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An Australian Government Initiative

**NATIONAL RECOVERY PLAN
FOR THE
CHRISTMAS ISLAND FRIGATEBIRD
*Fregata andrewsi***

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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 Frigatebird is the rarest endemic seabird on Christmas Island and is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In Australia, it is confined to Christmas Island where it breeds in terrace forests in only three small areas totaling about 170 ha in extent. The total population size, last estimated in the early 1980's was approximately 1620 pairs. Limits to total population size are unknown, however considerable areas of former breeding habitat have been cleared and the species was likely more numerous prior to this loss of habitat. Breeding areas of the Christmas Island Frigatebird are now threatened by the invasive Crazy Ant. These ants potentially threaten individual breeding birds as well as the nesting trees. Crazy Ants pose an imminent, extreme risk to the conservation of this and all Christmas Island birds. Much of the breeding colony areas of the Christmas Island Frigatebird lie outside the national park and do not have any formal protection. Other threats to the conservation of Christmas Island Frigatebirds include past pollution from phosphate mining, which has affected one nesting area, and the risk of catastrophic destruction of breeding colonies by wildfires or cyclones.

Background Information

Conservation Status

The Christmas Island Frigatebird *Fregata andrewsi* is the rarest of the five species of the family Fregatidae and breeds only on Christmas Island. It is listed as Vulnerable (ICBP 1981, Garnett 1992, EPBC Act) (B1, C2b), however Garnett & Crowley (2000) recommended it be considered Critically Endangered (A2c, e, B1, B2bce) due to the inferred impact of the Crazy Ant.

Taxonomic Status

The Christmas Island Frigatebird is one of three frigatebird species which breed on Christmas Island. The Greater Frigatebird (*F. minor*) is much more common on Christmas Island and has a much wider breeding distribution. The Lesser Frigatebird (*F. ariel*) was only recently discovered nesting on the island.

International Obligations

The Christmas Island Frigatebird is listed on the Japan-Australia Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA).

Distribution and population size

The Christmas Island Frigatebird breeds only on 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, which is 360km to the north. Christmas Island is truly oceanic and all its biota has colonised by sea or by air (Gray 1981). Christmas Island is 135km² and 75% is covered with original vegetation (Environment Australia 2002).

When not breeding, Christmas Island Frigatebirds range widely around South-east Asia and the Indian Ocean, and are occasional visitors to the shores of Java, Sumatra, Bali, Borneo, the Andaman Is, Darwin and the Cocos (Keeling) Islands (Gore 1968, Marchant & Higgins 1990). It is possible the young birds are nomadic and wander widely until they reach breeding age, however, adults have also been seen far away from the island. It has been speculated they may breed somewhere in the Anamba-Natuna islands (Chasen 1933, Gibson-Hill 1947), but this was based only on sightings in the vicinity of these islands.

Three modern nesting colonies are known on Christmas Island: the golf course, cemetery and dryers colonies (Figure 1). Stokes (1988) reported that the golf course colony covered c. 40 ha, the cemetery colony c. 65 ha, and the dryers colony c. 66 ha.

Gibson-Hill (1947) estimated the total breeding population to be 1000-1500 pairs. In 1972, the population almost certainly numbered fewer than 2000 pairs (Nelson 1972), and in 1975 it was claimed to comprise fewer than 1000 pairs and to be declining (Nelson 1975). The most recent estimate was of 1620 pairs (Stokes 1984). All the above figures except Stokes (1988) were not based on surveys. The Stokes estimate was based on a three-year count of nests in the golf course colony and estimations of the number of nests at the other two sites (T. Stokes pers. comm.). A census of nest sites in the golf course colony in 1985 revealed that it contained c. 854 occupied nests during the time of peak nest numbers in June/July (Stokes 1988). There is no historical or current census data on the numbers of nests in either the cemetery colony or the dryers colony, although it is possible the dryers colony may no longer be used for nesting (see Threats section). Further data is required on the habitat requirements for Christmas Island Frigatebird breeding and on the use of all nesting colony areas.

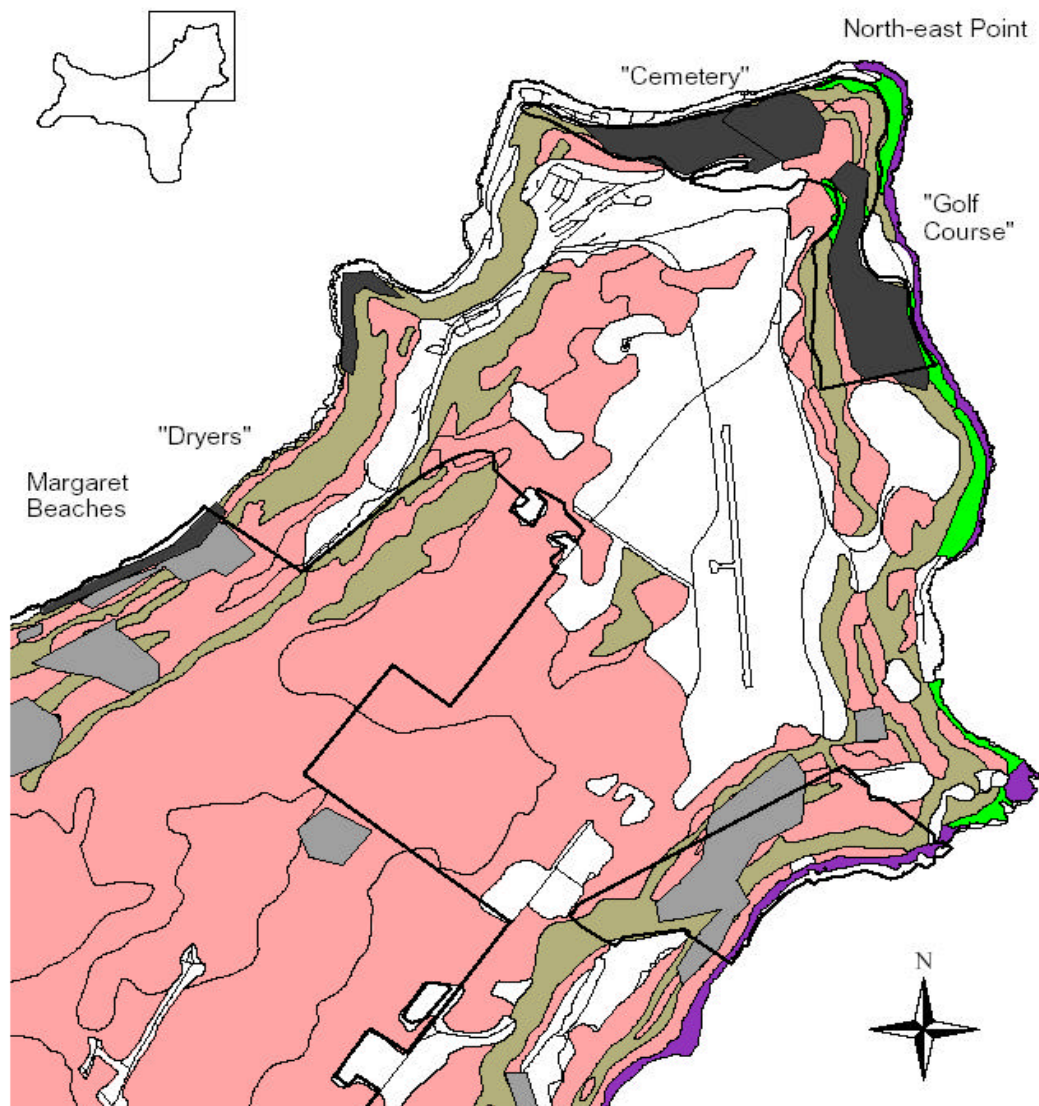


Figure 1: Location of Christmas Island Frigatebird colony areas, features mentioned in the text and Crazy Ant supercolonies.

-  National park boundary
-  Breeding colonies
-  Crazy Ant supercolonies
-  Primary Rainforest
-  Marginal Rainforest
-  Second Growth/ Cleared land
-  Open forest/vine woodland
-  Low woodland
-  Roads
-  Coast

1 0 1 2 Kilometers

Biology

Frigatebirds are a group of seabirds that are adapted morphologically for a highly specialized type of aerial feeding which affects their entire breeding ecology and behaviour. All have extremely prolonged breeding cycles. Frigatebirds in general, do not remain faithful to the same mate or nest site from year to year. Each new breeding effort involves setting up a new territory/nest site, and finding a new mate (Nelson 1975). There is no information on the nest site or mate fidelity of Christmas Island Frigatebirds, but they are probably similar to other frigatebirds.

It requires at least 15 months for a pair of Christmas Island Frigatebirds to raise one offspring to independence, although it is not known whether both partners are required for the entire period. Both Greater Frigatebirds and Lesser Frigatebirds share parental duties and only raise one offspring every two years. However, Magnificent Frigatebird (*F. magnificens*) males cease parental duties when the young are three to four months of age, leaving the females to raise the young to independence. As a result, males breed every year and the females every second year, and there is a skewed sex ratio (Diamond 1972). In Christmas Island Frigatebirds, females tend to feed the older juveniles more than males do (Gibson-Hill 1947, Marchant & Higgins 1990), but males have been recorded feeding free-flying young that were at least eight months old (Nelson 1975). Thus, it is not known whether male birds can attempt to breed annually. The sex ratio of Christmas Island Frigatebirds is not known.

At the beginning of each breeding season, adult males select sites from which they display to females. Males begin displaying in late December and begin forming pairs in late February (Marchant & Higgins 1990). The nest is built on the display site after a male has attracted a female (Nelson 1975). As many as 30 nests have been recorded in one tree (Nelson 1975; T. Stokes, pers. comm.).

Most young hatch between mid April and late June and are extremely slow-growing (Nelson 1975), but appear to grow more rapidly than other frigatebirds (Nelson 1972). Young frigatebirds first take to the air when they are *c.* 6 months old (Nelson 1975, Marchant & Higgins 1990), but remain dependent on the parents for at least a further 9 months (Nelson 1975). This extended period of dependence effectively means that the breeding cycle is biannual, since the time from laying to independence is approximately 15 months. Thus probably only about half of the adult population lay each year (Stokes 1988). Young birds attain adult plumage in the beginning of their fourth year (Gibson-Hill 1947) and the age of first breeding of frigatebirds, in general, is at least five to seven years, possibly older (Nelson 1975); it may even be as much as 9-10 years (Croxall & Rotherby 1991).

Probably 15 to 20% of eggs laid yield fledged young. However, Nelson (1975) found that Christmas Island Frigatebirds appeared to be more successful than other frigatebird species. Some groups on Christmas Island were able to successfully raise 60% of nestlings to at least half grown, but overall *c.* 30% at most reached fledging age; some groups had lower than 20% success (Nelson 1975). Probably no more than 20 to 30% of frigatebirds die during their first year of independence (Nelson 1975). It is likely that it takes a breeding pair at least 20 to 25 years to replace themselves. This would make recovery of population numbers from any decline extremely slow.

Nelson (1975) speculated that frigatebirds, in general, probably have an adult mortality rate of about 4% p.a., giving them an average life expectancy of about 25.6 years. He reasoned that some individuals probably live to 40 or 50 years.

Diet

Christmas Island Frigatebirds forage either by scooping up marine organisms or offal floating on the surface of the water or by their piratical habit of harassing other seabirds forcing them to disgorge some of their meal. Their main food is probably flying fish and squid (Gibson-Hill 1947), however they will occasionally take food off land, pick up carrion and offal from beaches, and steal eggs and nestlings. Grasshoppers have also been recorded from stomach contents (Marchant & Higgins 1990). Most nesting adult frigatebirds appear to forage in the waters immediately around the island. Young birds that have not yet reached breeding age and non-breeding adults probably forage much farther afield.

The waters surrounding Christmas Island may be unusually productive. Christmas Island Frigatebird nestlings were fed more frequently than Greater and Lesser Frigatebirds on other islands and grew much faster (Nelson 1972, 1975). Studies of Abbott's Boobys suggested that food availability in the waters surrounding the Christmas Island fluctuate greatly from year to year (Reville *et al.* 1990).

Habitat Critical to Survival

Christmas Island Frigatebirds can experience great difficulty in becoming airborne and cannot take off from perches less than 3m from the ground (Gibson-Hill 1947). During most of the year the prevailing wind on Christmas Island is the south-east trade winds, and nests are sited preferentially in the lee of the wind or protected (Stokes 1985). Frigatebirds nest under the top branches of trees and require a site that is calm enough to allow them to land safely. In 1994 a few appeared to nest in one or two trees high up the cliff above the road to Smith Point in Flying Fish Cove (A. Dunn unpubl. data). Nelson (1975) noted that they prefer to nest in Sea Almond *Terminalia catappa*. A survey of the golf course colony in 1983 found that the two species *T. catappa* and *Celtis timorensis* comprise 65.5% of all nest trees chosen (Stokes 1985). *Ficus* sp. trees are also often used for nesting (Marchant & Higgins 1990), but are rarely used in the golf course colony (Stokes 1985). These nest tree species occur right around the island and yet the species nests only in a small area of the island.

Data collected in the mid 1980s by T. Stokes may provide better characterisation of preferred nesting habitat. Analysis of this data is underway. Christmas Island Frigatebirds appear to be more restricted in their choice of nest sites, tending to nest well down on the shore terrace (Gibson-Hill 1947, Nelson 1972), whereas Greater Frigatebirds will also nest on the slope or lip of the inland cliff or higher up on the terraces (Gibson-Hill 1947).

Given the limited data on habitat requirements, habitat critical to survival of the Christmas Island Frigatebird is defined as all nesting areas. The approximate boundaries of the nesting colonies are given in Figure 1. Sympathetic management of areas adjoining nesting colonies may be very important. Abbott's Booby nesting colonies within 300m downwind of cleared forest have been shown to have significantly lower breeding success than colonies upwind of the cleared areas (Reville *et al.* 1990), and it is highly likely a similar result would be found for Christmas Island Frigatebirds. Increased wind turbulence around Christmas Island Frigatebird nest sites is a cause for concern. Applying a precautionary approach given the available information, clearance of vegetation within 300m of nesting colonies should be considered undesirable. Actions proposed in this plan will help to better define habitat critical to survival of the Christmas Island Frigatebird, including whether the dryers colony is still viable nesting habitat.

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 proposed frigatebird 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. 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 to 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 recovery plan will aid in determining what could be significant impacts on the Christmas Island Frigatebird (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 Frigatebird provides protection for numerous other listed species, including those in Table 1. Community education targeted at this species will promote awareness of all the endemic birds and their conservation needs.

Table 1: Native species listed under the EPBC Act which 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 (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
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
Great Frigatebird <i>Fregata minor minor</i>	M S C J

Notes: (e)=species or 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 CAMBA

J Listed under JAMBA

Relationship to other plans

The National Park Management Plan is the strategic nature conservation document for Christmas 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.

Threats to the taxon

Habitat loss

Since early settlement, the nesting distribution of Christmas Island Frigatebirds has been fragmented by human development resulting in the three colonies that remain today. Early accounts suggest that the shore terrace of Flying Fish Cove may once have been their main breeding area (Andrews 1900, Gibson-Hill 1947, 1949, Stokes 1988) and they probably had an almost continuous nesting distribution along the north-eastern coast from Margaret Beaches to North East Point, and a separate colony in the sheltered area where the golf course colony is now situated (Figure 1). During the early years of human settlement, much of the habitat of Christmas Island Frigatebirds in Flying Fish Cove and Settlement was cleared. Stokes (1988) estimated that approximately 90ha of breeding habitat had been cleared since settlement.

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 on the island (Orchard et al. 2002). These ants have the ability to form multi-queened 'super-colonies', in which the ants occur at very high densities. Supercolony formation has apparently been a relatively recent phenomenon; the first supercolony was discovered in 1989, with further dramatic increases in supercolony formation probably beginning around the mid-1990s.

At supercolony densities, this invasive, alien 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. Further, the feeding activities of these 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 it should be noted that groundings of birds in crazy ant supercolonies would most probably result in the death of the bird. 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 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% (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 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). Christmas Island Frigatebirds are especially at risk from Crazy Ants because of this concentration of supercolonies on terrace forests where all Christmas Island Frigatebirds nesting habitat occurs. The distribution of Crazy Ant colonies in relation to Christmas Island Frigatebird nesting areas is shown in Figure 1.

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 2500ha 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.

Dust from phosphate dryers.

Part of the phosphate mine, the “Dryers” chimneys were built in the early 1970's and emitted very large amounts of phosphate dust which settled on the downwind terrace forests causing dieback and death to some trees. A major refit has since reduced dust output from around 30kg/cubic metre of exhaust to well below 50mg/cubic metre of exhaust (M. Bennett, CIP, pers. comm).

An island-wide survey of terrace nesting seabirds in May/June 1984 (Stokes 1984) estimated that 100 pairs nested in the dryers colony. A decade later, a brief reconnoitre of the area found fewer than 30 Frigatebird nests between Smith point and Margaret beaches and it was estimated that there would have been at most 50 nests at the peak breeding time (A. Dunn unpub. data).

In 1967, Nelson (pers. comm to Stokes 1988) reported that the dryers and golf course colonies were the two main Christmas Island Frigatebirds nesting areas. Nelson did not note birds nesting in the area now supporting the cemetery colony. This prompted Stokes (1988) to suggest that the cemetery colony may have formed relatively recently from birds displaced from the dryers colony.

Since January 2000 Christmas Island Phosphates have carried out basic monitoring of the utilisation of the “dryers” breeding colony area by all birds including Christmas Island Frigatebirds and there was some suggestion that use of the area by birds generally had increased since the dust emissions were controlled (M. Bennett pers. comm.). However, as of May 2003 there are no Christmas Island Frigatebirds nesting in the area where the old dryers colony was.

Storms

Christmas Island tends to be affected by severe storms every five to ten years. The small population size and limited breeding distribution mean that chance events such as severe storms could have marked effects on breeding success and possibly survival of juveniles and adults. It is known that many eggs can be destroyed in strong winds (Marchant & Higgins 1990).

Fire

Although fires are uncommon on Christmas Island, they did occur in terrace forests during a long dry season in 1994, and again in terrace forest in September 1997. Terrace forests can become extremely dry during the dry season and a fire could have devastating effects on breeding areas. The limited area of the nesting colonies makes them especially vulnerable to fire. The Cemetery and Golf Course colonies are close to human activity, which substantially increases the risk of wildfire in those areas.

Disease

A serious threat to all island birds is the introduction of new disease, particularly when the populations are small. 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.

Weeds

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

Other Potential Threats

Sea-surface temperature was strongly correlated with average annual breeding success of Abbott's Boobies. It was hypothesised that cold water upwellings provided rich food resources (Reville et al. 1990). Higher sea-surface temperatures predicted as a result of global warming could reduce food availability in marine areas adjacent to Christmas Island.

Currently there is very little information on the areas in which Christmas Island Frigatebirds forage. It is likely that over-fishing is a potential problem in some of the foraging habitat of Christmas Island Frigatebirds.

Domestic cats could also pose a potential threat to grounded birds, especially in settled areas.

Recovery Objectives and Timelines

Overall Objective

?? To shift the status of the Christmas Island Frigatebirds from Vulnerable to Conservation Dependent within 10 years

Specific Objectives

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

1. Maximising extent of occurrence and total population size
2. Implementing threat abatement strategies
3. Increasing community involvement in and awareness of the Christmas Island Frigatebird
4. Implementing the Recovery Plan through a Recovery Team

Performance Criteria

- ?? Breeding distribution of Christmas Island Frigatebirds maintained or increased on Stokes (1988) levels
- ?? Total population size not significantly less than 1620 breeding pairs.
- ?? Protection of all habitat critical to survival of the Christmas Island Frigatebird
- ?? Crazy Ants having an insignificant impact on Christmas Island Frigatebirds
- ?? Maintenance of effective quarantine against the introduction of 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. Maximising extent of occurrence and total population size.
Criteria: Breeding distribution of Christmas Island Frigatebirds maintained or increased on Stokes (1988) levels.
Total population size not significantly less than 1620 breeding pairs.

Action: ***1. Develop techniques to monitor the total breeding population size.***

Develop a census methodology which is less expensive and more easily repeated than that used by Stokes (1988). Stokes surveyed nest distribution, particularly in the golf course colony, each year between 1983 and 1987, and also collected monthly data on breeding success at about 50 nests in 1985/86. Barry Reville carried out more detailed studies of a small number of nests in one tree in the cemetery colony. These data contain information on the attendance at nests by both sexes which is important to help interpret census data, as well as breeding and nesting success - an analysis would be invaluable in developing a census method. Other information that should be extracted from these studies includes: (i) Breeding success (and thus breeding requirements); particularly between years, and sites, (ii) timing of breeding, (iii) overlap between Christmas Island Frigatebirds and Great Frigatebirds in nesting distribution, (iv), information on feeding rates and the relative role of each sex in raising the young.

Frigatebirds are very difficult to catch and sensitive to handling (T. Stokes pers. comm.) and a censusing method will probably involve attempting to count the number of breeding attempts initiated in a particular year. Alternative methods of censusing Christmas Island Frigatebirds need to be evaluated due to the expense of repeating ground-based censuses of the number of nesting birds. Frigatebirds are prone to desertion of their nests and aerial surveys by conventional aircraft should not be considered (T. Stokes pers. comm.). However it may now

foot to facilitate later mapping of nest and display sites. This time could also be used to practice surveys and refine the survey technique. The first survey would take place in January/February followed by a two to three month period to analyse the data from these surveys and to prepare for the second survey. The second survey should be carried out in June/July and the resulting analysis and publication of results completed by the end of October.

If the total breeding population is significantly less than 1620 pairs then investigations should commence to reveal why. The decline may be explicable by the loss of breeding habitat in the Dryers colony and if this appears to be the case, there may be no need for other action. The monitoring program will suggest whether there has been significant loss of breeding habitat from the other colony areas, and if this is the case, investigations and strategies will need to be developed to try and reverse this loss of breeding habitat.

In the longer term, knowledge of where sub-adults and non-breeding adults forage is essential to allow planning for their long-term conservation in the face of inevitable, increased pressures on the marine resources of the north-east Indian Ocean. Seabird surveys in the Indian Ocean are carried out by a number of countries and the Recovery Team should support this work and facilitate its synthesis (see Cadee 1985, Dunlop *et al.* 1988, Ballance *et al.* 1997). The Recovery Team for both this species and Abbott's Boobies should support the placement of suitable observers such as from the Australasian Seabird Group of Birds Australia or other vessels conducting surveys in the eastern Indian Ocean.

Specific Objective: 1. Maximising extent of occurrence and total population size.
Criteria: Breeding distribution of Christmas Island Frigatebirds maintained or increased on Stokes (1988) levels.

Action: **3. Monitor and/or assist the recovery of the Dryers breeding colony.**

Monitor the recovery of the vegetation within dust affected areas. Dust affected areas need to be compared with unaffected areas. There are several possible methods of monitoring changes in the vegetation. One possibility is the use of some type of remote sensing technique such as the use of landsat images or aerial photography using a pixellated image. These techniques would require comparison with forest of a similar structure in a healthy condition. A colour scale which grades healthy to unhealthy trees would be used to assess the condition of the vegetation in the dryer's colony. Alternatively, individual trees could be mapped and their health monitored using subjective measures recorded from the ground. The resulting monitoring program should be as simple as possible and only need checking a few times each year. Ideally it should be set-up so that a monitoring round only takes a few hours every few months permitting PANCI staff to carry out monitoring.

Christmas Island Frigatebirds: Any remaining nests which occur along the fringes of the dust affected areas need be monitored (if they are still obvious). Five nest trees occurring in this fringing zone were found and labelled in September 1994, however, this short survey was not comprehensive (A. Dunn unpubl. data). These trees would have to be located and mapped and should be checked each year for use and if birds return to nest to the north of these on the shore terrace the nest trees should also be mapped. The initial mapping of trees may take several days but once these are established it should only take a few hours to check for activity in the trees and along the shore terrace. Trees occurring near the dust affected areas on the shore terrace should be searched for breeding activity. The site would only need to be visited once or twice per year during the time of peak breeding activity in June/July. Monitoring should be kept up for at least five years with a re-assessment after this time to determine any further actions needed, unless birds are observed in this area.

<i>Specific Objective:</i>	1. Maximising extent of occurrence and total population size.
<i>Criteria</i>	Protection of all habitat critical to survival of the Christmas Island Frigatebird.
<i>Action</i>	4. Development and implementation of a wildlife management plan for frigatebird habitat outside the national park.
<i>Action</i>	5. Ensure protection of habitat critical to survival outside the national park.

Most forested land outside the National Park is publicly owned by the Commonwealth. PAN staff on Christmas Island (and Darwin) 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 provide for the development of approved management programs to provide a more comprehensive protection regime outside the park. These plans can allow for the input of relevant landholders and decision makers, provide more strategic and comprehensive protection of flora and fauna while facilitating greater certainty for environmentally-sensitive developments.

The boundaries of all Christmas Island Frigatebird colony areas require re-mapping. Potential nesting habitat, and areas where nesting habitat might be re-established, should also be mapped. Any planned changes to land-use within 300m of nesting colonies should require examination under the EPBC Act referral process for potential impacts on Christmas Island Frigatebirds.

<i>Specific Objective:</i>	2. Implementing threat abatement strategies.
<i>Criteria:</i>	Crazy Ants having an insignificant impact on Christmas Island Frigatebirds.
<i>Action:</i>	6. Implement the Invasive Ants on Christmas Island Action Plan.

Parks Australia North is currently implementing an Invasive Ant 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.

<i>Specific Objective:</i>	2. Implement threat abatement strategies.
<i>Criteria:</i>	Maintenance of effective quarantine against the introduction of avian diseases.
<i>Action:</i>	7. Maintenance [and regular review] of a quarantine barrier between Christmas Island and all other lands to minimise 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.

Specific Objective: 3. Increasing community involvement in and awareness of the Frigatebird.

Criteria: Demonstrated increase in community awareness and support for habitat protection.

Action: **8. Conduct a community education program.**

Most of the nesting habitat currently used by Christmas Island Frigatebirds is close to areas of high human activity. The Golf Course colony abuts the only golf course on the island, the cemetery colony is adjacent to an area proposed for residential and commercial development in the proposed Town Plan (Rumpff, H. pers. comm.). Community support for the conservation of Christmas Island Frigatebirds will greatly increase the likelihood that management of this threatened species will be successful.

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, this project may include production of a multi-lingual pamphlet on Christmas Island seabirds in general stressing their uniqueness and vulnerability. This could be accompanied by a curriculum unit on endemic seabirds for both primary and secondary school students. The costs of this program could be shared with the Abbott's Booby and other Christmas Island threatened bird recovery plans.

Specific Objective: 4. To implement the Recovery Plan through a Recovery Team.

Criteria: Demonstrated successful operation of the Recovery Team over five years.

Actions: **9. Establish a recovery team which meets regularly**

10. Carry out a major review of the recovery plan.

A recovery team shall be formed to implement this recovery plan. The team should comprise staff from PANCI, may include a member from the Shire of Christmas Island and 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: analysis of 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.

Recovery Plan Project Design

Objective	Performance Criteria	Actions
1. Maximising extent of occurrence and total population size	<p>?? Breeding distribution of Christmas Island Frigatebirds maintained or increased on Stokes (1988) levels</p> <p>?? Total population size not significantly less than 1620 breeding pairs</p> <p>?? Protection of all habitat critical to survival if the Christmas Island Frigatebird</p> <p>?? Ensure protection of habitat critical to survival outside the national park</p>	<p>1. Develop techniques to monitor the total breeding population size</p> <p>2. Monitor the total breeding population size</p> <p>3. Monitor and/or assist the recovery of the Dryers breeding colony</p> <p>4. Development and implementation of a wildlife management plan for frigatebird habitat outside the national park</p> <p>5. Ensure protection of habitat critical to survival outside the national park</p>
2. Implement threat abatement strategies	<p>?? Crazy Ants having an insignificant impact on Christmas Island Frigatebirds</p> <p>?? Maintenance of effective quarantine against the introduction of avian diseases</p>	<p>6. Implement the Invasive Ants on Christmas Island Action Plan</p> <p>7. 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</p>
3. Increasing community involvement in and awareness of the Christmas Island Frigatebird	<p>?? Demonstrated increase in community awareness and support for habitat protection</p>	<p>8. Conduct a community education program</p>
4. Implement the Recovery Plan through a Recovery Team	<p>?? Demonstrated successful operation of the Recovery Team over five years.</p>	<p>9. Establish a recovery team which meets regularly</p> <p>10. Carry out a major review of the recovery plan</p>

Guide for Decision-makers

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

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

This taxon will benefit from active conservation management.

Any action which would remove nesting sites, potential nesting sites or 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

Action	Likely expenses	Cost estimate	Responsibility	Timeframe
Develop techniques to monitor the total breeding population	Salaries, remote-control helicopter hire	\$45,900	PANCI	Yr 1
Monitor total breeding population	Salaries, airfares, equipment, travel	\$126,500	PANCI	Yr 1-2
Monitor and/or assist recovery of the dryers breeding colony.	Salaries	\$10,000	PANCI, CIP	Yr 1-4
Develop and implement wildlife management plan for habitat outside the national park*	Salaries	\$10,000 then \$5000 pa	PANCI	Ongoing
Ensure protection of habitat critical outside the national park*	PANCI staff time	\$2,000 pa	PANCI	Ongoing
Implement the Invasive Ants on Christmas Island Action Plan*	PANCI staff, ant bait, contractors research	\$475,000 in 2002/3 then c. \$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 diseases*	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

* Actions which share some or all of their objectives with other Christmas Island Recovery Plans.

Summary table of costs

Year	1	2	3	4	5
Total Costs	\$612,150	\$186,250	\$123,000	\$123,000	\$125,500

Landholder incentives

Opportunities exist for the Natural Heritage Trust to be used to protect remnant vegetation on the small areas of native vegetation on private land. Management agreements can be put in place with landholder's 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

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.

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 consulted with the Department of the Environment and Heritage and has contributed to the development of this 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 newspapers. Also see action 8 - 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

- Andrews, C.W. 1900. *A Monograph of Christmas Island*. British Museum (Natural History), London.
- Ballance, L.T., R.L. Pitman & S.B. Reilly. 1997. Seabird community structure along a productivity gradient: importance of competition and energetic constraint. *Ecology* 78(5): 1502-1518.
- Cadee, G.C. 1985. Some data on seabird abundance in Indonesian waters, July/August 1984. *Ardea* 73: 183-88.
- Chasen, F.N. 1933. Notes on the fauna of Christmas Island, Indian Ocean. *Bull. Raffles Mus.* 8: 51-87.
- Croxall, J.P. & P. Rotherby. 1991. Population regulation of Seabirds: Implications of their demography for conservation. In: Perrins, C.M, J.D. Lebreton & G.J.M. Hiron (eds) *Bird population studies: relevance to conservation and management*. Oxford University Press, Oxford.
- Diamond, A.W. 1972. Sexual dimorphism in breeding cycles and unequal sex ratio in Magnificent Frigate-birds. *Ibis* 114: 395-398.
- Dunlop, J.N., R.D. Wooller & N.G. Cheshire. 1988. Distribution and Abundance of Marine Birds in the Eastern Indian Ocean. *Australian Journal of Marine and Freshwater Research* 39: 661-9.
- Environment Australia. 2002. Christmas Island National Park Management Plan. Commonwealth of Australia, Canberra.
- Garnett, S. 1992. *The action plan for Australian birds*. Australian National Parks and Wildlife Service, Canberra.
- Garnett, S.T. and Crowley, G.M. 2000. *The Action Plan for Australian Birds 2000*. Birds Australia, Melbourne and Environment Australia, Canberra.
- Gibson-Hill, C.A. 1947. Notes on the birds of Christmas Island. *Bull. Raffles Mus.* 18: 87-165.
- Gibson-Hill, C.A. 1949. Notes on the nesting habits of seven representative tropical sea birds. *Journal of the Bombay Natural History Society* 48: 214-235.
- Gore, M.J.E. 1968. A Check-list of the birds of Sabah, Borneo. *Ibis* 110: 165-196.
- Gray, H.S. 1981. *Christmas Island Naturally*. Geraldton, H. Gray.
- Green, R.E. & G.J.M. Hiron. 1991. The relevance of population studies to the conservation of threatened species. In: Perrins, C.M, J.D. Lebreton & G.J.M. Hiron (eds) *Bird population studies: relevance to conservation and management*. Oxford University Press, Oxford.
- Hay, R. 1986. Bird Conservation in the Pacific Island. ICBP Study Rep. 7. Cambridge, England.
- ICBP. 1981. *Endangered Birds of the World: The ICBP Red Data Book*. Smithsonian Institution Press, Washington.
- Marchant, S. & P.J. Higgins. 1990. *Handbook of Australian, New Zealand and Antarctic Birds. Vol. 1.*, Oxford University Press, Melbourne.
- Nelson, J.B. 1972. The biology of seabirds of the Indian Ocean, Christmas Island. *J. Mar. Biol. Ass. India* 14: 643-662.
- Nelson, J.B. 1975. The breeding biology of Frigatebirds: A comparative view. *Living Bird* 14: 113-155.
- Orchard, M, S. Comport 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. 1984. An Indicative Appraisal of the Effects of Proposed Clearing and Mining on Terrace-nesting Seabirds of Christmas Island, Indian Ocean. Unpublished report to the Administrator, Christmas Island, and Director, ANPWS, Canberra.
- Stokes, T. 1985. The 1984 results of Terrace Seabird studies on Christmas Island. Unpublished report to the Director, ANPWS, Canberra.
- Stokes, T. 1988. A review of the birds of Christmas Island, Indian Ocean. *ANPWS Occ. paper* no. 16