8. Establish a recovery team which meets regularly</li> <li>9. Carry out a major review of the recovery plan</li> </ol>

### ***Guide for Decision-makers***

The following management actions are required to aid the Christmas Island Hawk-owl viability and recovery:

1. Adequate resourcing of the identified management activities for the species;
2. Quarantine prevention of the introduction of new avian pathogens;
3. Quarantine prevention of the introduction of new invasive weeds; and
4. Quarantine prevention of the introduction of new predators.

This taxon is dependent on active conservation management.

Any action which would remove nesting sites or potential nesting sites; or remove or degrade habitat critical to survival, could result in a significant impact on the species and requires referral to the Commonwealth Environment Minister under the EPBC Act.

### ***Tools to Assist Implementation***

#### ***Costs***

<b>Action</b>	<b>Likely expenses</b>	<b>Cost estimate</b>	<b>Responsibility</b>	<b>Timeframe</b>
Monitor the population every two years to detect any significant change in the distribution or abundance	PANCI staff, training consultant, and local staff/contractor	\$17,500 in first year, then \$9,500 / 2 year*	PANCI	Every two years
Develop and implement wildlife management plan for hawk-owl habitat outside the national park	PAN staff time	\$10,000 then \$5000 pa	PANCI	Ongoing
Ensure protection of habitat critical to survival outside the national park.	PANCI staff time	\$2,000 pa	PANCI	Ongoing
Continue effective and long-term rainforest rehabilitation program managed by DOTARS & supported by other government depts, PAN and the mining company.	DOTARS staff time, PANCI supervision and monitoring, contractors.	\$750,000^ pa	DOTARS	Until mine ceases operation & all levy funds expended
Implement Invasive Ants on Christmas Island Action Plan.	PANCI staff, ant bait, contractors, research	\$475,000 in 2002/3 and \$100,000 pa	PANCI	Ongoing
Maintain [and regular review] of quarantine barrier between Christmas Island and all other lands	AQIS staff time, PANCI assistance to AQIS	\$2000 pa (PANCI)	AQIS	Ongoing
Community education program	PANCI staff, brochure production costs.	\$2000 pa	PANCI	Ongoing
Establish a recovery team which meets regularly *	PANCI	\$2000 pa	PANCI	Ongoing
Major review of the recovery plan	Recovery Team	\$2500	PANCI	Yr 5

Notes: PAN: Parks Australia North; PANCI: PAN Christmas Island staff

\* Consultant for 15 days from mainland including airfares and on island expenses \$8000 (first year only), Local trained staff: 25 nights work (4 sites/night) @\$250/night + \$1250 mileage: \$7500/year, Staff time to analyse data: \$2000/year

^ Funds provided by conservation levy, with total dependant on phosphate production levels

#### ***Summary table of costs***

<b>Year</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>Total Cost</b>	\$1,310,500	\$913,000	\$922,500	\$913,000	\$925,000

### ***Landholder incentives***

Small opportunities exist for the Natural Heritage Trust to be used to protect remnant vegetation on private land. Management agreements can be put in place with landholders' permission to protect and enhance native vegetation on the island.

### ***Role and interests of indigenous people***

Not relevant.

### ***Interests that will be affected by the plan's implementation or adoption***

Parks Australia North, Shire of Christmas Island, Union of Christmas Island Workers, Asia Pacific Space Centre Pty. Ltd., Department of Transport and Regional Services, Department of Immigration Multicultural and Indigenous Affairs, and Christmas Island Phosphates.

### ***Consultation with, and advice considered from relevant State and Territory Governments and the general public***

There are no relevant state or territory governments to consult with. Whilst Christmas Island is a Commonwealth non-self governing Territory, Western Australian laws are applied to the island as Commonwealth applied laws. A number of Western Australian agencies have roles on Christmas Island through agreements with the Department of Transport and Regional Services (DOTARS). DOTARS has contributed to the development of this plan.

This plan was originally written in 1996. The current version was completed by Birds Australia in consultation with Parks Australia North, staff of Christmas Island National Park, and the Department of the Environment and Heritage, Canberra. Both Christmas Island Phosphates and the Shire of Christmas Island were consulted during the preparation of this current plan.

As part of the requirements for the EPBC Act, a three month public consultation phase was undertaken whereby the public was able to contribute comments on draft plans, and where relevant these comments were then incorporated.

### ***Community Participation***

Regular press articles in Christmas Island newspaper. Also see action 7 - includes production of a multi-lingual pamphlet on Christmas Island seabirds and a potential curriculum unit on endemic seabirds for both primary and secondary school students.

## References

- Carew-Reid, J. 1987. Rehabilitation of mined clearings on Christmas Island, Indian Ocean. Unpublished report to the Director of the Australian National Parks and Wildlife Service, Canberra.
- Diamond, J.M. 1985. Population processes in island birds: immigration, extinction and fluctuations. In *Conservation of Island Birds*. ICBP Tech. Pub. 3.
- Du Puy. 1993. *Flora of Australia*, Volume 50. Oceanic Islands 2. Australian Biological Resource Study, Canberra.
- Environment Australia. 1994. Christmas Island National Park Management Plan. Commonwealth of Australia, Canberra.
- Environment Australia. 2002. Christmas Island National Park Management Plan. Commonwealth of Australia, Canberra.
- Hay, R. 1986. *Bird Conservation in the Pacific Island*. ICBP Study Rep. 7. Cambridge, England.
- Hill, F.A.R. and J. Young. 1995. Searching for the nests of Christmas Island Hawk-Owls *Ninox squamipila natalis*. Unpublished report to the Australian Nature Conservation Agency, Darwin.
- Hill, F.A.R. 1996. The Christmas Island Hawk-Owl: Its distribution, population size and conservation status. Unpublished report to the Australian Nature Conservation Agency, Darwin.
- Hill, F.A.R. and A. Lill. 1998a. Density and Total Population Estimates for the Threatened Christmas Island Hawk-Owl *Ninox natalis*. *Emu* 98: 209-220.
- Hill, F.A.R. and A. Lill. 1998b. Diet and Roost Site Characteristics of the Christmas Island Hawk-Owl *Ninox natalis*. *Emu* 98: 227-233.
- King, W.B. 1985. Island Birds: will the future repeat the past. In *Conservation of Island Birds*. ICBP Tech. Pub. 3.
- Garnett, S.T. and Crowley, G.M. 2000. *The Action Plan for Australian Birds 2000*. Birds Australia, Melbourne and Environment Australia, Canberra.
- Lacy, R.C. 1987. Loss of Genetic Diversity from Managed Populations: Interacting effects of drift, mutation, immigration, selection, and population subdivision. *Conserv.Biol.* 1(2): 143-58.
- Mitchell, B.A. 1974. Forest Flora of Christmas Island. *Comm. For. Review* 53: 19-29.
- Norman, J.A., L. Christidis, M. Westerman and F.A.R. Hill. 1998. Molecular data confirms the species status of the Christmas Island Hawk-Owl *Ninox natalis*. *Emu* 98: 197-206.
- Orchard, M, Comport, S. and P. Green. 2002. Control of the Invasive Yellow Crazy Ant (*Anoplolepis gracilipes*) on Christmas Island, Indian Ocean; progress, problems, and future scenarios. Unpublished Discussion Paper 1 February 2002.
- Reville, B.J., J.D. Tranter and H.D. Yorkston. 1990. Conservation of the Endangered Seabird Abbott's Booby on Christmas Island. 1983-1989. *ANPWS Occ. Paper* No. 20.
- Stokes, T. 1988. A review of the birds of Christmas Island, Indian Ocean. *Australian National Parks and Wildlife Service Occ. Pap.* No. 16.
- Tidemann, C.R., H.D. Yorkston and A.J. Russak. 1994. The diet of feral cats (*Felis catus*) on Christmas Island, Indian Ocean. *Wildlife Research* 21: 279-286.
- Van der Lee, G. and P. Jarman. 1996. The status of cats *Felis catus* and prospects for their control on Christmas Island. Report to the Australian Nature Conservation Agency, Canberra.
- van Tets. 1975. A report on the conservation of resident birds on Christmas Island. XII Bulletin of the ICBP.
- van Tets, G.F. and P.A. van Tets. 1967. A report on the resident birds of the territory of Christmas Island. *Emu* 66 (4); 309-19.