



Natural Heritage Trust

Helping Communities Helping Australia

An Australian Government Initiative

NATIONAL RECOVERY PLAN
FOR THE
CHRISTMAS ISLAND GOSHAWK
Accipiter fasciatus 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 55009 3

© 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 Goshawk *Accipiter fasciatus 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 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 Goshawk is currently listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). It is currently considered a subspecies of *Accipiter fasciatus*, but its taxonomy needs resolution. It is considered to be the rarest endemic bird on Christmas Island, where it occurs in all habitats from primary and marginal rainforests to suitable areas of secondary regrowth vegetation. The total population size is thought to be very small, perhaps as few as 100 adults, and is probably limited by the availability of suitable rainforest habitat. Crazy Ants pose an unknown but potentially critical threat to the survival of this bird. The recovery plan objective is to downgrade the Christmas Island Goshawk from Endangered to Conservation Dependent, primarily through successful implementation of the Invasive Ants on Christmas Island Action Plan and protection of habitat critical to the survival of the species from clearance. An assessment of goshawk population dynamics is the most essential requirement of this recovery plan, and community awareness and participation in the conservation of this endemic raptor are also important actions.

Background Information

Conservation Status

The Christmas Island Goshawk (*Accipiter fasciatus natalis*) is currently listed as Endangered (EPBC Act), however, according to Garnett & Crowley (2000) it now fulfils the criteria for Critically Endangered.

Taxonomic Status

Since the Christmas Island Goshawk was described by Lister in 1888 as a full species *Accipiter natalis*, debate has continued over whether it is more closely allied to the Brown Goshawk *Accipiter fasciatus*, or to the Grey Goshawk *A. novaehollandiae*. Lister (1888) thought the Christmas Island Goshawk was allied to the Grey Goshawk from the Maluku *A. n. griseogularis*. Chasen (1933) disagreed, thinking it a member of the *A. fasciatus* group. The Christmas Island Goshawk may have been isolated from populations of either of these species for a long period of time, and Carter (1994) raised the possibility of resurrecting the Christmas Island subspecies *natalis* to a full species.

International Obligations

The Christmas Island Goshawk is not listed under international agreements.

Distribution and location

The Christmas Island Goshawk is restricted to Christmas Island, a volcanic island in the Indian Ocean (10°0'S; 105°40' E), approximately 1400km northwest of Australia. The island sits on the northernmost edge of the Australasian continental plate, and immediately north the ocean floor drops into the Java Trench and depths of up to 6000m. The nearest land is Java in the Republic of Indonesia, 360km to the north. Christmas Island is truly oceanic and all its native biota has colonised by sea or by air (Gray 1981). The island is 135km² and 75% is covered with original vegetation (Environment Australia 2002).

Gibson-Hill (1947) reported that Christmas Island Goshawks seemed to prefer areas of 'slightly thinner growth on the edge of thick jungle or the borders of clearings'. During 1994 and 1995 goshawks were observed in all major habitats on the island (Hill unpubl. data.). Goshawks were regularly seen hunting in regrowth vegetation along roadsides. This may be merely because they were much more visible in this habitat compared to intact forests. Parks Australia North (PAN) data from a systematic survey over all habitat of the island (over 1000 survey points) suggest that more goshawks are located within rainforest (95% of sightings) than in cleared areas. The Christmas Island Goshawk is the least frequently encountered diurnal forest bird and might best be described as 'widespread and uncommon'.

There are no data on adult or juvenile movements. Adult Christmas Island Goshawks are probably resident on their territories year-round. Grey Goshawks defend a territory around the nest site which appears to be significantly smaller than the home range in which they feed (Burton 1991).

There are no detailed population estimates for Christmas Island Goshawks. New Caledonian Brown Goshawks, a similar-sized closely related bird, occurred at a density of 0.89 - 0.96 adults/km² in rainforest (Thiollay 1993). There is approximately 101 km² of primary forest on Christmas Island which suggests that it is unlikely that there are many more than 50 pairs or 100 mature Christmas Island Goshawks on Christmas Island.

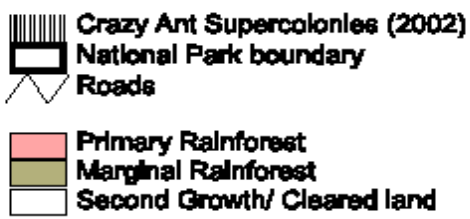
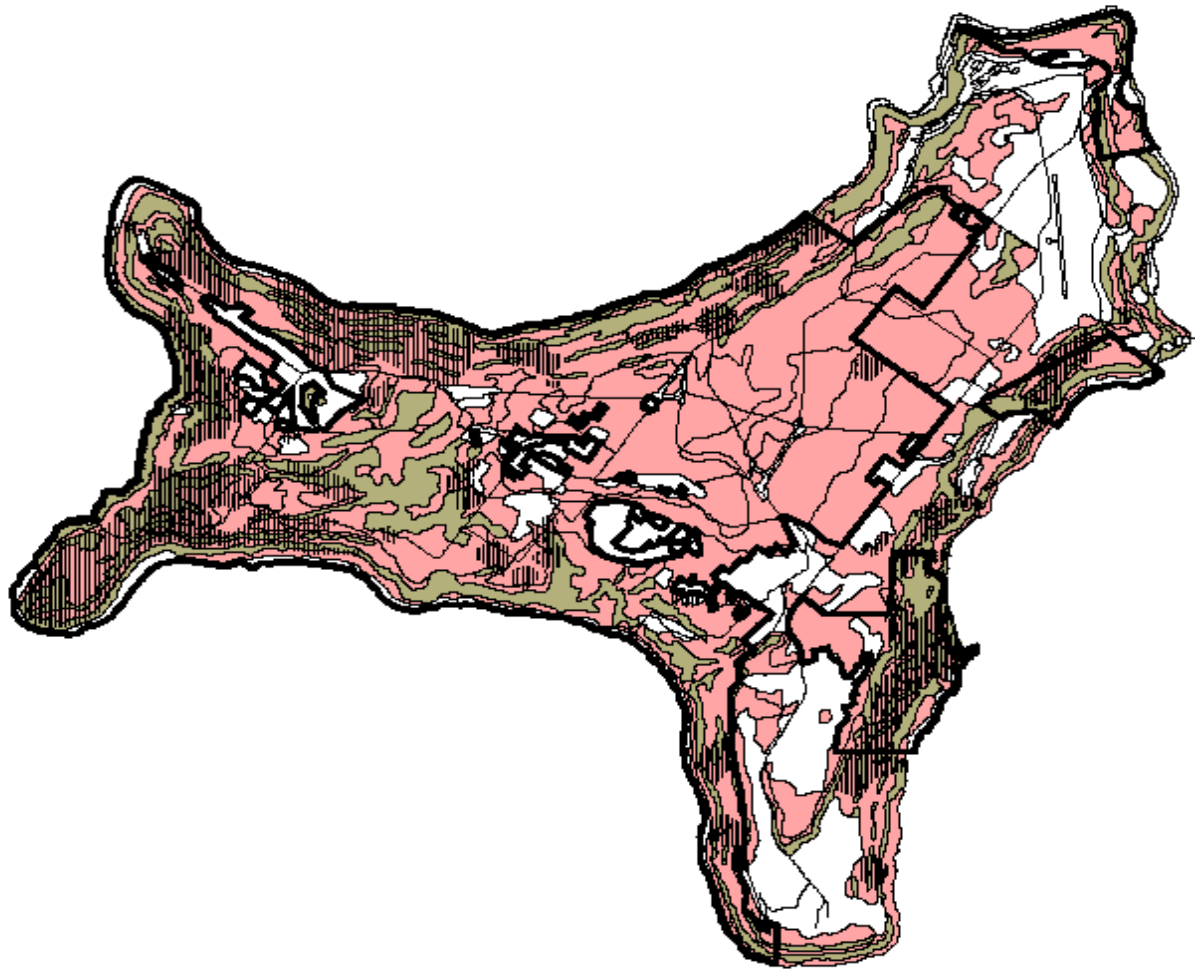
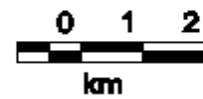


Figure 1: Distribution of Primary Rainforest and Marginal Rainforest on Christmas Island and Crazy Ant supercolonies (after Orchard et al. 2002).



Biology

The Christmas Island Goshawk has been recorded eating a wide range of vertebrates and invertebrates including birds, small mammals and insects. Prey includes Christmas Island White-eye *Zosterops natalis*, Island Thrush *Turdus poliocephalus*, Emerald Dove *Chalcophaps indica*, Java Sparrow *Lonchura oryzivora*, domestic chickens *Gallus gallus*, (Lister 1888, Gibson-Hill 1947, Hill, unpubl. data); as well as nestling Red-footed Boobies *Sula sula* (Hill, unpubl. data) and an adult Golden Bosun *Phaethon rubricauda westralis* (J. Tranter pers. comm.). It has also been recorded catching rats *Rattus rattus* (Gibson-Hill 1947) and ‘lizards’ (Lister 1888). It is frequently seen catching grasshoppers (probably *Valanga sp.*) which are common in secondary vegetation around the island (Gibson-Hill 1947, Hill unpubl. data). Gibson-Hill (1947) also recorded it feeding on the large centipede *Scolopendra morsitans*, which is widespread on the island, and on beetles (Coleoptera) and mantids (Mantidae).

The Christmas Island Goshawk captures its prey off the ground or in the air by seizing it in flight with its long, strong legs. Like other goshawks, it will hunt from a perch where it may sit for some time waiting for suitable prey. Christmas Island Goshawks will chase small flying birds through the forest as well as pounce on birds foraging on the ground (Hill unpubl. data). Hill observed goshawks ‘short-stay perch-hunting’ (after Newton 1986) flying along a track, perching for a few minutes then flying 50-100m further and landing again, as well as pursuing insects on the ground and snatching insects off foliage. There is likely to be some sex differences in hunting and in diet, as is found in both Brown and Grey Goshawks (Marchant & Higgins 1993). Given the large sexual dimorphism (similar to Grey Goshawk, Hill unpubl. data) and the opportunity for niche expansion on the island in the absence of other diurnal raptors, this difference may be quite pronounced.

Gibson-Hill (1947) described three Christmas Island Goshawk nests all of which were in near-horizontal forks of forest trees, one 10m high and two 15-20m in tall forest trees. Hill (unpubl. data) observed four nests: two in *Syzygium nervosum* in Primary rainforest; and two in *Terminalia catappa* in Marginal rainforest. All nests were 25-35m above the ground, in the fork of two or more branches, three towards the edge of the crown, and one in the middle of the tree. One nest (probably not used) was 30-40cm in diameter, two others were 50-80cm in diameter, and the fourth was under construction. Nest size and location within the tree share more similarities with Grey than Brown Goshawks (J. Young pers. comm.; see Burton *et al.* 1994).

Habitat

Approximately 75% of Christmas Island is still covered with natural vegetation and 84% of this (or 63% of the island) is protected within National Park (Figure 1). The remaining Primary rainforest is currently protected from clearance by a Federal Government moratorium, in conjunction with the requirements for approval under the EPBC Act and *Environment Protection and Biodiversity Conservation Regulations 2000* (EPBC Regulations). Marginal rainforest and Second-growth rainforest or Secondary Vegetation outside the National Park may only be cleared if approval is given under the EPBC Act and Regulations.

Schedule 12 of the EPBC Regulations use Du Puy’s classification to describe the Christmas Island forests. Primary Rainforest is restricted to the central plateau and is evergreen closed forest 30-40m high with emergent trees up to 45m. 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 *Arenga*

listeri, *Leea angulata*, *Ochrosia ackeringae*, *Pisonia umbellifera* and *Aidia* aff. *racemosa* (Environment Australia 1994).

Marginal Rainforests grow 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. Marginal rainforest is generally lower than Primary Rainforest, often less than 30m, and may include many vines. The canopy height and shape are 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 low second-growth 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.

Habitat Critical to Survival

Identification of habitat critical to survival of the Christmas Island Goshawk is difficult due to the lack of information on specific habitat requirements. Although Christmas Island Goshawks may be generalists which forage in most habitats, it is highly likely that they require rainforest to breed as these habitat contain suitable trees. Applying the precautionary principle and using the criteria provided by the EPBC Act, habitat critical to survival of the Christmas Island Goshawks is defined as all Primary Rainforest, Marginal Rainforest (Du Puy 1993) and possibly second-growth forest suitable for nesting. Primary Rainforest and Marginal Rainforest has been identified and mapped (Figure 1). Dexter (2000) recommended mapping the ecological quality of second-growth forests outside the national park. As this has not occurred, and there is insufficient information on the habitat requirements of the Christmas Island Goshawks, suitable second-growth forest cannot be identified at this time.

Affected Interests

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

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 will the goshawk monitoring program. Christmas Island endemic birds attract specialist bird watching groups each year which 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, and potential economic effects of preventing illegal destruction of Christmas Island goshawks by residents. 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 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 Goshawk (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 goshawk 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 Hawk-owl (e) <i>Ninox natalis</i>	VJ
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 Plan of Management 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

A Recovery Team for the Christmas Island Goshawk has not yet been formed. The team should comprise representatives of PAN, the Shire of Christmas Island, the Department of Transport and Regional Services, an independent environmental consultant, and other members as thought appropriate.

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 in infested areas. 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. 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.

PAN field workers and assistants conducted an island-wide ant survey during May-August, 2001. The survey was designed by CAMBI (Centre for the Analysis and Management of Biological Invasions, Monash University). Of 972 sites surveyed; 741 surveyed points fell in natural forest. Crazy ants were recorded at 46.7% of sites in natural forest. Super-colony densities were recorded at 22.7% of sites in natural forest. Using these survey points as a representative sample of the forest, it was estimated that 2,379 ha of the estimated 10,492 ha of forest on the island was infested with crazy ants at supercolony densities (Orchard et al. 2002). Crazy ants are not evenly distributed throughout natural forest but are more commonly found on terrace forests and less commonly found in deep-soil tall-closed forest, which make up most of the natural forests on the island plateau. Deep-soil tall-closed forest made up 31% of census sites in natural forest but only 6.5% of supercolony records (Orchard et al. 2002).

In September 2002 an aerial baiting program was undertaken, and all known supercolonies treated with insecticide. Results so far indicate the program was successful in controlling supercolonies over 2500ha of Christmas Island. Crazy ants are still present in low densities,

however, 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 diseases. 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 has been 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, Secondary Vegetation on stockpiles, and roads and housing (Environment Australia 1994). This has meant a loss of available forested habitat, although secondary vegetation growing along roadsides and on stockpiles contributes to the feeding habitat for Christmas Island Goshawks at least at some times of the year. Nonetheless, based on the decrease in available habitat, the total Christmas Island Goshawk population has probably decreased by at least 25% since settlement (Stokes 1988).

Primary forests on Christmas Island have been fragmented in places by clearing and most Primary Rainforest is 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 Secondary Vegetation.

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 goshawk habitat. One development condition for the satellite launching facility is to develop and implement an environment management plan, 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 Goshawk will aid in determining potential impacts of these and future developments on goshawk habitat.

The Christmas Island Rainforest Rehabilitation Program (CIRRP) is a long term program to revegetate old minefields. The CIRRP is funded by a conservation levy that is collected from Phosphate Resources Limited at an indexed rate per tonne. Rehabilitation priorities are primarily determined to protect Abbott's Booby sites, although other threatened species are also considered in determining the priority of sites. A significant additional result of CIRRP will be the reestablishment of habitat that supports other species such as the goshawk.

Natural Catastrophes

Although goshawks, as generalist raptors, are likely to cope well with habitat modifying natural catastrophes, the effect of events such as cyclones are more severe on small populations. There is a possibility of an increase in severe storms and cyclones occurring as a result of Greenhouse gas-induced climate change. It would be useful to understand the effects of cyclones and severe storms on goshawk populations to help predict the impact of any increases.

Small population size

The risk of extinction varies inversely with population size (Lacy 1987) due primarily to demographic and environmental variability the effects of which can become marked in small populations. Demographic variability is the individual variation in reproductive success, which is masked when population size is large. Very small populations (< 30 individuals) can easily become extinct as a result of random demographic variation between individuals (Caughley & Sinclair 1994).

The reproductive success of a population is also likely to vary with fluctuations in the environment. The degree of this fluctuation is determined by how much seasonal and annual variation in habitat quality there is. The influence of this on the risk of extinction increases markedly with decreasing population size. For example, a cyclone, an extreme example of environmental variation, causing the death of half the population of 10000 animals has an insignificant affect on the probability of extinction of that population. However, if half a population of 200 animals dies, the risk of extinction of that population increases significantly (Caughley & Sinclair 1994).

Inbreeding Depression

The risks of inbreeding depression increases with decreasing population size due to the increase in frequency of homozygous alleles. Populations at risk of inbreeding depression are probably a couple of dozen individuals or smaller in size which have been at that size for several generations, as a population contraction must last for several generations to lead to a significant loss of heterozygosity (Caughley & Sinclair 1994). Any action on the island which might permanently, rather than temporarily, reduce the number of mature individual Christmas Island Goshawks (such as permanent forest clearance rather than temporary storm damage) would raise the possibility of inbreeding depression as a concern in their conservation.

Other Potential Threats

Killing of Christmas Island Goshawks, especially by poultry owners, has been considered to be a significant threat to goshawks in the past (Stokes 1988). Given the small population size, any killing of either juveniles or adult Christmas Island Goshawks would be considered a significant threat to this taxon. Another possible threat is posed by cats, especially near settled areas.

Road killed Christmas Island Goshawks have been reported. A substantial increase in vehicular traffic will be associated with the proposed satellite launching station and the new immigration, reception and processing centre (IRPC). 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.

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

Recovery Objectives and Timelines

Overall objective:

To shift the status of the Christmas Island Goshawk from Endangered to Conservation Dependent within 10 years.

Specific objectives:

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

1. Determine taxonomic status
2. Determine and maximise total population size and area of occupancy
3. Implement threat abatement strategies
4. Increase community involvement and awareness
5. Implement the Recovery Plan through a Recovery Team

Performance Criteria

- Taxonomic position of Christmas Island Goshawk clarified.
- Distribution of Christmas Island Goshawks widespread on the island in all suitable habitats as demonstrated by population monitoring.
- Density of Christmas Island Goshawks increased as demonstrated by population monitoring
- Crazy Ants having an insignificant impact on Christmas Island Goshawks.
- Protection of all habitat critical outside the national park on Christmas Island.
- 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 of the Recovery Team over five years.

Actions

Specific objective 1. Determine taxonomic status

Performance Criteria Taxonomic position of Christmas Island Goshawk clarified.

Action ***1. Investigate the taxonomic status of the Christmas Island Goshawk.***

This project is designed to describe the relationships of the Christmas Island Goshawk to the Brown and Grey Goshawks by comparing DNA sequences of selected mitochondrial genes. Mitochondrial DNA may be collected from feathers allowing specimens already in collections to be used for analysis. The Museum of Victoria has material from Christmas Island Goshawks.

Specific objective 2. Determine and maximise total population size and area of occupancy

Performance Criteria Distribution of Christmas Island Goshawks widespread on the island in all suitable habitats as demonstrated by population monitoring

 Density of Christmas Island Goshawks increased as demonstrated by population monitoring

Action **2. Conduct detailed population survey**

The recovery team will obtain estimates of population size, distribution, age structure, fledging success, and survival rates. This is required to assess the status of this taxon. Data on age structure and fledging success will be used to monitor the population, and will, over time, indicate whether or not any significant change in population size is occurring.

Trap and colour band the Christmas Island Goshawk population across the island with the aim of individually marking the majority of the population. A majority of the population will remain individually marked by periodic supplementary trapping after this initial program. This action will provide data on the age-structure of the population, distribution on Christmas Island (including some information on habitat), ranging behaviour and spacing of individuals from resightings during the 18 month study, and thus some data on population size.

The members of the Australasian Raptor Association (ARA), part of Birds Australia, include many of the Australian professional and amateur experts on birds of prey. They may be able to provide unpaid assistance in trapping and marking birds, and in training of local staff in trapping techniques. The cost of their involvement would be airfares from Australia and accommodation and transport on Christmas Island. With the involvement of the ARA this project lends itself to being done by a post-graduate student. If ARA involvement was not possible dedicated researchers would be required, and the cost would be substantially higher.

Action **3. On-going monitoring of the population**

It is essential to formally and regularly monitor the size of the population, and breeding success. The recovery team will monitor the total population size at regular intervals (initially annually) such that, if a decline takes place, it provides sufficient warning to managers to allow remedial management and research to take place. The monitoring program shall be based on observations of the individually marked population of Christmas Island Goshawks. PAN Christmas Island staff, tour operators, and the community in general will be encouraged to record all observations of goshawks, and to report their locations accurately. This will provide an ongoing data set on the proportion of resightings of marked birds, and on the habitats in which birds are seen. Once every five years, volunteers from the ARA will visit the island and trap and mark additional birds to maintain a majority of marked birds in the population.

In addition a sample of goshawk nests should be monitored annually. Monitoring of ten nests over a number of years will provide a considerable amount of information on breeding success, diet, and habitat requirements, and would be relatively inexpensive. Breeding success data will allow evaluation of the species' status and population viability. Knowledge of diet is essential to evaluate the effects of habitat change, and predict the likely impact of any proposed changes in land management on the island. Information on diet and breeding requirements, combined with data from the population survey on distribution, ranging and spacing, will enable refinement of the definition of habitat critical to the survival of Christmas Island Goshawks, and determination of at what stage/s they utilise rehabilitated areas.

Ten nests will be monitored for signs of breeding, and once breeding has commenced monitored regularly (fortnightly) while the breeding attempt continues. In addition roost sites of parents should be located and pellets collected for dietary analysis. The pellets should be relatively straightforward to analyse due to the limited number of potential vertebrate prey. Insects should be identified as accurately as possible. Monitoring of nesting and collection and analysis of pellets could be part of the general duties of the resource management staff of PANCI.

<i>Specific objective</i>	2. Determine and maximise total population size and area of occupancy
<i>Performance Criteria</i>	Protection of all habitat critical outside the national park.
<i>Action</i>	4. Develop and implement wildlife management plan outside the national park
<i>Action</i>	5. Ensure protection of habitat critical outside the national park.

Most forested land outside the National Park is publicly owned, by the Commonwealth. PAN staff are routinely involved with the other stakeholders in negotiations over development proposals. This is ongoing. These proposals can occur unexpectedly and as there is no overall wildlife management plan outside the park, are assessed on an *ad hoc* basis. While consultation with other agencies and proponents on projects will be essential and ongoing (under the EPBC Act referrals process), achievement of long-term protection of threatened species outside the park requires a more comprehensive and considered approach through the development of a wildlife management program. 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 Goshawk meets the definition of a protected species.

The plan should allow for the input of relevant landholders and decision makers, and provide more strategic and comprehensive protection of flora and fauna, 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 which are critical to survival.

<i>Specific objective</i>	2. Determine and maximise total population size and area of occupancy
<i>Performance Criteria</i>	A continuing increase in suitable habitat through implementation of the Christmas Island Rainforest Rehabilitation program.
<i>Action</i>	6. Continue effective and long-term rainforest rehabilitation program managed by DOTARS & supported by PAN and the mining company.

The Christmas Island Rainforest Rehabilitation Program has been occurring over the last three decades. Currently, the main aim is to revegetate mined areas adjacent to Abbott's Booby nesting habitat to reduce wind turbulence caused by the clearings and implicated in reduced nesting success of the booby (Reville *et al.* 1990). There are approx. 70 clearings covering 3200ha or 24% of the island area (Carew-Reid 1987). It is not known how Christmas Island Goshawks use these areas and at what stage of rehabilitation this habitat become important for foraging and for nesting – this will be investigated as part of the monitoring program.

In 2002, the Government decided to redirect the payment of the conservation levy to the portfolio agency with responsibility for the mine lease (DOTARS). A MOU between PAN and DOTARS was signed in February 2004 to allow PAN to continue the CIRRP within Christmas

Island National Park. Rehabilitation is critical in terms of increasing rainforest habitat to further protect a range of species including the goshawk. The CIRRP is funded through a conservation levy that forms part of Christmas Island Phosphate's lease. Effective management of the lease by DOTARS will ensure optimal outcomes for rainforest rehabilitation.

Specific objective 3. Implement threat abatement strategies
Performance Criteria Crazy Ants have a negligible impact on Christmas Island Goshawk
Action **7. Implement the Invasive Ants on Christmas Island Action Plan.**

PAN is currently implementing an Invasive Ants Action Plan, which aims to control and minimise the impact of Crazy Ants across the island. This program will require ongoing monitoring of Crazy Ant numbers and control of populations as detected. The recovery team must ensure that the control program does not have any negative impacts on Christmas Island Goshawks.

Specific objective 3. Implement threat abatement strategies
Performance Criteria Maintenance of effective quarantine against the introduction of all avian diseases
Action **8. 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.**

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.

Specific objective 4. Increase community involvement and awareness
Performance criteria Demonstrated increase in community awareness and support for habitat protection
Action **9. A community education program to raise awareness and interest in the conservation of Christmas Island Goshawks.**

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 Goshawk stressing their uniqueness and how they are part of Christmas Island ecosystems. This pamphlet would encourage the community to report sightings of colour-banded goshawks. It should also discuss managing problem goshawks around poultry, emphasising that goshawks are protected, and offering solutions to dealing with problem birds.

This should be further supported by a conservation related curriculum unit for both primary and secondary school students which raises awareness of the Christmas Island habitats and species generally.

Specific objective	5. Implement the Recovery Plan through a Recovery Team
Performance criteria	Demonstrated successful operation of the Recovery Team over five years

Actions

- 10. Establish a recovery team which meets regularly**
- 11. Carry out a major review of the recovery plan**

A recovery team shall be formed to implement this recovery plan. The team should comprise representatives of PANCI, the Shire of Christmas Island, the Department of Transport and Regional Services, an independent environmental consultant, and other members as thought appropriate eg. other affected Christmas Island interests, 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. Investigate taxonomic status	<ul style="list-style-type: none"> Taxonomic position of Christmas Island Goshawk clarified 	1. Investigate the taxonomic status of the Christmas Island Goshawk.
2. Determine and maximise total population size and area of occupancy	<ul style="list-style-type: none"> Distribution of Christmas Island Goshawks widespread on the island in all suitable habitats as demonstrated by population monitoring. Density of Christmas Island Goshawks similar to, or greater than, that of other tropical forest <i>Accipiter</i> spp Protection of all habitat critical outside the national park on Christmas Island. A continuing increase in suitable habitat through implementation of the Christmas Island Rainforest Rehabilitation program. 	2. Conduct detailed population survey 3. On-going monitoring of the population 4. Develop and implement wildlife management plan for habitat outside the national park 5. Ensure protection of habitat critical outside the national park. 6. Continue an effective and long-term rainforest rehabilitation program managed by DOTARS and supported by PAN and the mining company.
3. Implement threat abatement strategies	<ul style="list-style-type: none"> Crazy Ants have a negligible impact on Christmas Island Goshawk populations Maintenance of effective quarantine against the introduction of all avian diseases 	7. Implement the Invasive Ants on Christmas Island Action Plan 8. 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.
4. Increase community involvement in and awareness of the Christmas Island Goshawk	<ul style="list-style-type: none"> Demonstrated increase in community awareness and support for habitat protection 	9. A community education program to raise awareness and interest in the conservation of Christmas Island Goshawks.
5. To implement the Recovery Plan through a Recovery Team	<ul style="list-style-type: none"> Demonstrated successful operation / implementation of the Recovery Team over five years 	10. Establish a recovery team which meets regularly 11. Carry out a major review of the recovery plan

Guide for Decision-makers

The following management actions are required to aid the Christmas Island Goshawk viability and recovery:

1. Adequate resourcing of the identified management activities for the species, in particular, the crazy ant action plan;
2. Prevention of illegal destruction of goshawks by Christmas Island residents;
3. Quarantine prevention of the introduction of new avian pathogens;
4. Quarantine prevention of the introduction of new invasive weeds; and
5. Quarantine prevention of the introduction of new predators.

This taxon is dependent on active conservation management.

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

Community Participation

This recovery plan aims to involve the community in a significant way in monitoring Christmas Island Goshawks. They will be encouraged to report all sightings or suspected sightings of goshawks to PANCI. In addition, goshawks will be colour-banded with an easily legible code or colour-combination that the community will be encourage to report. Validated reports will provide important population monitoring data.

Tools to Assist Implementation

Costs

Action	Likely expenses	Cost estimate	Responsibility	Timeframe
Investigate taxonomic status	Museum Victoria	\$6000	PANCI	Yr 1-2
Detailed population survey	PANCI staff, training consultant, and local staff/contractor/ARA volunteers	\$73,800#	PANCI	Yr 1-2
On-going population monitoring	PAN staff time ARA volunteers	\$11,000 pa, + \$7,000 /5 year^	PANCI	Ongoing
Develop and implement wildlife management plan for habitat outside national park	PANCI staff time	\$10,000 then \$5000pa	PAN	Ongoing
Ensure protection of habitat critical outside the national park*	PANCI staff time	\$2,000 pa	PANCI	Ongoing
Continue effective and long-term rainforest rehabilitation program managed by DOTAR and supported by other government departments, PAN and the mining company.	DOTARS staff time, PANCI supervision and monitoring, contractors.	\$750,000** pa	DOTARS	Until mine ceases operation
Implement the Invasive Ants on Christmas Island Action Plan. *	PANCI staff, ant bait, contractors, research	\$475,000 in 2002/3) approx \$100,000 pa	PANCI	Ongoing
Maintenance [and regular review] of a quarantine barrier between Christmas Island and all other lands to minimise risks of new avian disease establishing*	AQIS staff time, PANCI assistance to AQIS	\$2000 pa (PANCI)	AQIS	Ongoing
A community education program to raise awareness and interest in the conservation of Christmas Island Goshawks. *	PANCI	\$2000 pa	PANCI	Ongoing

Establish a recovery team which meets regularly *	PANCI	\$2000 pa	PANCI	Ongoing
Carry out a major review of the recovery plan	Recovery Team	\$2500	PANCI	Yr 5

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

* Actions that are wholly or partly shared with other Christmas Island recovery plans.

MSc student on island for 18 months with stipend paid- savings may be made if offer to support a student with a scholarship; Assumes involvement of ARA volunteers rather than dedicated researchers in trapping, marking birds and training local staff

^ Local trained staff est. 30 nights work @\$250/night + \$1500 mileage: \$9000/year, Staff time to analyse data: \$2000/year; 2 ARA volunteers visit every 5 years (airfares + accom. and transport Total \$7000 /5 yr);

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

Summary table of costs

Year	1	2	3	4	5
Total Costs	\$1,015,800	\$924,000	\$924,000	\$924,000	\$926,500

Landholder incentives

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, the Department of Immigration and Indigenous Affairs, 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 PAN, staff of Christmas Island National Park, and the Department of Environment and Heritage, Canberra. Both Christmas Island Phosphates and 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 is undertaken whereby the public are able to contribute comments on draft plans, and where relevant these comments are then incorporated.

Community Participation

Regular press articles in Christmas Island newspapers. Participation by community and visitors in reporting sightings of colour-banded goshawks will be an important part of the proposed goshawk monitoring program. Also see action 9 - 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

- Burton, A.M. 1991. Resource partitioning between two sympatric goshawks in the Australian wet tropics. PhD thesis, James Cook University of North Queensland.
- Burton A.M., Alford, R.A. and J. Young. 1994 Reproductive parameters of the Grey Goshawk (*Accipiter novaehollandiae*) and Brown Goshawk (*Accipiter fasciatus*) at Albergowrie, northern Queensland, Australia. *J. Zool.* London 232:347-363.
- 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.
- Carter, M. 1994. Christmas Island Birds. *Wingspan*: 1994, Summer.
- Caughley, G. and A.R.E. Sinclair. 1994. *Wildlife Ecology and Management*. Blackwell Science, Cambridge.
- Chasen, F.N. 1933. Notes on the birds of Christmas Island. *Bull. Raff. Mus.*: 55-87.
- Dexter, N. 2000. *A Draft Conservation Management Plan for Terrestrial Wildlife on Christmas Island outside the National Park*. Environment Australia, 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.
- Garnett, S. and G. Crowley. 2002. Threatened and extinct birds of Australia. Royal Australasian Ornithologists Union. *Australian National Parks and Wildlife Service, RAOU Report 82*. Melbourne.
- Gibson-Hill, C.A. 1947. Notes on the Birds of Christmas Island. *Bull. Raffles Mus.* XVIII 1947: 87-169
- Gray, H.S. 1981. *Christmas Island Naturally*. Geraldton, H. Gray.
- Hay, R. 1986. *Bird Conservation in the Pacific Islands*. ICBP Study Rep. 7. Cambridge, England.
- King, W.B. 1985. Island Birds: will the future repeat the past. In *Conservation of Island Birds*. ICBP Tech. Pub. 3.
- 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.
- Lister, J.J. 1888. On the natural history of Christmas Island. *Proc. Zool. Soc. Lond.* 1888: 512-31.
- Marchant, S. and P.J. Higgins. 1993. *Handbook of Australian, New Zealand and Antarctic Birds*, Vol II Raptors to Lapwings. Oxford University Press, Melbourne.
- Newton, I. 1986. *The Sparrowhawk*. Poyser, Staffordshire, UK.
- 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
- Thiollay J.M. 1993. Habitat segregation and the insular syndrome in two congeneric raptors in New Caledonia, the White-bellied Goshawk *Accipiter haplochrous* and the Brown Goshawk *Accipiter fasciatus*. *Ibis* 135 : 237-246.