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Department of Environment and Conservation

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PROPOSED MANAGEMENT PLAN FOR CATS AND BLACK RATS ON CHRISTMAS ISLAND

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Front cover
Main: Feral cat at South Point, Christmas Island (Dave Algar). Top left: Feral cat approaching bait suspension device on Christmas Island (Scoutguard trail camera). Top right: Black rats in bait station on Cocos (Keeling) Islands that excludes land crabs (Neil Hamilton).

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Acknowledgments

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Australian Government
Director of National Parks

Report outline

The impact of cats on the biodiversity of Christmas Island is of concern to land management agencies and the broader community. Domestic[1] and stray[2] cats reside in the residential, commercial and light industrial area while a population of feral[3] cats exists across the rest of the island (i.e. mining lease, national park and other Crown land). Concern has been raised regarding the threat that all 'classes' of cats present to the viability of a number of endangered fauna populations. Additionally, previous research has demonstrated that the cats on the island also have a very high prevalence of *Toxoplasmosis,* a parasite that can lead to serious human health complications. The management of cats on the island is a complex task as reduction/eradication in cat numbers alone could lead to changes in the abundance of other exotic species populations, especially the introduced black rat which then may threaten wildlife species and also have disease implications.

Land management agencies on Christmas Island have commissioned this report which describes the rationale and development of a long-term cat and black rat management and eradication plan to mitigate the environmental and social impacts of cats and black rats across all land tenures (shire-managed lands, Crown land including mine leases and Christmas Island National Park).

The report provides a background to the threats and impacts of cats and black rats on the island's natural and social environment, including wildlife predation and disease threats to wildlife and human health. It documents previous reports in relation to impact and management of cats and black rats on Christmas Island. The current local cat management laws (*Shire of Christmas Island Local Law for the Keeping and Control of Cats 2004*) under the *Local Government Act 1995 (WA) (CI)* are evaluated (see Appendix 1) with the aim of limiting domestic and stray cat impact on the iconic native fauna of Christmas Island, promoting responsible cat ownership, compliance and enforcement of cat management laws and measures required to implement a 'last cat policy' for the Island.

Cat and rodent eradication programs and strategies developed and/or implemented by other conservation agencies and local governments, particularly for islands are evaluated for their utility on Christmas Island. A strategy is recommended that provides a staged approach to cat and black rat management and control leading to eradication of one or both target species. Techniques, actions and priorities are described as are recommendations of where additional research is required. A monitoring program to measure the effectiveness of the strategy is reported which enables investigation of the potential relationships between cats and their invasive species prey, including rodents and centipedes, and strategies to address any negative environmental or social impacts of cat control. Monitoring requirements to maintain a cat and black rat free status including quarantine requirements to prevent, detect and quickly manage, new incursions are also discussed.

Timelines and resource requirements to undertake this program are provided in Appendix 2.

[1] Domestic cats are those owned by an individual or a household. Most of their needs are supplied by their owners.
[2] Stray cats are those found in and around towns and rubbish dumps. They may depend on some resources provided by humans, but are not owned.
[3] Feral cats are those that live and reproduce in the wild and survive by hunting and scavenging. None of their needs are satisfied intentionally by humans.

1. Background

1.1 Impact of invasive cats and rats on endemic island fauna

There is extensive evidence that the introduction of domestic cats (*Felis catus*), to both offshore and oceanic islands around the world can have deleterious impacts on endemic land vertebrates and breeding bird populations (e.g. van Aarde 1980; Moors and Atkinson 1984; King 1985; Veitch 1985; Bloomer and Bester 1992; Bester *et al*. 2002; Keitt *et al*. 2002; Pontier *et al*. 2002; Blackburn *et al*. 2004; Martinez-Gomez and Jacobsen 2004; Nogales *et al*. 2004; Ratcliffe *et al*. 2009). Insular faunas that have evolved for long periods in the absence of predators are particularly susceptible to cat predation (Dickman 1992).

Invasive rats (black (*Rattus rattus*), Polynesian (*R. Exulans*); and Norway (*R. Norvegicus*)) have been widely distributed around the world and today at least one of the three invasive rat species can be found on 80 per cent of the world's major island groups (Atkinson 1985; Russell *et al.* 2008). Like cats, rats have a deleterious impact on native birds (Moors and Atkinson 1984; Moors *et al.* 1992; Hobson *et al.* 1999; Martin *et al.* 2000; Blackburn *et al.* 2004; Jones *et al.* 2008), small mammals (Collins 1979; Vigne and Valladas 1996; Towns *et al.* 2006), reptiles and invertebrates (Atkinson 1989; Whitaker 1978; Towns *et al.* 2009) via predation, resource competition and disease transmission.

1.2 Impact of feral cats and rats on Christmas Island

Christmas Island is no exception with four of the five mammal species which were present at settlement in 1888 having since become extinct. The bulldog rat (*R. nativitatus*) was a diurnal species and was reportedly common at the time of settlement while Maclear's rat (*R. macleari*) was highly arboreal, nocturnal and extremely abundant. The Christmas Island shrew (*Crocidura attenuate trichura*) has not been seen since 1985 and is believed extinct and, most recently, the Christmas Island pipistrelle (*Pipistrellus murrayi*) is also thought to have become extinct in 2009 (L. Lumsden pers. comm.).

While several factors are likely to have contributed to the demise of these native animals including disease, habitat destruction (land clearing and natural catastrophes such as cyclones) and the proliferation of exotic yellow crazy ants (*Anoplolepsis gracilipes*), the introduction of exotic competitors and predators such as the feral cat and black rat are also crucial factors.

A recent Parks Australia report (Parks Australia 2008) lists five threatened species under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) which are at risk in part from impact by cats and rats on Christmas Island: the emerald dove (*Chalcophaps indica natalis*), Christmas Island hawk-owl (*Ninox natalis*), Christmas Island thrush (*Turdus poliocephalus erythropleurus*), Lister's gecko (*Lepidodactylus listeri*) and pink blind snake (*Typhlops exocoeti*). Other species considered at risk from cat predation include the blue-tailed skink (*Cryptoblepharus egeriae*) and forest skink (*Emoia nativitatis*).

Studies in 2005 and 2006 demonstrated very low survival rate of red-tailed tropicbird chicks (*Phaethon rubricauda*) on Christmas Island. Chicks were disappearing from their nests and it appeared that predators were involved (Ishii 2006). More recent work has shown predation, primarily by cats but also including rats, has resulted in no chicks surviving nesting during the past three years (J. Hennicke pers. comm.). It has also been demonstrated that cats are predating adult birds. Rapid and effective improvement to the management of predators must be adopted to minimise potential for local extinction of this species.

In February 2009, the Commonwealth Minister for the Environment, Heritage and the Arts established a scientific Expert Working Group (EWG) in response to growing concern about the possible extinction of the Christmas Island pipistrelle. Following an interim report, the EWG was expanded and re-briefed to include all threats to the island's ecology, biodiversity management and any other issues relating to the conservation management of Christmas Island and its surrounds. In addition to the species listed by the Parks Australia report, the EWG indicated that the white-tailed tropicbird (*P. lepturus fulvus*) and Christmas Island white-eye (*Zosterops natalis*) were also threatened by cat and rat predation and there was also concern about cat

predation of brown booby chicks (*Sula leucogaster*) (Beeton *et al*. 2009). A summary of reported impacts by cats and rats on native fauna on Christmas Island is provided in Table 1.

At the time of preparing this cat and rat management plan the Department of the Environment, Water, Heritage and the Arts (DEWHA) was preparing a recovery plan under the EPBC Act for Christmas Island's ecosystems and native species. This cat and rat management plan provides a basis for informing recovery plan priorities and actions related to cat and rat management.

Table 1. Summary of known cat and rat impact on native fauna on Christmas Island, conservation status under the EPBC Act and other comments

Native mammals	EPBC Act status	Cat impact	Rat impact	Comment
Christmas Island pipistrelle (*Pipistrellus murrayi*)	Critically Endangered	Schulz and Lumsden (2004)	Schulz and Lumsden (2004)	Assumed extinct 2009. No evidence of direct impact known but both rats and cats are potential predators and/or disease hosts of this species. Rats have been photographed climbing on known roost trees (L. Lumsden pers. comm.).
Christmas Island flying-fox (*Pteropus melanotus natalis*)	Threatened	Tidemann *et al*. (1994)		
Christmas Island shrew (*Crocidura attenuata trichura*)	Endangered	Schulz (2004)	Schulz (2004)	Presumed extinct. No evidence of direct impact known but both rats and cats are potential predators and/or disease hosts of this species.
Maclear's rat (*Rattus macleari*)	Extinct		Wyatt *et al. (*2008)	
Bulldog Rat (*R. nativitatus*)	Extinct		Wyatt *et al*. (2008)	
Native reptiles				
Giant gecko (*Cyrtodactylus sadleiri*)	None	Tidemann *et al*. (1994); van der Lee (1997)		
Christmas Island gecko *(Lepidodactylus listeri)*	Vulnerable	Parks Australia (2008)		
Blue-tailed skink (*Cryptoblepharus egeriae*)	None	Tidemann *et al*. (1994); van der Lee (1997); Parks Australia (2008)		Species at risk of extinction following recent range contraction (Beeton *et al*. 2009)
Forest skink (*Emoia nativitatis*)	None	Tidemann *et al*. (1994); van der Lee (1997); Corbett *et al.* (2003); Parks Australia (2008)		Species at risk of extinction following recent range contraction (Beeton *et al.* 2009)
Foreshore skink (*Emoia atrocostata*)	None	Tidemann *et al*. (1994)		Population at risk of local extinction following recent range contraction (Beeton *et al* 2009)
Pink blind snake (*Ramphotyphlops exocoeti*)	Vulnerable	Parks Australia (2008)		Likely to predated by cats and rats. Rats also likely to consume eggs if found.
Green turtle	Vulnerable			Feral cat predation of hatchlings possible. Feral cats

(*Chelonia mydas*)				known to consume loggerhead turtle hatchlings (Hilmer *et al*. *in press*).
Hawksbill turtle *Eretmochelys imbricata*	Vulnerable			Feral cat predation of hatchlings possible. Feral cats known to consume loggerhead turtle hatchlings (Hilmer *et al*. *in press*).
Native land birds				
Christmas Island imperial-pigeon (*Ducula whartoni*)	None	Stokes (1988); Tidemann *et al*. (1994); Corbett *et al.* (2003)		
Christmas Island emerald dove (*Chalcophaps indica natalis*)	Endangered	Tidemann *et al*. (1994); Stokes (1988); Corbett *et al.* (2003); Parks Australia (2008)	Stokes (1988)	
Christmas Island hawk-owl (*Ninox natalis*)	Vulnerable	Parks Australia (2008)		
Christmas Island thrush (*Turdus poliocephalus erythropleurus*)	Endangered	Tidemann *et al*. (1994) Corbett *et al.* (2003); Parks Australia (2008)		
Christmas Island white-eye (*Zosterops natalis*)	None	Tidemann *et al*. (1994); Corbett *et al.* (2003)		Potential predation by cats and rats Beeton *et al*. (2009)
Native sea birds				
Brown booby (*Sula leucogaster*)	None	Beeton et al. (2009)		
Red-tailed tropicbird (*Phaethon rubricauda westralis*)	None	Ishii (2006); J. Hennicke pers. comm.	Ishii (2006)	
White-tailed tropicbird (*Phaethon lepturus fulvus*)	None	Beeton *et al. (*2009)	Beeton *et al.* (2009)	

Control of feral cats is recognised as one of the most important fauna conservation issues in Australia today and, as a result, a national 'Threat Abatement Plan (TAP) for Predation by Feral Cats' has been developed (EA 1999; DEWHA 2008a). Under the TAP the goal is to protect affected native species and ecological communities, and to prevent further species and ecological communities from becoming threatened. In particular the first objective of the TAP is to:
prevent feral cats from occupying new areas in Australia and eradicate feral cats from high-conservation-value 'islands'. [4]

Several Christmas Island species are listed under the TAP as species that are likely to be adversely affected by cats. These include the endemic Christmas Island emerald dove (listed under the EPBC Act as endangered); the red-tailed tropicbird (an EPBC Act-listed marine species) and forest and blue-tailed skinks which are not yet listed under the EPBC Act as threatened but are under serious decline and under threat of extinction.

While the TAP refers specifically to impacts of feral cats, it is recognised that in any given situation the category of cat causing the most damage to wildlife needs to be identified because management actions will depend on the type of cat causing the damage (TAP Background document – DEWHA 2008b). Although the responsibility for managing domestic cats ultimately rests with their owners, we suggest that the objectives must be broadened to provide for mitigation of the impact that owned and stray cats on Christmas Island have on biodiversity.

The Australian Government has also prepared a separate TAP to reduce the impacts of exotic rodents on biodiversity on Australian offshore islands of less than 100,000 hectares. This document provides background, summary of impacts and recommendations for management of exotic rodents with respect to eradication or undertaking sustained control programs (DEWHA 2009).

In addition to the direct impact of predation by cats and rats on native species, they are also the hosts and reservoirs for a number of diseases such as *Toxoplasma gondii.* This parasitic protozoan causes the disease *Toxoplasmosis* that can affect the wellbeing of wildlife (e.g. research has demonstrated that *Toxoplasma* can infect and kill skinks; (Stone and Manwell 1969)) and can cause health problems to the human population. One of the major reasons for conducting a cat control program on the neighbouring Cocos (Keeling) Islands was the community's concern of potential health risks due to the presence of feral/stray cats (Algar *et al*. 2003). Analysis of the cat population sampled indicated a high incidence of hookworm infection (op cit.). Hookworm larvae can burrow into human skin causing a disease called *cutaneous larval migrans*, also known as 'ground itch'.

As part of an earlier study examining potential cat control strategies for Christmas Island, a trapped population was sampled for the incidence of disease and parasites (Algar and Brazell 2005). Analyses indicated a widespread and high level of parasite infestation and significantly, the prevalence of *Toxoplasma gondii* in 92 per cent of these cats (Adams *et al*. 2008). Detection to this extent indicates that there may be a high level of environmental contamination with *T. gondii* oocysts on Christmas Island. It is believed that cycling of this parasite would be occurring between the cats and the rodent fauna (rats and mice). The cats and rats themselves would not present an infection risk to the population (i.e. as pets) however, human contact with cat faeces and soil in the vicinity of cat defecation points could present an infection risk. Particular concern is for women becoming infected with *T. gondii* while pregnant, as this can lead to spontaneous abortion and birth defects.

The common presence of wandering cats in residential areas also presents a significant nuisance problem through the night with cats caterwauling, fighting, urinating, defecating and scavenging from refuse bins around the houses. The presence of rats in the residential area also presents similar annoyance problems.

1.3 Introduction of cats and rats onto Christmas Island

Cats were taken to Christmas Island, at the time of first settlement in 1888 and a feral population became established soon thereafter (Tidemann *et al*. 1994). Initially, cats were concentrated around settlement and

[4] Islands being defined as offshore islands such as Christmas Island and mainland 'islands' that are isolated

mining areas where they had access to discarded human food (Tidemann 1989; Tidemann *et al*. 1994). With the expansion of introduced black rats across the island, feral cats became more widespread (Tidemann 1989). Today, there is also an abundant domestic and stray cat population within residential, commercial and light industrial area.

Cats are generally categorised into three groups according to their dependence on human contact (DEWHA 2008b). The dependent (non-feral) domestic cat is housed and fed. The semi-dependent (semi-feral) is the stray cat that receives some food from humans, indirectly by scavenging. The independent (feral) cat has no reliance whatsoever on human contact for its survival and obtains all its food from the environment. These classes of cats are not discrete and there is movement between classes. On Christmas Island all three groups of cats impact negatively on environmental and social values.

Black rats were introduced to Christmas Island from the ship *Hindustan* in 1899. It is now known that the endemic Maclear's rat became extinct because of the introduction of a disease parasite, murid trypanosome, brought in by black rats and transmitted by fleas (Wyatt *et al*. 2008). The other endemic rat, bulldog rat, also became extinct at the same time, almost certainly from the same cause.

1.4 Previous studies on the management of cats and rats on Christmas Island

Several studies have reported on feral cat abundance and distribution and also cat diet on Christmas Island. There have been no detailed studies on rats on Christmas Island, however some information is available on abundance and distribution collected as part of general fauna surveys. The results of these studies are summarised below.

1.4.1 Feral cat abundance and distribution

A brief study of feral cat distribution was conducted on Christmas Island in 1981 which found that cats were widespread, but were concentrated around areas that were being mined (Yorkston 1981). In this study, records of cats sighted along a survey route during the day suggested an index of relative abundance of 0.13 cats per kilometre. Other studies have reported the density of cats on the island at 0.3 cats per kilometre from combined spotlighting and shooting data (Tidemann 1989) and 0.19 cats per kilometre from spotlighting data (van der Lee 1997). These latter two studies indicated that although cats were found in primary rainforest and other unmodified vegetation on the island, by far the highest numbers were observed in re-growth vegetation.

A short spotlight survey in 2003 indicated a relative abundance of 0.15 cats per kilometre (Algar and Brazell 2003). However, it is important to note that spotlight surveys can only provide a somewhat limited indication of animal numbers at a single point in time. Reliance on spotlight data, particularly when surveys are conducted through areas of dense vegetation, can often lead to inaccurate indices of abundance. Differences in methodologies prevent any direct comparison of these abundance estimates and also determination of whether cat density has changed over time. In a later survey of cat abundance, along the same spotlight survey route used in 2003, measurement of cat abundance and distribution was based on bait station activity, capture and records of cats sighted (Algar and Brazell 2005; Algar and Brazell 2008). Combined data from these three sources suggested an index of abundance of 1.34 cats per kilometre was present along the survey route, a figure far higher than recorded on the mainland (D. Algar unpub. data). Although cats were distributed across most of the survey route, abundance varied with certain areas devoid of cat activity and other sites having a number of cats present. Distribution and abundance of cats will vary with habitat preference and resource availability and is unlikely to be uniform across the landscape.

1.4.2 Feral cat diet

Tidemann *et al*. (1994) analysed 93 cat gut/scat contents (based on 21 guts collected in 1981, five guts in 1987, 64 guts and three scats collected in 1988) and found that a wide range of animals (mammals, birds, reptiles and invertebrates) was consumed, but diet by weight was dominated by three vertebrate species: Christmas Island imperial-pigeon (*Ducula whartoni*); Christmas Island flying-fox (*Pteropus natalis*) and introduced rats. An analysis of 19 cat stomachs (van der Lee 1997) found that reptiles such as the giant gecko (*Cyrtodactylus sadleiri*), forest skink and blue-tailed skink were frequently found in cat stomachs, representing approximately 30–40 per cent by volume. Invertebrates were also present in similar quantities

to reptiles and the majority of stomachs also contained various amounts of hair, presumably black rats (van der Lee 1997). In conclusion, van der Lee (1997) stated 'the absence of large numbers of freshly eaten rats in cat stomachs suggests that these are not a major component of the diet of cats. It appears that cats rely heavily upon reptilian and invertebrate prey and supplement their diet with rats, passerine birds and scavenge opportunistically'.

Corbett *et al*. (2003), while undertaking a fauna survey in mining lease and national park reference areas in 2002, collected 92 cat scats. Black rats, grasshoppers and various bird species were the most common dietary species. Corbett *et al*. (2003) suggested that although strict comparison between stomach versus scat samples may not be statistically legitimate, there obviously has been a major change in the diet during the 20 years that dietary information has been collected. In particular, fewer reptiles, more birds and a greater variety of insects were consumed in 2002 than in 1988. The predominance of rodents and grasshoppers was similar between the surveys and data on other diet items, including flying foxes, were too few to form firm conclusions.

Algar and Brazell (2005) trapped 26 feral cats of which 17 had items in their stomachs. Prey items were predominately grasshoppers and various terrestrial bird species.

1.4.3 Rat abundance and distribution

Existing publications suggest that black rats have been quite uncommon historically except in re-growth and coastal fringe vegetation and they occurred at higher densities in coastal fringe vegetation than in re-growth (Tidemann 1989). He further suggests that it is likely that competition for food with crabs may restrict rat numbers and predation on rat nestlings by robber crabs (*Birgus latro*) could also be a significant limiting factor. The fact that rats appeared most common in coastal fringe vegetation and re-growth (where crabs were uncommon, at least in the dry season) would tend to support the notion that crabs may be a major factor in 'controlling' rat numbers (Tidemann 1989; Tidemann *et al*. 1993). In the survey conducted by Corbett *et al*. (2003) only 12 rats were captured in 1,252 trap nights and these were located in re-growth forest sites.

Circumstantial evidence suggests, quite strongly, that there have been quite marked fluctuations in rat numbers since they first colonised the island (Tidemann 1989; Tidemann *et al*. 1993). Garnett and Crowley (2000) suggest the presence of red crabs (*Gecarcoidea natalis*) throughout the island's rainforest may have previously limited the ability of the black rat to establish populations away from disturbed areas. The reduction in crab numbers since the late 1990s through the impact of invasive ants may provide an opportunity for rats to establish in some areas – particularly in 'ghosted' areas where crabs are now absent.

1.5 Review of current control measures on Christmas Island

1.5.1 Management of domestic and stray cats in settled areas

1990s to present: Shire of Christmas Island and Parks Australia conducted trapping programs, using cage traps, for stray cats in The Settlement. Intensity of trapping varies between years.

Late 1990s: Parks Australia, Shire of Christmas Island and Attorney General's Department share costs to bring a veterinary surgeon to island twice a year to de-sex cats.

2003: MoU signed between the Shire of Christmas Island and Parks Australia and Christmas Island Phosphates to continue subsidising veterinary visits to Christmas Island.

2004: Draft cat local laws introduced.

2005: Ban on further importation of cats to Christmas Island approved by the Attorney General's Department.

2007: Shire of Christmas Island introduced local cat management laws (*Shire of Christmas Island Local Law for the Keeping and Control of Cats 2004*) under the *Local Government Act 1995 (WA) (CI)*. The objectives of the local laws were to:
a) control the number of cats kept by residents (two cats per house)
b) to promote responsible cat ownership
c) to reduce the number of non-de-sexed cats on the island
d) to reduce the nuisance cats can cause
e) aid in the protection of native animals and birds
f) provide for the impounding and disposal of cats.

2008–2009: Parks Australia and Shire of Christmas Island planning for a project (up to $40,000) to prepare an island wide cat management strategy in 2009.

1.5.2 Management of feral cats

Since the 1980s, a number of feral cats have been killed as part of various studies to determine diet (Yorkston 1981; Tidemann 1989; van der Lee 1997; Algar and Brazell 2005) and to test the effectiveness of control techniques (van der Lee 1997; Algar and Brazell 2008; Johnston *et al*. 2008; Algar *et al*. 2010; Johnston *et al*. 2010). However, there has been no concerted effort to control feral cats on Christmas Island. Feral cats are shot opportunistically in the national park and adjacent areas by park staff. However, this practice is rare and somewhat *ad hoc*, with no formal data recording maintained and is unlikely to have much impact on cat populations.

1.5.3 Rat management

Except for their management in residential dwellings and commercial buildings, there has been no rodent control programs conducted on the island.

1.6 Recommendations to control/eradicate cats and black rats on Christmas Island

In the third *Management Plan for Christmas Island National Park* (Environment Australia 2002) it was noted that feral cats and black rats were widespread across all terrestrial island habitats and were a severe threat to native species. It was stated that an ongoing, integrated program of cat control involving Parks Australia, Shire of Christmas Island and the Christmas Island Administration would be desirable.

In the subsequent draft issues paper for the development of a *Regional Recovery Plan for Christmas Island* (Parks Australia 2008) recovery actions included:

Objective 3: To control introduced predators and reduce impacts on high conservation value biodiversity of Christmas Island.

Action 3.2: Control of introduced rodents on Christmas Island

Investigate the need for control programs for introduced rodents in the Christmas Island National Park. Any control programs should be integrated with feral cat control activities.

Action 3.3: Control of feral cats on Christmas Island

1). Monitor the impact of feral cats on selected native species known to be vulnerable to cat predation.

2). Investigate the feasibility of an island-wide control program for feral cats via the collaborative efforts of Parks Australia, the Christmas Island Administration and the Shire of Christmas Island. Any control program should be integrated with rodent control activities.

3). Implement the Shire of Christmas Island Cat Control Law via registration, identification and de-sexing of domestic animals.

The Australian Government currently seeks to improve the management of ecological processes on Christmas Island to prevent further loss of biodiversity (Garrett 2009). The recently formed scientific Expert

Working Group was of the view that both cats and rats should be eradicated from Christmas Island, as is now a common goal on oceanic islands (Beeton *et al*. 2009). There is an ever-growing recognition and acceptance of this need, and of techniques which work and examples of successful implementation (op cit.). Their recommendations were as follows:

Recommendations Level 2: Management of the island's ecological processes to prevent further loss of biodiversity.

- **Recommendation 15: (High priority)** The eradication of black rats and feral cats from Christmas Island be carried out as soon as possible in a coordinated project.
- **Recommendation 19: (High priority)** Sampling take place to establish disease (including parasite) levels in exotic plants and animals now present on Christmas Island (specifically including black rats, feral cats, dogs, tree sparrows, Java sparrows, house geckos, wolf snakes and giant African land snails).

Recommendations Level 3: Management actions that can be taken to prevent immediate biodiversity loss.

- **Recommendation 26: (High priority)** Measures be implemented immediately to exclude cats from red-tailed tropicbird nesting areas along the Settlement shoreline.

2. Cat and rat eradication from Christmas Island

Christmas Island poses some very unique challenges to cat and rat control leading to eradication because of its location, size, topography and access, climate, an abundant land crab fauna and multiple land tenures and governance. The characteristics of Christmas Island that confront a management strategy are discussed in more detail below.

2.1 Location

Christmas Island is located in the Indian Ocean (10° 25'S and 105° 40'E) approximately 2,800 kilometres west of Darwin, 2,600 kilometres north-west of Perth, and 360 kilometres south of the Indonesian capital of Jakarta (Figure 1).

The island's isolation from the Australian mainland creates a major difficulty if aerial deployment of baits is being contemplated. Helicopters have been used by Parks Australia in 2002 and 2009 to bait yellow crazy ant super-colonies. They were dismantled, packaged into a shipping container, freighted to the island and then re-assembled on-site. There is no further planned helicopter baiting of crazy ants on the island (C. Boland pers. comm.) onto which any cat/rat baiting could be added. An aircraft capable of undertaking aerial baiting in discrete areas or radio-telemetry of collared cats would provide significant assistance to some aspects of the project. It is noted that ultra-light aircraft have been used previously on Christmas Island (for spotting whale sharks) and further investigation of the capabilities of these aircraft may be worthwhile.

Figure 1. Location of Christmas Island. Image reproduced from DEWHA website

2.2 Size, topography and access

The island has an area of approximately 135 kilometre^2. The island was formed from an undersea volcano that rose to the surface and has since subsided and risen over geological time. Terraces have formed around the island as a result of marine reef development and erosion processes. The oceanic island is composed primarily of Tertiary limestone overlying volcanic andesite and basalt (Tidemann *et al*. 1994; Environment Australia 2002). The island rises steeply from the surrounding ocean and consists of a series of fringing limestone terraces, separated by rugged limestone cliffs and scree slopes, rising to an internal central plateau at about 200 metres and extending to 360 metres above sea level.

Most of the coast consists of sheer rocky cliffs 10 to 20 metres high, often undercut, with a few beaches of sand and coral rubble. Above the coastal cliffs is the shore terrace, a level terrace of approximately 50 to 200 metres in width which marks the outer edge of the island. Inland cliffs and terraces occur between the shore terrace and the plateau. The first inland cliff encircles most of the island and varies in height from 75 to 200 metres. The second major terrace sits above the first inland cliff and rises by a series of small cliffs and scree-slopes to a third terrace of variable width. A final cliff or steep slope strewn with limestone blocks leads to the central plateau. The nature of the limestone and volcanic cliffs and scree slopes with many holes and fissures provide good cover for feral animals.

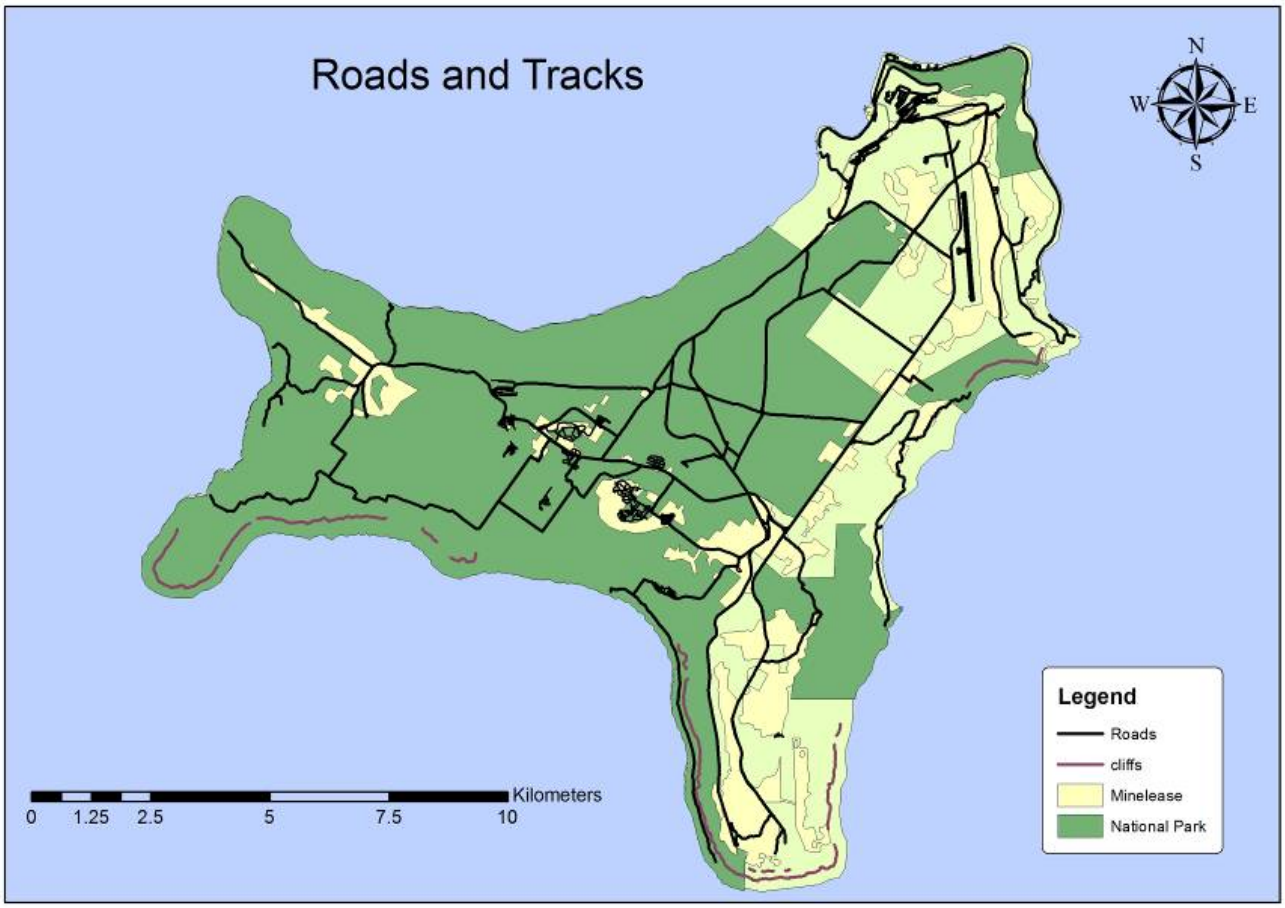

Figure 2. Road and track network on Christmas Island

The island has 122.6 kilometres of road/track network (see Figure 2) which provides excellent coverage of the island, as much of the island is within one kilometre of a road.

The rugged nature of the island and accessing the coastline will need to be given careful consideration in the planning for any eradication program.

2.3 Climate

Christmas Island has a typical tropical, equatorial climate with a wet and a dry season. The wet season is from December to April when the north-west monsoon blows and about 60 per cent of the annual rainfall occurs. For the rest of the year south-east trade winds bring slightly lower temperatures and humidity, and much less rain. Although the seasons are distinct, south-easterly winds may occur in the wet season and some rain may fall in any month of the year.

The mean annual rainfall (based on data collected during the past 25 years) is 2,154 millimetres. Most falls between November and May with February and March the wettest months, August, September and October are the driest months. The pattern of the average number of rain-days per month follows that of the average monthly rainfall, decreasing from 20 in March to nine in September–October. During the monsoon, heavy downpours lasting several days and periods of humid calm weather are punctuated by gusty north-westerly winds. From May to November, long dry periods with steady south-east trade winds and occasional showers predominate. In years of significant El Niño activity in the Pacific Ocean, rainfall on the island tends to be relatively low. Cyclones and cyclonic swells from the north-west sometimes affect the island during the wet season.

Mean daily temperatures are 23–28°C in March and April and 22–26°C in August and September (Bureau of Meteorology 2009). Temperature varies little from month to month. The mean daily maximum is 28°C in

March–April and the mean daily minimum is 22°C in August–September. Humidity also varies little between months and usually ranges from 80–90 per cent.

Any eradication program must consider climatic factors so that operation of control techniques is conducted when they are likely to be most effective. Baiting campaigns for cats and rats and also trapping programs where a food based lure is used are most effective when the prey resource is at its lowest. Prey abundance would naturally be at its least towards the end of the dry season. Stability of bait medium and lures is detrimentally affected by rainfall and therefore their deployment would be more effective in the dry season. In addition, traversing the island would also be easier during this time period. As such, it is suggested that any eradication effort be restricted to the months May–October.

2.4 Land crabs

Christmas Island has a highly abundant land crab fauna. The most abundant is the Christmas Island red crab (*Gecarcoidea natalis*), which has an annual breeding migration in the early wet season. The robber crab (*Birgus latro*) is the largest terrestrial crab and is also abundant across the island. Both crab species will consume ground laid cereal-based bait used for rat control (Wegmann 2008) and robber crabs will also eat meat-based cat baits (Algar and Brazell 2008). Bait consumption by these very abundant crab species will not kill them (see sections 3.1.1.1 and 3.2.1.1 for detail) but will significantly reduce bait availability to the target species and therefore deleteriously impact on baiting efficacy. Baiting campaigns and also trapping programs will of necessity need to consider restricting access to the bait and/or trap devices by the crab fauna using suitably robust devices.

2.5 Island tenure and governance

Christmas Island has been an external territory of the Commonwealth of Australia since its transfer from British jurisdiction in 1958. The island is administered as a Commonwealth territory. The tenure system on Christmas Island is shown in Table 2. The governance of the island is split between a number of Australian Government departments. In addition, a number of Western Australian Government departments and corporations are involved in the contracting out of ‘governance’, as is the local Shire Council.

Table 2. Land tenures and their area on Christmas Island (taken from Beeton *et al.* 2009)

Land tenure	Area (ha) (percentage of island)
National park	8,760 (63.0%)
Unallocated Crown land (UCL)	2,670 (19.2%)
Phosphate Resources Limited mine lease	1,900 (13.7%)
Residential/industrial/future urban zones	300 (2.1%)
Airport	165 (1.2%)
Christmas Island Resort	47 (0.3%)
Immigration Reception and Processing Centre (IRPC)	43 (0.3%)
Golf course	14 (0.1%)

Any eradication strategy will need to take into account these different land tenures and governances. An eradication program will only be feasible if there is a clear mandate to carry out required procedures at all sites.

3. Eradication

For successful eradication on an island there are a number of obligate rules that must be met (Parkes 1990; Bomford and O'Brien 1995; Myers *et al*. 2000).

1. Community support for the program
2. All target species are considered to be at risk
3. The population can be killed faster than replacement
4. Reinvasion must be prevented. Eradication will only be temporary if the influx of individuals continues
5. The target species can be detected at relatively low densities. Easy detection allows residual pockets of individuals to be identified and targeted for treatment
6. The cost can be justified and resources must be sufficient to fund the program to its conclusion.

In addition to these rules, an additional requirement for successful eradication must be that the lines of authority are clear and allow the individual or lead agency to take all necessary actions (Myers *et al*. 2000).

There are three strategic options to manage feral cats and black rats on Christmas Island and meet the terms of reference:

1. eradicate both cats and rats
2. eradicate the cats and provide broad-scale control of rats
3. provide broad-scale control of cats and rats across the island.

The optimal result would be eradication of both cats and rats. The review of available literature for Christmas Island suggests that rat numbers outside the residential, commercial and light industrial area are relatively low and only present in any numbers in re-growth and the coastal fringe vegetation. These data will be reassessed to provide a current rat abundance estimate in each vegetation community (see Section Knowledge Gaps for Rat Control). Furthermore, it has been suggested that the abundant land crab fauna may restrict rat numbers through competition for food resources and direct predation on nestlings rather than a consequence of cat predation. Therefore, a case could be made that eradication of cats alone would be sufficient to ameliorate the threat to endangered wildlife, an argument made by van der Lee (1997). However, there is concern that removal of cats alone (the top predator) may result in 'mesopredator release' of rats as the mesopredator (rat) is released from predation. Any increase in mesopredator density may increase the impact on shared prey species and in the extreme case may even drive these prey species to extinction. Therefore removal of the top predator alone is not recommended. This is a top-down driven system where cat predation is a factor in the control of rat abundance. This is not usually the case for rats however, which have a large intrinsic population growth rate which can sustain high levels of predation (Krebs 1999). Although the potential for such indirect effects following management interventions is now recognised, and has been modelled (Courchamp *et al.*1999, Bull and Couchamp 2009, Russell *et al.* 2009*)*, real-world examples remain relatively uncommon (Bergstrom *et al*. 2009). Several studies have shown a negative effect on endemic species following cat eradication, due to expansion of rodent populations (Rayner *et al.* 2007; Rauzon *et al.* 2008). On Macquarie Island the expansion of black rats following cat eradication has had serious consequences for at least nine bird species that breed on the island (Department of Primary Industries, Parks, Water and Environment 2009). However, on Wake Atoll in the Northern Pacific Ocean, rat numbers and predation by them fluctuated in response to rainfall and subsequent vegetation growth and therefore rat abundance appeared to be regulated by food availability rather than predation (Rauzon *et al*. 2008) as was also found on Ascension Island (Ratcliffe *et al*. 2009).

Removal of cats alone from Christmas Island would undoubtedly be a controversial and potentially risky strategy. As described earlier, there is strong evidence that there have been quite marked fluctuations in rat numbers since colonisation of the island and rat numbers may remain more abundant for longer periods of time in the absence of cat predation. Tidemann (1989) and Tidemann *et al*. (1993) recommended that should any form of cat control be attempted on the island, that an integrated program to control rats and cats at the same time was of paramount importance due to the interaction between these species.
This document will focus on providing techniques and strategies that meet the obligate rules for eradication, with the ultimate goal of eradicating both stray and feral cats and black rats.

3.1 Cat eradication on Christmas Island

Cat eradications have been attempted on islands world-wide with 82 successful campaigns on islands that range in size from five to 29,000 hectares (Campbell *et al*. in press). There have also been eradication attempts on a further 15 islands that have failed (op cit.). All successful campaigns (for which methods are known) on islands >2,500 hectares utilised primary poisoning with toxic baits, with the exception of Santa Catalina, California (3,020 hectares). Interestingly, seven failed campaigns on the five largest islands (all >400 hectares) for which methods are known did not use toxicants (Campbell *et al*. in press).

3.1.1 Techniques

3.1.1.1 Baits, toxins and baiting

Baiting is recognised as the most effective method for controlling feral cats on mainland Australia (Short *et al*. 1997; EA 1999; Algar and Burrows 2004; Algar *et al*. 2007), on islands (Algar *et al*. 2002; Algar *et al*. in press) and indeed on Christmas Island (van der Lee 1997; Algar and Brazell 2008; Algar *et al*. 2010; Johnston *et al*. 2010). Baiting is recommended as the primary control technique in the feral cat eradication campaign on Christmas Island and an outline of how it could be done is provided below.

Baits

The preferred feral cat bait medium (Algar *et* al. 2007) is similar to a chipolata sausage in appearance—it is approximately 20 grams wet-weight, dried to 15 grams, blanched and then frozen. The bait is composed of 70 per cent kangaroo meat mince, 20 per cent chicken fat and 10 per cent digest and flavour enhancers that are highly attractive to feral cats (Patent No. AU 781829) (see detailed description in Algar and Burrows 2004). Prior to laying, the baits are thawed and placed on racks, in direct sunlight. This process enables the oils and digest material to come to the surface of the bait. At this time, all baits are lightly sprayed with an ant deterrent compound (Coopex®, Bayer Crop Science, East Hawthorn, Australia) at a concentration of 12.5 gl^{-1} as per the manufacturer's instructions. Ant attack on baits rapidly degrades the bait medium, reducing palatability and the persistence of ants on the bait deters uptake by feral cats (D. Algar pers. obs.).

Two poison bait products intended for the management of feral cat populations in Australia use the same bait medium. When dosed with sodium monofluoroacetate (compound 1080) this bait product is known as *Eradicat*®. When dosed with para-aminopropiophenone (PAPP) it is known as *Curiosity*®. *Eradicat* and *Curiosity* are registered trademarks of the Western Australian and Commonwealth governments respectively. These two toxins can be used on Christmas Island, under license, for the control of cats.

Toxins

Sodium monofluoroacetate is used as a pesticide especially for mammalian pest species. Fluoroacetate is similar to acetate, which has a pivotal role in cellular metabolism. Fluoroacetate disrupts the citric acid cycle (Krebs cycle) by combining with co-enzyme A to form fluoroacetyl CoA, which reacts with citrate synthase to produce fluorocitrate. A metabolite of fluorocitrate binds to aconitase, thereby halting the citric acid cycle. This inhibition results in an accumulation of citrate in the blood which deprives cells of energy (Proudfoot *et al*. 2006). *Eradicat*® baits contain 4.5 milligrams of directly injected toxin '1080' (Algar and Burrows 2004).

On Christmas Island, the only non-target species that are likely to consume cat baits are land crabs (Algar and Brazell 2008) and they are unaffected by 1080 (van der Lee 1997; Pain *et al*. 2008). The likelihood of secondary poisoning to crabs from consuming cat carcasses that have died from 1080 poisoning is therefore also unlikely to be of risk. Land crabs are also unable to remove baits from the specifically designed bait stations (described below see Section *Baiting*).

In addition to 1080, a collaborative project between the Department of the Environment, Water, Heritage and the Arts, the Department of Sustainability and Environment (DSE) and the Department of Environment and Conservation (DEC) has been developing a 'humane, felid-specific toxin and bait delivery system'. The project involves bringing together the feral cat bait medium and an encapsulated pellet known as the 'Hard Shell Delivery Vehicle' (HSDV), which contains the toxicant PAPP. PAPP works by converting healthy haemoglobin into methaemoglobin that cannot transport oxygen (Bright and Marrs 1983). The use of the

acid-soluble HSDV ensures that the toxin does not disperse throughout the bait but releases in the cat's stomach where it quickly overwhelms the cat's physiological processes (Johnston *et al*. in press).

This method of delivering the bait also plays a key role in reducing the potential exposure of non-target species. When feeding, feral cats simply shear food items into manageable portions and swallow those portions whole. Thus, they will reliably swallow a pellet that is implanted into a bait. Conversely, most wildlife species process food items more thoroughly in the mouth. This means most animals other than cats tend to reject the HSDV as they eat whereas it is reliably consumed by feral cats (Marks *et al*. 2006; Hetherington *et al*. 2007; Forster 2009; Johnston unpub. data). Direct injection of PAPP toxin into the bait (i.e. without the pellet delivery device) is not appropriate because it would significantly increase the amount of toxin required. The pellet delivery device contains about 78 milligrams of PAPP toxin in pellet form and, importantly, there is no risk of secondary poisoning (Johnston *et al*. in press).

Baiting

Deployment of baits from an aircraft is not feasible on Christmas Island firstly because of the difficulties and cost of getting a suitable machine to the island and secondly, due to the removal of baits by the abundant land crabs. Previous baiting exercises on the Cocos (Keeling) Islands (Algar *et al*. 2003) where baits were placed on the ground, highlighted the potential problem of non-target species removing ground-laid baits. Land crabs (*Cardisoma carnifex*), which dominate the forest floor, hermit crabs (*Coenobita perlata*), black rats and feral chickens (*Gallus domesticus*) readily consumed baits placed on the ground in that study. Similarly, a study on Christmas Island demonstrated that robber crabs also readily removed baits laid on the ground (Algar and Brazell 2003). Bait removal by non-target species reduces bait availability to feral cats and therefore control efficacy. In a later trial, Algar and Brazell (2008) demonstrated a device to suspend baits above the ground that effectively reduced bait removal by non-target species yet provided ready access to feral cats (Figures 3 and 4). A 1 metre^2 'sand pad' of crushed phosphate dust was placed underneath each 'bait suspension device' (BSD) to enable the identification of species visiting the site.

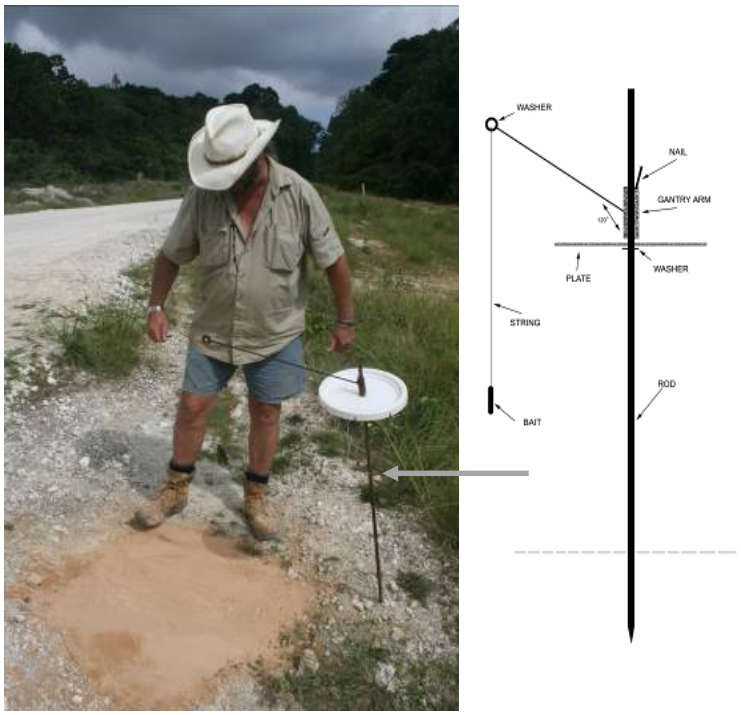

Figure 3. Bait suspension device

Schematic diagram reproduced from Algar and Brazell (2008)

Figure 4. Feral cat activity at a bait suspension device

Note the cat footprints and missing bait

Algar and Brazell (2008) demonstrated the target specificity of the bait delivery technique on Christmas Island with only approximately one per cent of baits being removed by non-target species. Similarly, in the 2009 trials of the *Curiosity* feral cat bait (Johnston *et al*. 2010) a comparatively small number of baits (1.3 per cent) were removed by non-target species (Robber Crabs and ants). The consumption of baits by ants would be prevented by the application of a residual insecticide (Algar and Burrows 2004). A larger, less rigid plate may be sufficient to prevent robber crabs from climbing around the plate on the bait suspension device.

A key finding of these trials was that the BSD should be used in future cat-control programs on Christmas Island. In both trials, bait stations were located at 100-metre intervals along the road/track network. This bait station spacing was sufficient to provide a significant reduction in feral cat numbers along the survey route (Johnston *et al*. 2010). It is thought that baiting efficacy could possibly be further improved by placing BSDs at the intervening 50-metre intervals on the

opposite side of the major roads. It would also be possible to use the BSDs along a transect grid network where there is no road or track access such as the island-wide survey conducted by Parks Australia. The optimum spacing and location of BSDs will be determined from research that will provide detailed information on cat activity patterns (see Section 5, Knowledge Gaps). This information will be used in planning of baiting transects to maximise the likelihood of feral cats encountering a bait within the shortest possible time, rather than arbitrarily assigning transect spacing. This will optimise baiting efficacy and provide a more cost-effective baiting campaign.

3.1.1.2 Trapping

Live capture techniques must be both efficient and humane. Wire cage traps, with treadle plates, baited with food lures wired to the rear of the trap are an effective technique to capture stray and domestic cats that are roaming within the residential, commercial and light industrial area.

Padded leg-hold traps have been found to be significantly more effective than wire cage traps for catching feral cats (Friend and Algar 1993; Lee 1994). Considerable research has been conducted on the efficacy and assessment of injury of trap types, particularly by government agencies in America and Canada. This research has indicated that padded leg-hold traps (such as the Victor 'Soft Catch' traps® [Woodstream Corp., Lititz, Pa.; U.S. Patent 4, 184,282]) significantly reduce injury to restrained animals compared to standard leg-hold traps and snares, and in the opinion of the authors, are more humane (Olsen *et al.* 1988; Onderka *et al.* 1990). Similarly, research in Australia (Meek *et al.* 1995) found Victor Soft Catch traps to be 'humane devices'. Feral cats captured during these studies sustained no more injury than minor oedema. The national *Threat Abatement Plan for Predation by Feral Cats* states "soft-jawed traps, such as the Victor Soft Catch traps, are humane" (EA 1999).

The soft catch is a modified Victor double coil-spring trap. The soft catch traps have replaceable synthetic rubber jaw pads and a 15-centimetre centre-mounted chain with attached coil spring to cushion the struggle of captured animals. Soft catch leg-holds have become an important conservation tool to the management and translocation of threatened felids in North America.

Figure 5. A cat trapped using the 'bucket trap method' to exclude robber crabs on Christmas Island

We have adopted the best management practices (BMPs) for trapping in the United States which was written by the Furbearer Conservation Technical Work Group of the Association of Fish and Wildlife Agencies (IAFWA 2006). The purpose of the BMP process is to scientifically evaluate the traps and trapping systems used for capturing furbearers in the United States. Evaluations are based on animal welfare, efficiency, selectivity, practicality, and safety. Results of this research are provided as information to state and federal wildlife agencies and trappers. Trapping BMPs identify both techniques and traps that address the welfare of trapped animals and enable the efficient, selective, safe, and practical capture of furbearers. The booklet *Best Management Practices for Trapping in the U.S.* provides internationally recognised animal welfare criteria for live traps; greater than or equal to 70 per cent of the sample of trapped animals must fall within injury class I or II (IAFWA 2006).

There are a number of different trap sets and lure types suitable for use on Christmas Island depending on the situation and location. We have also developed a highly effective elevated trap set 'bucket trap' (see Figure 5) that has been successfully employed on Christmas Island to trap feral cats in areas where robber crabs have proven a hindrance to trap placement. Research is also under way to develop a trap tab on the throw arm for feral cats that could incorporate a toxicant (e.g. PAPP) or sedative agents (M. Fenby pers. comm.). Successful development of this device could lead to a humane death soon after animals were captured, potentially reducing checking requirements, particularly in remote areas on the island.

3.1.1.3 Shooting

Opportunistic shooting is another method that may prove to be a useful technique in removing stray and feral cats.

3.1.2 Strategy

Prior to any effort to control cats across Christmas Island, all owned cats would firstly need to be effectively managed by neutering and stray cats within the residential, commercial and light industrial area would need to be removed. Without this strategy in place, a significant source of cats particularly natal recruits would be available to disperse into or reinvade territories vacated across the rest of the island where control measures had reduced the cat population. Similarly, stray cats that are reportedly routinely fed by residents at the Immigration Reception and Processing Centre (IRPC) need to be destroyed. Suggested revisions to the current local cat management laws (*Shire of Christmas Island Local Law for the Keeping and Control of Cats 2004*) under the *Local Government Act 1995 (WA) (CI)* to accommodate the changes outlined above are provided in Appendix 1.

With this objective in mind, it is proposed that the eradication campaign commence with the removal of stray and unwanted domestic cats within the residential, commercial and light industrial zone (including the IRPA) immediately following revision and acceptance of the local cat management laws. Use of wire cage traps is probably the most effective technique to capture stray and domestic cats that are roaming within the residential and light industrial area. Cage trapping would be the primary control technique employed to remove stray cats from this area. The use of leg-hold traps may be warranted in circumstances where individual animals have become wary of cage traps. Baiting selected areas would be an effective method in removing stray cats. Bait application would be restricted to single nights and only following agreement with the local residents to keep their domestic cats inside overnight. Opportunistic shooting is another technique that may prove useful in removing stray cats.

Within this zone, cat control is an immediate priority at the red-tailed tropicbird rookeries located at the Sitting Room and Rumah Tinggi along the Settlement shoreline as recommended by Beeton *et al*. (2009). Outside of this zone, it may also be essential to immediately target Egeria Point, at the south east tip of the island, as this is the last-known habitat for most of the island's native reptiles.

It is envisaged that if a substantial control effort is conducted in the residential, commercial and light industrial area in the first year of the project the majority of the cats would be removed and the control effort in subsequent years to mop-up remaining individuals would be significantly reduced. During this first year, time would also be available to complete research necessary to answer those questions outlined in the section 'Knowledge gaps' for the effective removal of feral cats across the island and the monitoring of this campaign's success.

Removal of feral cats that is, those animals on Crown land, mining lease and national park should commence in year two of the project. We suggest that this project proceed progressively across the island given that the area to be 'treated' is large and complex and aerial baiting cannot be used. It will not be possible to conduct a control exercise across the island simultaneously but rather the program should progress systematically across the landscape along a front. Previous work on Christmas Island has suggested that cats are distributed across the island but there are certain areas where they are more abundant probably due to the prey resource. These sites should be targeted as a matter of priority as they will provide sinks into which resident cats will disperse.

The primary control technique would be baiting followed by a trapping program to remove those animals that survive the baiting. Any tools used in the eradication program, especially trapping techniques, should be employed sequentially rather than on an *ad hoc* basis. This will ensure that the cats do not become familiar with the variety of control devices and techniques that are available and therefore the element of novelty is maintained over time. Adopting this strategy will reduce the risk of animals avoiding being captured or detected for an extended period of time. Surveillance of sign of cat activity would be reliant on deployment of suitable detection devices (such as hair traps and phosphate dust pads) as evidence of track activity is unlikely to be observed. The effectiveness of these detection devices will play a crucial role in directing where control effort should be located to maximise the likelihood of eradication success, when the cat population is at a low level.

It is anticipated that the strategy proposed will take up to four years to complete. This will provide a suitable timeframe to firstly undertake cat removal in the residential, commercial and industrial areas, progressively remove feral cats across the island and also undertake the black rat control described below. All control effort would be confined to the dry season (see Section 2.3).

3.2 Rat eradication on Christmas Island

Black rats have been eradicated from numerous islands world-wide (Howald *et al.* 2007) including islands off the Western Australian coastline (Burbidge and Morris 2002). Islands where there has been successful eradication of black rats mostly occur in temperate and subantarctic regions or on arid tropical islands (Beeton *et al*. 2009). Black rat eradication on tropical rainforested islands with significant populations of land crabs present significant new problems (Wegmann *et al*. in press) and failures have resulted (e.g. Isla Isabel Mexico, Rodríguez *et al*. 2006; Wake Atoll, Rauzon *et al*. 2008).

3.2.1 Techniques

The techniques used to undertake rat control that lead to eradication are well established in temperate and subantarctic regions (Russell *et al.* 2008). Poison baiting, via bait stations or aerial broadcast baiting using a cereal-based bait containing a second generation rodenticide and trapping are techniques frequently used (Howald *et al*. 2007). However, the management of rats on Christmas Island will be complicated by the presence of a large human population and especially the activity and abundance of land crabs. Conventional rodent control techniques are generally complicated at sites where land crabs exist by reducing bait availability to rodents and interfering with trap or monitoring devices (Wegmann 2008; Wegmann *et al*. 2009a; Wegmann *et al*. in press). Wegmann (2008) makes the point that land crab interference with eradication efforts is a serious challenge unique to the tropics, thus eradication projects on tropical islands should not be strictly modelled after eradication projects on islands outside of the tropics and without land crabs. These authors also suggest that there may also be issues with rats that live semi-permanently in the canopy, especially in coconut palms (*Cocos nucifera*) as they may not be sufficiently exposed to rodenticide laid on the ground (Wegmann 2008; Wegmann *et al*. 2009a; Wegmann *et al*. in press).

3.2.1.1 Baits, toxins and baiting

Baits and toxins

There are 10 toxins that are commonly used for rat control or eradications from islands around the world (Russell *et al*. 2008). The rodenticide most frequently used in rat control programs is Brodifacoum, a highly lethal anticoagulent poison. The favoured bait type employed in the above rat programs on tropical islands was Brodifacoum 25W (Bell Laboratories Inc. Wisconsin, USA) which is highly palatable to rats and has been developed for wet tropical areas where baits are often saturated by rainfall and are in contact with wet soil. Brodifacoum 25W contains 25 ppm brodifacoum. Brodifacoum, like most anticoagulant poisons, has the advantage that one of its first symptoms is dehydration, forcing the rodent to search of water. As a result there is less chance that homeowners will encounter a dead rat inside their house. In any case, dehydrated bodies also dry out more readily, more likely leaving an odourless, mummified carcass.

Brodifacoum inhibits the enzyme vitamin K epoxide reductase which is required for the reconstitution of the vitamin K in its cycle from vitamin K epoxide, and so brodifacoum steadily decreases the level of active vitamin K in the blood. Vitamin K is required for the synthesis of important substances including prothrombin, which is involved in blood clotting. This disruption becomes increasingly severe until the blood effectively loses any ability to clot. A poisoned animal will suffer progressively worsening internal bleeding, leading to shock, loss of consciousness, and eventually death.

Land crabs are not affected by second generation anticoagulant rodenticides such as Brodifacoum (Pain *et al*. 2000) however, crabs that have consumed bait will become a secondary pathway for the exposure of the toxin for anything that consumes them (Wegmann 2008). This latter point has implications for human health – the community must be provided adequate warning about consuming crabs during and after the rat baiting program.

Baiting

Research, including eradication trials, on islands in the Pacific Ocean suggests that black rat eradication is possible on tropical rainforested islands, but the rodenticide needs to be applied at much higher rates when broadcast methods are used from the air or ground than has been done in the past because land crabs consume much of the bait (Buckelew *et al*. 2005; Wegmann *et al*. 2009a; Wegmann *et al*. in press). Wegmann *et al*. (2009a) found that labelled application rates of 18 kilograms per hectare followed by a second application of nine kilograms per hectare seven days later were insufficient for eradication on Palmyra Atoll. Similarly, a higher initial application of 36 kilograms per hectare followed by a second application of 36 kilograms per hectare was also insufficient to eradicate rats on the same Atoll. They recommended the application rate used successfully by Buckelew *et al*. (2005) which was two applications, 10 to 14 days apart, of 90 kilograms per hectare. This application rate by Buckelew *et al*. (2005) was necessary to overcome land crab bait removal and to ensure that bait was available to all rats, especially weanlings, for a minimum of four days (a convention employed in rat eradication campaigns). Bait application rates considered sufficient for eradication are somewhat variable, possibly due to the number of land crab species present and their abundance. For example, on Wake Atoll, a biomarker labelled non-toxic application of 18 kilograms per hectare followed by a second application of nine kilograms per hectare seven days later was tested and considered sufficient for eradication (Wegmann *et al*. 2009b). Similarly, on small islands adjacent to Pohnpei in the Federated States of Micronesia, an application rate of 50 kilograms per hectare was sufficient for rat eradication (Wegmann *et al*. 2007). High application rates will decrease the probability of eradication failure. However, the amount of bait remnant will pose a greater risk of exposure to non-target species.

An alternative to broadcast baiting is to place the bait in bait stations that exclude non-target species. These bait stations are located at intervals such that at least one bait station is present in the home range of every rat present. There are a number of different bait station designs (see Howald *et al*. 2004; Wegmann *et al*. 2007; Russell *et al.* 2008). A bait station consisting of a 20-litre plastic bucket, shown on the front cover, effectively excluded land crabs while permitting access by black rats on Cocos (Keeling) Islands (D. Algar unpub. data) and has also been used successfully on Wake Atoll (Rauzon *et al*. 2008). However, there are potentially several problems with utilising bait stations. One is that there is a greater risk of missing rats if there are large distances between bait stations (Wegmann *et al*. 2007). The other issue is that rats may be neophobic towards an unfamiliar object in a familiar place in which food is presented and therefore there may be a time lag between bait placement and bait take (Wegmann *et al*. 2007; Russell *et al*. 2008). It is unknown to what extent rats move between the ground and tree canopy and how long rats spend above the ground. This has implications for spacing and even applicability of bait stations located only on the ground.

3.2.1.2 Trapping

There are a number of trap types and designs that are available for capturing rats (see review, Russell *et al*. 2008). 'Live traps' (that contain the animal rather than killing it) and 'break-back traps' that meet humaneness guidelines (i.e. ISO) will both prove useful as secondary control options.

3.2.2 Strategy

The *Draft Plan for Eradication of Rodents of Lord Howe Island* (Lord Howe Island Board 2009) provides considerable detail on the reasons and rationale for eradicating rats from an island, which could be applied to managing black rats on Christmas Island.

There are many similarities between how the rat and cat eradication strategies should be structured, which will enable the two programs to be conducted concurrently. Rats should firstly be effectively managed within the residential, commercial and light industrial area where they appear most abundant. Without such a program in place, a significant source of rats particularly natal recruits would be available to disperse into or reinvade territories vacated across the rest of the island. The Immigration Reception and Processing Centre should be treated using similar techniques as those in the residential area. Techniques for the removal of rats from the remainder of the island should then be implemented.

Immediate black rat control is necessary throughout the red-tailed tropicbird rookeries along the Settlement shoreline to cease the rat predation impact of eggs and chicks. Either 'break-back' and/or live traps may be used throughout these areas.

The reduced abundance of crabs in the residential, commercial and industrial zone may enable the adoption of conventional control techniques. Poison bait laid in robust bait stations can be located in industrial and

vegetated areas within these zones to minimise the potential for exposure of people and responsibly owned domestic animals. Baits should be housed in stations that exclude chickens. Traps can also be utilised within this area to remove rats. A break-back trap should be employed in areas where access by non-target species can be prevented. Live traps should be distributed throughout this area, particularly where the food resource is most abundant. Determination of the required density of control devices within the residential area is necessary, particularly with respect to use and duration on private land and within built structures. Chickens that consume poisoned rat carcasses and also those chickens' eggs may also present a secondary poisoning hazard to humans.

Baits and/or traps should be made available at no-cost to residents for use on private land. The extent to which the community will support the management (eradication) of rats is unknown. There will be a significant imposition on all community members to take responsibility for managing rodents on their private land (including inside the residential area) and possibly also at their community facilities and workplace. Cultural and religious beliefs will also need to be taken into account which may create challenges in the management of rat eradication program.

While the rat removal is occurring in the area of human inhabitation, research will be undertaken to answer those questions outlined in the section 'Knowledge Gaps' for the effective removal of rats across the remainder of the island and the monitoring of this campaign's success. Of particular significance will be the data collected on rat distribution and density across the island as well as the home range of rats in different habitats. This information will be used to focus the control effort and scale, and also dictate the most effective strategy.

Aerial broadcast rat baiting across Crown land, mining lease and national park on Christmas Island would be cost-prohibitive both in terms of getting a machine on-island to undertake the task and the sheer amount of bait material required to conduct such an operation. Even at the minimum labelled application rate of 18 kilograms per hectare followed by a second application of nine kilograms per hectare seven days later which may be insufficient for eradication in some situations (Wegmann *et al*. 2009a) a total of 364,500 kilograms of bait material would be required. By way of comparison, the rabbit/rat/mouse eradication program on Macquarie Island (~13,000 hectares, i.e. similar in size to Christmas Island) is planning on distributing 305,000 kilograms of bait as part of a $24.6 million project. Another concern with using aerial broadcast baiting on Christmas Island is the occurrence of two species of birds that may consume rodenticide baits, i.e. the Christmas Island emerald dove and the Christmas Island imperial-pigeon. These birds may be susceptible to the proposed rodenticides (Beeton *et al*. 2009).

A more prudent and lower cost option, although yet more labour intensive rat removal strategy would involve systematically targeted placement of suitably robust bait stations. Use of bait stations would minimise removal of bait material by non-target species and therefore also address the risk of toxin exposure to any susceptible non-target species. Bait stations would also protect bait material from rainfall and therefore increase bait longevity.

A trapping campaign for rats that survive the baiting programs, because of bait station wariness, should be conducted immediately post-bait application. 'Break-back' traps would be recommended for this exercise as they can be set, left *in situ* and checked periodically. Trapping efficacy of different trap and bait types should be tested before broad-scale trapping campaigns are implemented. These trials should also examine trap placement to minimise non-target risk and any requirement for application of ant deterrent compounds to reduce bait removal by ants.

The deployment of techniques for the removal of rats follows the same principle as that pertaining to cats. Any tools used in the eradication program, especially trapping techniques, should be employed sequentially rather than on an *ad hoc* basis. This will ensure that the rats do not become familiar with the variety of control devices and techniques that are available and therefore the element of surprise is maintained over time. Adopting this strategy will reduce the risk of animals avoiding being captured or detected for an extended period of time. Gaining information on rat activity is essential and recognised as a knowledge gap (detailed further in section 5.2). Surveillance for rat activity will be reliant on deployment of suitable detection devices as evidence of footprint track activity is unlikely to be observed. The effectiveness of these detection devices will play a crucial role in directing where control effort should be located to maximise the likelihood of eradication success, when the rat population is at a low level.

As this will be an integrated cat and black rat eradication campaign, the program will be conducted over a four-year period. All control effort will be confined to the dry season (see section 2.3).

4. Monitoring

A key component of this eradication program is to employ monitoring methods that will provide quantitative estimates of the effectiveness of control operations. Information provided by the replicated monitoring of cat and rat abundance that measure the efficacy of discrete control programs will permit sound decisions and actions to be made on broad management activities and will therefore be a critical component to successful eradication.

To provide a measure of control efficacy, cat and rat activity will be surveyed at monitoring plots before and after control programs. The techniques used to survey activity to measure control effectiveness must necessarily be different (or independent) to those used for control, otherwise impact effect will be confounded by the treatment. The techniques must also be capable of detecting animals at low density populations and importantly be appropriate for use on Christmas Island.

There are a number of methods used to detect the presence of cats (see Algar *et al*. in review) and rats (summarised in Russell *et al.* 2008). Selection of the type of detection device/s will to a large extent be determined by site characteristics such as climate, topography, available soil substrate, disturbance by non-target species and so on. Analysis of count data can provide measures of population size at various levels. At a rudimentary level presence/absence data can be used to provide indices of relative activity (Engeman *et al*. 1998; Engeman 2005). If detection probabilities (i.e. the probability that the species will be detected on the site if it is in fact present, using a specified survey effort) are determined, estimates of occupancy can be derived from presence/absence data (MacKenzie *et al*. 2006; Long and Zielinski 2008). Identification of individual animals at monitoring plots by non-invasively collecting hair on hair-snag devices for the extraction of DNA provides a simple and cost-effective method of calculating the more robust estimates of population size. Using this data, we would have the ability to identify specific individuals at plots and provide more accurate estimates of population size. Through DNA analysis of hair samples collected at monitoring plots we would have the ability to quantitatively assess changes in population abundance, and this has the potential to greatly advance our understanding of the effectiveness of the control strategies (Berry *et al*. in review).

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) have agreed in principle to offer CSIRO's in kind co-investment to undertake the DNA analysis of hair samples from the monitoring plots and those collected from hair tubes (see section 'Biosecurity') because of the relevance to their 'Invasive Species and Plant Biosecurity Theme' (A. Sheppard pers. comm.).

Monitoring tools will necessarily be varied in order to undertake specific tasks (i.e. during population reduction or detection of new individuals in quarantine zones). Existing tools may need adaptation and will therefore benefit from studies identified in the Knowledge Gaps (see section below).

Biometric support will be a necessary component of the monitoring program and advice will be sought from those skilled in aspects of detection probability.

In addition to monitoring cat and rat abundances, it would be useful to measure the recovery of key indicator native species such as the nesting success and population demographics of the red-tailed tropicbird colonies along the Settlement shoreline. This can highlight species recovery early on in the program which will provide evidence to demonstrate the success of the program (i.e. of species recovery not just cat and rat control). This information will assist to promote the programs success; gain ongoing support and assist with future funding for other aspects of cat and rat control.

5. Knowledge gaps

Knowledge gaps are areas where research is required to optimise control efficacy. Fortunately there are relatively few knowledge gaps for cat control as techniques developed elsewhere are directly applicable to Christmas Island or were designed and developed while on-island (eg. baiting technique). In contrast, more areas of research are required for rat control as little study has been undertaken on rats in wet tropical zones and there appears to be significant site variability with limited data available. Information on rats on Christmas Island is often anecdotal or based on small sample sizes and therefore only of partial value. Much of this research is necessary to inform project design (i.e. techniques, number of devices etc) that will lead to the desired outcome at this site. Many techniques or ecological data cannot be directly transferred from studies at other sites due to the abundance and activity of land crabs on Christmas Island.

5.1 Knowledge gaps for cat control

1. Determine the efficacy of hair snagging devices in the tropics to capture hair for DNA analysis to provide estimates of abundance. Will need to test several structures, lures and hair-snagging tools on the island to select the most appropriate technique.
2. Provide detailed information on cat activity patterns before implementing baiting to optimise baiting efficacy and provide a cost-effective baiting campaign. Will GPS data-logger radio-collars locate satellites under the closed canopy of the rainforest and in the complex limestone areas? If the GPS collars are effective under such conditions, a number of cats will be fitted with data-logger radio-collars to provide this information. This data would be invaluable in determining the optimum spacing and location of BSDs to maximise the likelihood of feral cats encountering a bait within the shortest possible time, rather than arbitrarily assigning transect spacing. Information on movement patterns can be used to assess rates of encounter (detection probabilities) for monitoring transects and plots at various spacing across the island. It will then be possible to select the best spacing for these transects/plots to optimise encounter during survey periods.
3. Undertake a more thorough investigation of feral cat diet to provide an indication of which species might be affected by the eradication of cats.

5.2 Knowledge gaps for rat control

1. Determine the most effective technique for surveying for black rats including determining survey intensity for optimal detection probability.
2. Survey of density and distribution of rats across the island.
3. Determine the home range of rats, using radio-tracking and trapping, in different habitats across the island (primary and secondary rainforest on both the plateau and terraces, disturbed areas, ant affected areas, including in ‘ghosted’ areas). How are rats using the rainforest? How much time is spent off the ground and in the tree canopy?
4. Determine the optimal configuration of bait stations and traps based on the information collected in 1) and 2).
5. Test efficacy of different bait station and trap types. Examine non-target issues.
6. Test different bait types for palatability and longevity based on other wet tropical bait types.
7. Test the efficacy of hair snagging devices to capture hair for DNA analysis to provide estimates of rat abundance.
8. Investigate if the rat population exhibits any resistance to rodenticides such as brodifacoum.
9. Undertake a thorough investigation of black rat diet to provide an indication of which species might be affected by the eradication of rats.

Most of the knowledge gaps for effective rat control should not provide an insurmountable barrier. However, the amount of time or effect required to do it properly should not be underestimated. It is suggested that these research areas are ideally suited to university post-graduate projects and would be undertaken prior to the major drive of the eradication campaign. However, it needs to be recognised that these are critical research areas that need to be undertaken and if suitable post-graduate students are not available these studies will need to be conducted by the eradication team.

In addition to the knowledge gaps listed above, there are others that need to be considered by the island managers. The occurrence of multiple introduced animals that interact with each other to an unknown extent on Christmas Island presents special problems for planning eradications. The integrated eradication of black rats and feral cats may enable other introduced animals that cats and rats prey on to increase in abundance as a response to a reduction in predation, notably the house mouse (*Mus musculus*) and the giant centipede (*Scolopendra morsitans*). Thus there is a risk that a reduction in predation on mice and centipedes by both cats and rats may lead to an increase in their abundance, with possible deleterious effects on indigenous species such as lizards. Beeton *et al*. (2009) suggest that a precautionary approach should be adopted where:

(i) there is monitoring of both indigenous and introduced animals that might become more abundant after feral cat and black rat eradication occurs.

(ii) threatened animals such as pigeons and lizards that might be deleteriously affected by the eradication are managed, e.g. via establishment of 'insurance' populations by captive breeding. We also suggest other safeguards should also be investigated.

The scientific Expert Working Group has also identified a lack of knowledge on disease prevalence in animals now present on Christmas Island (Beeton *et al*. 2009).

Recommendation 19: (High priority) Sampling take place to establish disease (including parasite) levels in exotic plants and animals now present on Christmas Island (specifically including black rats, feral cats, dogs, tree sparrows, Java sparrows, house geckos, wolf snakes and giant African land snails).

Tissue and blood sampling of cat and rats on the island can be routinely undertaken and the School of Veterinary and Biomedical Sciences, Murdoch University have agreed to analyse these for disease and parasite presence.

6. Biosecurity

The significant expenditure and effort associated with the attempted eradication of exotic species on islands can be very quickly wasted if the target species are able to readily re-establish from other locations. Similarly, the arrival of other exotic species may create further impacts on the biodiversity of Christmas Island. Bomford and O'Brien (1995) nominate the prevention of immigration as part of the criteria necessary to achieve success in eradication programs.

Christmas Island is sufficiently isolated to preclude arrival of cats or rodents swimming or drifting independently from other land masses. The coastline is largely formed from overhung limestone cliffs which would present a significant challenge for many terrestrial species to scale. These cliffs may also be sufficient to prevent landing of species following shipwreck unless the incident occurs adjacent to one of the nine small beaches on Christmas Island.

6.1 Cats

Prevention of the arrival of cats onto the island does not require significant further management. The importation of domestic cats onto Christmas Island was prohibited under the 2006 amendments to the 'Importation of Dogs and Cats Ordinance 1973'. However, an application form for the 'import of cats and dogs on Christmas Island' is currently available on the internet (www.daff.gov.au/data/assets/pdffile/0018/112860/dogcatxmas.pdf) to facilitate importation of dogs as assistance animals (C. Brockway pers. comm.). No applications were received during 2009. This form should be reviewed to reflect the ban on importation of cats onto Christmas Island.

6.2 Rats

There is, however, greater potential for unintended arrival of rodents via established transport routes, particularly marine vessels but also aircraft. Responsibility for the maintenance of quarantine on Christmas Island rests with the Australian Quarantine and Inspection Service. Beeton *et al.* (2009) provide examples of numerous deficiencies with the current quarantine situation that must be addressed if land managers are to be confident that immigration of new or existing species can be prevented or detected on Christmas Island. Beeton *et al*. (2009) provide recommendations and Parks Australia (2008) provides an action plan for an effective quarantine management system for Christmas Island.

Commercial aircraft fly in from Australian and international airports. The aircraft flying from Australian locations conduct a circuit including Perth International and Cocos (Keeling) Island airports. International carriers that fly to Christmas Island leave from Kuala Lumpur (Malaysia) and Singapore airports.

The airport is currently fenced with cyclone mesh. This fence could be modified to a standard where it is 'rat-proof' with resident rats removed and a quarantine zone created. Once established, a high density of rat detection devices (traps, hair tunnels etc) could be installed within the quarantine zone to detect new arrivals.

Commercial shipping (phosphate and freight) regularly arrives at Flying Fish Cove (~120 arrivals in 2009) using a system of moorings. Government vessels (Navy and Customs) visit regularly and may tie up at moorings or alternatively disembark personnel from small vessels. Fuel bunkering and cruise ships tie up using moorings established 200 metres offshore from Smith Point. Passengers from cruise ships are disembarked via smaller craft that tie up in Flying Fish Cove.

There is no direct interface between these vessels and the docks. The distance between various ships and land varies somewhat dependent upon the vessel but is approximately 20 metres for cargo and government ships and 80 to 100 metres for phosphate transporters.

Five moorings are provided for recreational yachts within Flying Fish Cove. Approximately 40 yachts visited Christmas Island in 2009. These moorings are located ~150 metres off shore.

Illegal fishing and/or people smuggling vessels are held at a distance of 250 to 400 metres off Flying Fish Cove. However, one such vessel arrived and landed personnel on Christmas Island undetected in April 2009 before being towed out to sea by authorities (Arup 2009). These vessels are sunk at sea.

Australian Quarantine Inspection Service officers utilise standardised protocols for shipping with regard to rodents. Every vessel is inspected on arrival at Christmas Island and rodent activity is targeted as part of the routine vessel inspection. Ships are required to present on arrival a valid 'Ship Sanitation Certificate' which is awarded for a period of six months following inspection by an Australian Quarantine Inspection Service officer.

From time to time rodents or evidence of rodents are found or seen on vessels at Christmas Island. When this occurs the vessel must put up ratguards on all mooring lines and undertake a control program using baiting and trapping. Australian Quarantine Inspection Service increases surveillance on the vessels to ensure that the control conditions are being maintained.

Studies into the swimming abilities of invasive rat species have been summarised by Russell *et al*. (2008) who noted that rats were generally poor swimmers and exhibited poor orientation towards shore but were able to drift for distances up to one kilometre. Swimming ability seems to be highly variable between individuals but is improved with experience. One radio-collared Norway rat (*Rattus norvegicus*) was observed to have swum a distance of 400 metres across open water between two New Zealand islands (Russell *et al*. 2005). Spennemen and Rapp (1987, 1989; cited in Russell *et al*. 2008) conducted trials of rats' swimming ability in Tonga and found that only one of nine black rats reached the shore from a distance of five metres and actively swam for a period <20 minutes. The proximity of moorings to the beach at Flying Fish Cove would suggest that is possible that some rats may successfully reach the land if they were to 'disembark' a vessel.

The port district is currently unfenced and presents a significant weakness in the maintenance of rat-free quarantine status of the island, with particular reference to potential for escape of animals from unloaded containers. This situation should be reviewed to determine the extent to which a rat-proof fence encircling the port area would impact on port efficiency. Poison baits in stations and traps should be placed throughout the port area. Similarly, detection devices should be located throughout the port area to determine at what point 'rat free' status has been achieved. This surveillance would need to be ongoing beyond when rat free status had been achieved.

Notably, the construction of fenced quarantine zones (i.e. docks and airport) would require regular inspection (i.e. weekly) of fence integrity and also of detection devices.

Quarantine on Christmas Island, i.e. preventing the arrival of new individuals or species would be simplified if aircraft and maritime vessels visiting the island were required to maintain a strict quarantine procedure on-board that included enforced detection and notification protocols.

DNA samples should be taken from rodent populations at all points of origin for shipping and aircraft (Table 3) and stored as reference samples. If there are significant differences in the genetic profiles from different locations, they can then be compared with DNA sampled from rats caught at entry ports to Christmas Island to identify where quarantine measures are failing (e.g. Miller *et al*. in press).

Table 3. Source of air and sea transport visiting Christmas Island

Note that * indicates frequent visitation, ** very frequent, @ inward cargo (usually from Singapore and Port Kelang) and # occasional inward cargo

Port	Country	Frequency	Purpose	Vessel type
Bangkok	Thailand	*		
Bangkulu	Indonesia			
Banjarmasin	Indonesia			
Belawan	Indonesia	*		
Bintulu	Malaysia	*		
Cigading	Indonesia	*		
Cocos (Keeling) Islands	Australia	** @	Passenger/light cargo. Container freight.	Aircraft (commercial and military). Freight and cruise ships. Recreational yachts
Dumai	Indonesia	*		
Fremantle	Australia	** @	Container and fuel oil freight	Ship
Gresik	Indonesia			
Ho Chi Minh City	Vietnam			
Jakarta	Indonesia	**		
Kuala Lumpur	Malaysia	**	Passenger/light cargo	Commercial airlines
Kuching	Malaysia			
Laem chabang	Thailand			
Lahad datu	Malaysia			
Lampung	Indonesia			
Learmonth RAAF	Australia	**	Passenger/light cargo transport	Aircraft (commercial and military)
Lhoksemawe	Indonesia			
Mariveles	Philippines			
Medan	Indonesia			
Merak	Indonesia			

Muntok	Indonesia			
Padang	Indonesia	*		
Palembang	Indonesia	*		
Panjang	Indonesia	*		
Pasir gudang	Malaysia	** #		
Pelintung	Indonesia	*		
Perth International Airport	Australia	**	Passenger/light cargo transport	Commercial airline
Pontianak	Indonesia			
Port kelang	Malaysia	** #		
Prai	Malaysia	*		
Sandakan	Malaysia			
Singapore	Singapore	** #	Container freight. Passenger and light cargo	Ships Commercial aircraft
Sri racha	Thailand			
Surabaya	Indonesia	*		
Tanjung priok	Malaysia			
Tawau	Malaysia			
Ujung pandang	Indonesia			

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8. Appendices

8.1 Appendix 1 (revision of the SOCI 'Keeping and control of cats Local Law 2004')

We provided a suggested revision of the SOCI 'Keeping and control of cats Local Law 2004' from a base document forwarded via David Neilson (4 Feb 2010). These revisions were examined by the Shire and their authorities on Local Law. Several modifications to our original submission have been adopted following discussions with all parties. What follows is the final version of the Local Law that was presented to the Shire Council on 25 May 2010 and accepted unanimously.

In the course of this drafting we have consulted with: -

- Mick Simms - Cocos (Keeling) Islands Shire (IOT)
- Hank Bower - Lord Howe Island Board (NSW)
- Ken Hunt - Department of Conservation - Chatham Islands (NZ)
- Stuart Murphy - Phillip Island Nature Park (VIC)
- Mike Misso - Parks Australia, Christmas Island National Park (IOT)
- Dave Stephenson - Parks Victoria, French Island National Park (VIC)
- Rottnest Island (WA) where we have previously eradicated cats - is classified as Class A nature reserve.
- Steve Moore (Bureau of Animal Welfare - Dept of Primary Industries (VIC) - extensive experience in local laws from Shire and State Government perspective)

LOCAL GOVERNMENT ACT 1995(WA)(CI)

SHIRE OF CHRISTMAS ISLAND

CATS LOCAL LAW 2010

(This is a new Cats Local Law which includes the majority of amendments contained in the Amendment Local Law and the changes suggested by Algar and Johnston.

LOCAL GOVERNMENT ACT 1995 (WA)(CI)

SHIRE OF CHRISTMAS ISLAND

CATS LOCAL LAW 2010

Under the powers conferred by the *Local Government Act 1995 (WA)(CI)* and by all other powers, the Council of the Shire of Christmas Island resolved on **[insert date]** to make the following local law.

PART 1.-.PRELIMINARY

Citation

1.1 This local law may be cited as the *Shire of Christmas Island Cats Local Law 2010.*

Application

1.2 This local law applies throughout the district of the Shire of Christmas Island.

Objects

1.3 The objectives of this local law are to –

(a) protect the iconic native fauna of Christmas Island;
(b) promote responsible cat ownership;
(c) control the number of cats kept on premises;
(d) require all cats to have identification and be neutered;
(e) reduce potential health risks (eg. Toxoplasmosis) and nuisance to the community caused by cats;
(f) provide for the impounding and disposal of cats; and
(g) prevent the introduction of new cats onto Christmas Island.

Definitions

1.4 In this local law unless the context otherwise requires —

"Act" means the *Local Government Act 1995 (WA)(CI);*

"applicant" means the occupier of the premises who makes an application for an exemption under this local law;

"authorised person" means a person authorised by the local government to perform the functions conferred on an authorised person under this local law;

"cat" means a domestic cat of the species F*elis catus* and includes all domestic, feral and stray cats of that species;

"cat prohibited area" means an area of the district designated as a cat prohibited area under Part 5 of this local law;

"cat boarding premises" means any premises where a cat is boarded on behalf of the cat's keeper;

"CEO" means the Chief Executive Officer of the Shire of Christmas Island;

"Council" means the Council of the Shire of Christmas Island;

"district" means the district of the local government;

"identified cat" means a cat, which is identified under clause 2.1(2);

"keeper" in relation to a cat means each of the following persons —

(a) the owner of the cat;
(b) a person by whom the cat is ordinarily kept;
(c) a person who has or appears to have immediate custody or control of the cat;
(d) a person who keeps the cat, or has the cat in her or his possession for the time being;
(e) a person who occupies any premises in which a cat is ordinarily kept or ordinarily permitted to live;
(f) a permit holder or the holder of an exemption issued in relation to a cat;

"local government" means the Shire of Christmas Island;

"Minister" means the Minister for Territories and Local Government;

"neutering" means, castration (removal of the testes) and salpingo-oophorectomy (removal of the ovaries and fallopian tubes), called "neutering" or "spaying" when applied to cats, used to reduce or eliminate sexual behaviour and to prevent conception;

"permit" means a permit issued by the local government in relation to the keeping of a cat;

"permit holder" means a person who holds a valid permit issued under this local law;

"premises" includes:

(a) any land and any improvements; and

(b) any part of any building in separate ownership or separate occupation, or any unit, flat, townhouse, duplex or apartment;

"public place" means any place to which the public has access, and includes a place that is on private property, which the public is allowed to use;

"unidentified cat" means a cat, which is not identified under clause 2.1(2);

"universal mark of de-sexing via neutering" means the standard symbol, represented in Schedule 3, recognised throughout Australia as the indicator that a cat has been neutered;

"veterinary surgeon" means a veterinary surgeon registered under the *Veterinary Surgeons Act 1960 (WA)(CI);* and

"zoning" means a zoning under the local planning scheme of the local government made under the *Planning and Development Act 2005(WA)(CI)*;

Repeal

1.5 The *Shire of Christmas Island Keeping and Control of Cats Local Law 2004* as published in the *Territory of Christmas Island Gazette* on 27 July 2007 is repealed.

PART 2.-.IDENTIFYING CATS

Keeper of a cat shall identify it
2.1(1) The keeper of a cat shall identify the cat.
(2) A cat will be taken to be identified if the cat has –

(a) a collar around its neck and the collar, or a tag securely attached to the collar, that is marked with information that may be used to obtain the current address or telephone number of a keeper of the cat; and
(b) a microchip implanted in its body containing information that may be used to obtain the name of a keeper of the cat, the current address and telephone number of the keeper.

No interference with identification
2.2 A person, other than the keeper of a cat or a person acting with the keeper's authority, shall not without reasonable cause interfere with or remove the means by which a cat is identified under clause 2.1(2).

Address of keeper for giving notice
2.3 For the purpose of giving a notice to a keeper of an identified cat, the keeper's address is to be taken to be that ascertained from the cat's collar or tag, and obtained from the microchip.

No marking of universal mark of de-sexing via neutering unless neutered
2.4 A person shall not tattoo, or cause to be tattooed, the universal mark of de-sexing via neutering on the inside of a cat's ear unless the cat has been neutered.

PART 3.-.PERMIT REQUIRED FOR KEEPING CATS

Cats not to be kept on any premises without a permit
3.1 (1) A person shall not, unless the provisions of sub-clause (2) apply, keep a cat on any premises except in accordance with a valid permit issued in relation to those premises.
(2) A permit is not required under subclause (1) if the premises concerned are –

(a) an animal pound which has been approved by the local government;
(b) a veterinary surgery or research facility established by the Commonwealth Government or the local government to conduct cat control research; or
(c) the subject of an exemption granted by the local government.

Application for a permit to keep a cat
3.2 An application for any permit under this local law shall be –

(a) made by an owner or occupier of the premises;
(b) in a form approved by the local government;
(c) accompanied by the consent in writing of the owner of the premises, where the occupier is not the owner of the premises to which the application relates; and
(d) accompanied by any fee imposed and determined by the local government, in accordance with Section 6.16 to 6.19 of the Act.

Limitation on the number of cats
3.3 (1) With the exception of a permit granted for a cat boarding premises the local government shall not grant a permit for the keeping of more than two cats on any premises.
(2) Subject to sub-clause (3), the local government shall not grant a permit for the keeping of cats on any premises within a designated cat prohibited area.
(3) The local government may grant a permit for the keeping of a cat on premises within a designated cat prohibited area if the cat was being kept on the premises prior to the premises being designated.

Refusal to determine application
3.4 The local government may refuse to determine an application for any permit under this local law if it is not made in accordance with the provisions of clause 3.2.

Factors relevant to determination of application
3.5(1) In determining an application for any permit under this local law the local government may have regard to –

(a) the physical suitability of the premises for the proposed use;
(b) the suitability of the zoning of the premises for the proposed use;
(c) the structural suitability of any enclosure in which any cat is to be kept;
(d) the likely effect on the amenity of the surrounding area of the proposed use;
(e) the likely effect on the local environment including any pollution or other environment damage which may be caused by the proposed use;
(f) any submissions received under subclause (2) within the time specified in subclause (2); and
(g) such other factors which the local government may consider to be relevant in the circumstances of the particular application.

(2) The local government may, before determining an application for a permit under this local law, require an applicant to –

(a) consult with adjoining landowners or occupiers; and
(b) advise the adjoining landowners or occupiers that they may make submissions to the local government on the application for the permit within 14 days of receiving that advice.

Decision on application

3.6(1) The local government may –

(a) approve an application for any permit under this local law subject to the conditions referred to in clause 3.7;
(b) approve the application for a permit to use a premises as a cat boarding premises subject to the conditions referred to in clause 4.2(1); or
(c) refuse to approve an application for any permit under this local law.

(2) If the local government approves an application for any permit under this local law a permit shall be issued to the applicant in the form determined by the local government.

(3) If the local government refuses to approve an application then it is to advise the applicant accordingly in writing.

Conditions

3.7(1) Every permit issued under this local law, unless otherwise specified by the local government, is issued subject to the following conditions –

(a) each cat kept on the premises to which the permit relates shall be an identified cat;
(b) each cat on the premises, unless already so, shall be neutered within 12 months of the date of issue of the permit;
(c) the premises shall be maintained in good order and in a clean and sanitary condition;
(d) adequate space shall be provided on then premises for the exercise of the cats; and
(e) the permit holder shall not substitute or replace any cat once that cat -
    (i) dies; or
    (ii) is permanently removed from the premises,

without first obtaining the consent of the local government.

(2) A cat will be taken as neutered if –

(a) it has been tattooed with the universal mark of de-sexing via neutering; or
(b) the keeper holds a certificate signed by a veterinary surgeon stating that the cat is or is considered to be neutered.

Duration of permit

3.8 Unless otherwise specified a permit issued for the keeping of cats on a premises as required by clause 3.1(1) commences on the date of issue and is valid for a period not exceeding three (3) years;

Revocation of permit

3.9 The local government may revoke any permit issued under this local law if the permit holder fails to observe any provision of this local law or a condition of a permit.

Permit not transferable

3.10 Any permit issued under this local law is not transferable, either in relation to the permit holder or the premises.

PART 4 – CAT BOARDING PREMISES

Permit required for Cat Boarding Premises

4.1 The local government may grant a permit for the keeping of more that two cats on any premises not in a

cat prohibited area if the purpose of the application is to use the premises as a cat boarding premises.

Additional conditions for Cat Boarding Premises

4.2(1) In addition to the conditions referred to in clause 3.7, every permit to use a premises as a cat boarding premises is issued subject to the following conditions –

(a) each cat is to be confined within an enclosure on the premises at all times;
(b) the enclosure for the cats shall be structurally sound, have impervious flooring, be well lit and ventilated;
(c) the premises shall have a feed room, wash area and isolation cages;
(d) enclosures shall be thoroughly cleaned and disinfected at least once a week;
(e) materials used in structures are to be of a type approved by the local government;
(f) the internal surfaces of walls are, where possible to be smooth, free from cracks, crevices and other defects;
(g) all fixtures, fittings and appliances are to be capable of being easily cleaned, resistant to corrosion and constructed to prevent the harbourage of vermin;
(h) washing basins and running hot and cold water shall be available;
(i) the maximum number of cats to be kept on the premises;

(2) The permit holder shall keep an entry book and record in respect of each cat the –

(a) date of admission;
(b) date of departure;
(c) breed, age colour and sex; and
(e) name and residential address of the keeper;

(3) The permit holder shall produce the entry book for inspection at the request of an authorised person.

(4) A permit may be issued subject to such other conditions as the local government may consider appropriate.

(5) A permit holder shall not contravene any conditions of a permit.

Duration of permit for cat boarding premises

4.3 Unless otherwise specified by the local government a permit issued in relation to a cat boarding premises has effect for a period of twelve (12) months from the date of issue.

PART 5 – CAT PROHIBITED AREAS

Designation of Cat Prohibited Area

5.1 The local government may designate land as a cat prohibited area by stating a description of the land in Schedule 4.

5.2 The local government, by resolution of the Council, may designate further areas as cat prohibited areas but shall not do so without first giving local public notice of its intention to designate land or an area as a cat prohibited area and considering any submissions received in response to the local public notice.

5.3 In designating land for the purpose of clause 5.1 the local government may have regard to the following matters in relation to the land –

(a) that the land should preferably be greater than 1 hectare in area;
(a) the proximity of the land to any other land that has been recognised by any authority as having fauna of significance to Christmas Island;
(b) the nature of the fauna habitat on the land or any nearby public place;
(c) whether there are any artificial or natural barriers between the land and the land described in paragraphs b) and c) above; and
(d) such other matters which the local government considers relevant.

PART 6 - REMOVAL AND IMPOUNDING OF CATS

Act Regulates Removal and Impounding of Cats

6.1 The removal impounding and disposal of cats shall be in accordance with Subdivision 4 of Division 3 of Part 3 of the Act and Regulation 29 of the *Local Government (Functions and General) Regulations 1996*.

Identifying cats

The local law requires that the keeper of a cat shall identify the cat by a collar or a microchip

Impoundment of cats

6.2 An authorised person may –

(a) pursue, seize, detain and impound a cat involved in contravention of Part 11;

(b) unless a permit has been issued under clause 3.3(3), pursue, seize, detain and impound a cat that is in a designated cat prohibited area;

(c) at any time enter upon either local government property or private property for the purpose of placing a trap to give effect to paragraphs a) and b) provided that no entry shall be made upon privately owned land without the prior authority of the owner or occupier of that land;

(d) where a permit issued under this local law is revoked under clause 3.9, seize and impound any or all of the cats on the premises; and

(e) during the term of a permit issued under this local law seize and impound any or all of the cats on the premises, if the authorised person suspects that a breach of the permit, or of any condition of the permit, has occurred.

Establishment of Cat Pounds

6.3 The local government may establish and maintain a pound or pounds, and may approve an animal pound maintained by any person, for the impounding of cats under this local law.

6.4 The local government may determine from time to time –

(a) the times when a cat pound will be open for the reception and release of cats; and

(b) under sections 6.16 to 6.19 of the Act a scale of impounding fees to be paid on the release of impounded cats.

Register of Impounded Cats

6.5(1) The local government is to keep a record of impounded cats (the "Register")

(2) The register is to contain the following information about each impounded cat –

(a) the breed and sex of the cat;

(b) the colour, distinguishing markings and features of the cat;

(c) if known, the name and address of its keeper;

(d) the date and time of its impoundment;

(e) the name of the person who impounded the cat;

(f) the reason for the impoundment;

(g) the place from where it was impounded; and

(h) the date of release or disposal.

No unauthorised release, breaking into or damage of pound

6.6 Unless the person is an authorised person, a person must not –

(a) release or attempt to release a cat from a pound;

(b) destroy, break into, damage or in any other way interfere or render not cat proof a pound;

(c) destroy, break into, damage or in any other way interfere with any container used for the purpose of catching, holding or conveying cats; or

(d) destroy, break into, damage or in any way interfere with any container or device used for the purpose of photographing, catching or feeding cats.

Dealing with impounded cats

6.7 Where a cat is impounded and the keeper of the cat can be readily identified, the authorised person shall cause written notice to be given to the keeper of the cat, advising that the cat may be claimed within a specified time and upon the payment of a specified fee.

6.8 The payment of any fees by a keeper in the respect of the impounding and keeping of a cat does not relieve the keeper of any liability to a penalty for an offence against any provisions of this local law.

6.9 Where –

(a) a keeper wishes to reclaim a cat within the period stated in the notice of impounding; and

(b) a permit is required for the keeping of the cat,

the cat shall not be released until such permit is obtained.

Destruction of impounded cat because of disease

6.10(1) Subject to sub-clause (2) where an impounded cat is diseased, emaciated, injured or sick, the local government may destroy the cat, upon written authority of the CEO.
(2) Where an identified cat is diseased, emaciated or sick, the local government shall take all reasonable steps to notify the keeper of the cat of its condition, prior to destruction under sub-clause (1), unless the condition of the cat is such that it should be destroyed immediately.

Disposal of unclaimed impounded cat
6.11 Where either an unidentified cat; or an identified cat is impounded and it is not claimed within seven (7) days of it being impounded, the local government may –

(a) cause the cat to be destroyed; or
(b) cause the cat to be re-housed.

PART 7 - ABANDONMENT OF CATS

No abandonment
7.1 A person shall not abandon a cat.

Delivery to an authorised person not abandonment
7.2 A person who delivers a cat into the custody of an authorised person is to be taken not to have abandoned the cat.

PART 8 – MISCELLANEOUS

8.1 A notice given under this local law may be given –

(a) personally to the keeper of the cat;
(b) by registered mail addressed to the keeper;
(c) by leaving it for the keeper at his address; or
(d) by attaching it on some conspicuous part of the premises on or in which the cat is ordinarily kept or permitted to live.

PART 9 - EVIDENCE

Averment that a person is a keeper
9.1 In proceedings for any offence against any provision of this local law an averment in the complaint that at a specified time a person was a keeper of the cat is evidence of the fact in the absence of proof to the contrary.

PART 10 - OBJECTIONS AND APPEALS

Objection and appeal rights
10.1 Any person who is aggrieved –

(a) by the conditions imposed in relation to a permit, the revocation of a permit, or by the refusal of the local government to grant a permit may lodge an objection to the decision with the Council.
(b) by the conditions imposed in relation to a permit, the revocation of a permit or by the refusal of the local government to grant a permit, and where that decision adversely affects the business or livelihood of the appellant, they may in the prescribed manner and in the prescribed time appeal against the decision to the local court or the Minister, as the appellant elects.

PART 11 - OFFENCES AND PENALTIES

Division 1 – General

Offences
11.1 A cat shall not be in a public place unless –

(a) it is held by a person over the age of 18 years; or
(b) it is securely tethered or contained in a receptacle; or
(c) it is in a motor vehicle.

11.2 If a cat is at any time in a public place in contravention of this provision, every keeper of the cat commits an offence unless the person satisfies the Court that he or she took all reasonable precautions and exercised all due diligence to avoid the contravention or in the case of a keeper that at the material time, the cat was in the possession or control of some other person without the consent of the keeper, expressed or implied.

11.3 A cat shall not be in any place that is not a public place unless consent to its being there has been given –

a) by the occupier or a person apparently authorised to consent on behalf of the occupier; or
b) if the place is unoccupied by the owner or a person apparently authorised to consent on behalf of the owner.

11.4 If a cat is at any time in a cat prohibited area and a permit has not been issued under clause 3.3(3), the keeper of the cat commits an offence.

11.5 The permit holder who fails to comply with a condition of a permit commits an offence.

11.6 Any person who contravenes or fails to comply with a provision of this local law commits an offence and shall upon conviction be liable to a penalty not exceeding $5,000.00, and if the offence is of a continuing nature, an additional penalty not exceeding $500.00 for each day or part of the day during which the offence continues.

Division 2 – Infringement notices and modified penalties

Prescribed offences

11.7 The offences prescribed in Schedule 1 are in relation to which a modified penalty applies, and the amount appearing directly opposite each such offence is the modified penalty payable in relation to that offence.

Forms

11.8(1) Where an authorised person has reason to believe that a person has committed an offence against this local law he or she may serve upon that person an Infringement Notice and the Infringement Notice issued under this local law shall be in the form of Form 1 of Schedule 2.

(2) An Infringement Notice may be served on an alleged offender personally or by posting it to their last known address as ascertained at the time or immediately following the occurrence giving rise to the allegation of the offence.

(3) Where a person who has received an Infringement Notice fails to pay the prescribed penalty within the time specified in the notice, or within such time as may in any particular case be allowed, they are deemed to have declined to have the alleged offence dealt with by way of a modified penalty.

(4) An Infringement Notice may, whether or not the prescribed penalty has been paid, be withdrawn by sending a notice in the prescribed form to the alleged offender at the address specified in the notice or his last known place of residence or business.

(5) The Notice of Withdrawal of Infringement Notice issued under this local law shall be in the form of Form 2 of Schedule 2.

SCHEDULE 1

Local Government Act 1995(WA)(CI)

Shire of Christmas Island

CATS LOCAL LAW 2010

MODIFIED PENALTIES

Item No.	Clause No.	Nature of Offence	Modified Penalty
1	2.1	Failure of a keeper to identify a cat	$200
2	2.2	Interference with or removal of the identification of a cat	$100
3	2.4	Marking cat with universal mark of de-sexing via neutering when cat not neutered.	$200
4.	3.1(1)	Keeping a cat without a permit	$200
5	4.1	Using a premises as a cat boarding premises without a permit	$200
6	6.6(a)	Releasing or attempt to release a cat from a pound	$200
7	6.6(b)	Destroy, break into, damage or in any other way interfere or render not cat proof a pound	$200
8	6.6(c)	Destroy, break into, damage or in any other way interfere with any container used for the purpose of catching, holding or conveying cats	$200
8	7.1	Abandonment of cat	$200.
9	11.1	Cat in a public place	$200
10	11.3	Cat in a place that is not a public place.	$100
11	11.4	Cat in a cat prohibited area	$250
12	11.5	Breach of a condition of permit	$250.

SCHEDULE 2

Form 1

Local Government Act 1995 (WA)(CI)

Shire of Christmas Island

CATS LOCAL LAW 2010

INFRINGEMENT NOTICE

No.....
Date…../…../…..

To (Name of alleged offender).....……

It is alleged that at (place of alleged offence).....……..

on the.....day of.....20.....……

you committed an offence in that you (particulars of alleged offence).....……

……

……
……...

(to be signed by an authorised person)……

You may dispose of this matter —

by payment of a penalty of $……....(insert amount of penalty) within 28 days of the date of this Notice to (insert address of office where payment may be made).....……; or

by having it dealt with by a court.

If this modified penalty is not paid within the time specified, court proceedings may be taken against you.

SCHEDULE 2

Form 2

Local Government Act 1995(WA)(CI)

Shire of Christmas Island

CATS LOCAL LAW 2010

NOTICE OF WITHDRAWAL OF INFRINGEMENT NOTICE

No.....

Date…../…../…..

To (Name of alleged offender)).....

Infringement Notice No.....dated..... for the alleged offence of (particulars of alleged offence).....…….

.....……
……

……

Penalty (amount of penalty prescribed) $.....is hereby withdrawn.

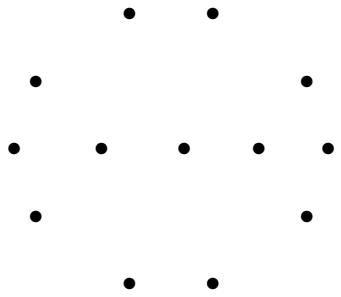
* No further action will be taken

* It is proposed to institute court proceedings for the alleged offence.

.....

(to be signed by an authorised person)

SCHEDULE 3



Universal Mark of De-sexing via Neutering

Date [insert date]

The Common Seal of the Shire of Christmas Island was affixed under the authority of a resolution of the Council in the presence of –

Cr G. THOMSON, Shire President
D. NIELSEN, Acting Chief Executive Officer

SCHEDULE 4

Local Government Act 1995(WA)(CI)

Shire of Christmas Island

CATS LOCAL LAW 2010

CAT PROHIBITED AREAS

Area 1

All land indicated as Cat Prohibited Area as shown on Map 1 of this schedule.

8.2 Appendix 2 (Budget required to implement the Eradication Plan)

It is anticipated that the strategy proposed will take up to four years to complete, with all control effort being confined to the dry season (6 months on-island/year). The program will require the presence of four persons on the island to undertake the work and individual staff will be rotated on a monthly basis. In addition, a logistical/support officer will be required in Perth to co-ordinate activities (total personnel = 2.5 FTE/year). The timeline of activities are presented in Table 4, with the main body of work to commence in May 2011. A summary of the funds required to undertake this program is provided in Table 5 and are itemised with associated indicative costs in Table 6.

Table 4. Timeline of activities

Activity	2010	2011	2012	2013	2014
Revision and endorsement of the current local cat management laws (*Shire of Christmas Island Local Law for the Keeping and Control of Cats 2004*) under the *Local Government Act 1995 (WA) (CI)*					
Census of owned domestic cats					
De-sex, microchip and collar/tag domestic cats					
Remove all stray cats and rats from residential, commercial and industrial areas, including IRPC					
Control cats and rats along Settlement shoreline and Egeria Point					
Undertake research requirements to fill knowledge gaps					
Eradicate feral cats and rats from Crown land, mining lease and national park					
Monitor efficacy of eradication campaigns					
Annual report to Stakeholder group					
Liaison and consultation with CI community					
Publication and dissemination of results					

Table 5. Summary of the funds required to undertake this program

Year	2011	2012	2013	2014
	$1,008,254	$816,310	$813,480	$833,124
Grand Total	**$3,471,168**			

Table 6. Itemised budget requirements

	2011	2012	2013	2014
Personnel				
Salary (2. 5 FTE, 6 months/year)	250,000	250,000	250,000	250,000
Travel allowance $122/day (4 people/6 months)	87,840	87,840	87,840	87,840
Overtime $95/day (4 people/6 months)	68,400	68,400	68,400	68,400
Transport				
Personnel flights $1600 return (4 people/6 months)	38,400	38,400	38,400	38,400
Interstate, overseas travel/allowances	20,000	20,000	20,000	20,000
Shipping of equipment	10,000	10,000	6,000	6,000
Aircraft freight	10,000	10,000	10,000	10,000
Emergency transportation	5,000	5,000	5,000	5,000
Accommodation				
Fully furnished house $1000/week (4 people/6 months)	26,000	26,000	26,000	26,000
Extra equipment/infrastructure for house	10,000	2,000	2,000	2,000
Container+ storage and transport on island	10,000	-	-	-
Vehicles				
2 x 4WD vehicle ($1306/month/vehicle incl. fuel and mileage costs on-island, DEC lease plan for 12 months)	31,344	31,344	31,344	31,344
4x ATVs (with front and rear carry containers, $12000 each)	48,000	-	-	-
Tool kits (4WD and ATVs, $600 each)	3,600	-	-	-
Replacement of tools	-	500	500	500
Spare tyres for ATVs and vehicle ($600 set)	3,600	1,200	1,200	1,200

Registration costs for ATVs	800	800	800	800
Air compressor for ATVs x 4	1,000	-	-	-
Service vehicles and ATVs	5,000	5,000	5,000	5,000
Baiting				
Cat baits (35c/bait, 15000 baits)	5,250	5,250	5,250	5,250
Freight of baits	5,000	5,000	5,000	5,000
PAPP toxin ($1/capsule x 1000)	1,000	1,000	1,000	1,000
Ant deterrent	2,000	2,000	2,000	2,000
BSDs		supplied		
Plastic tops for BSDs	1,500	1,500	1,500	1,500
Toxic rat baits	50,000	100,000	100,000	100,000
Lock up freezer for 1080 baits	5,000	-	-	-
Rat bait stations (Buckets, $20 x 500)	10,000	-	-	-
Replacement of rat bait stations	-	2,000	2,000	2,000
Trapping				
Cat cage traps ($70 x100)	7,000	-	-	-
Cat leg-hold traps ($100 x100)	10,000	-	-	-
Cat trap bait	1,000	1,000	1,000	1,000
Cat trap lure	1,000	1,000	1,000	1,000
Leg-hold trapping equipment	2,000	-	-	-
Rat traps (live capture, $50 x100)	5,000	-	-	-
Rat traps (break-back, $30 x100)	3,000	-	-	-
Rat trap bait	1,000	1,000	1,000	1,000
Rat trap lure	1,000	1,000	1,000	1,000
Fumigation chamber to kill rats + CO canisters	1,000	1,000	1,000	1,000
Replacement of cat and rat traps, trapping equip.	-	5,000	5,000	5,000
Firearm ammunition ($50/carton)	100	100	100	100

Monitoring				
Student research	50,000	50,000	50,000	50,000
Cat GPS collars ($2100 x 20+ $300 freight)	42,300	-	-	-
Refurbishing of cat GPS collars ($1040 x20 + $300 freight)	-	21,100	-	-
Rat telemetry collars ($176 x 20+ $300 freight)	3,820	-	-	-
Replacement of rat telemetry collars ($140 x 20 + $300 freight)	-	3,100	3,100	-
Receiver ($1200 x 2), Yagi stick ($300 x 2) + $300 freight	3,300	-	-	-
Hair snares for cats ($50 x 100)	5,000	-	-	-
Cat hair snare lure + snagging device	5,000	5,000	5,000	5,000
Hair snares for rats ($30 x 100)	3,000	-	-	-
Rat hair snare lure + snagging device	5,000	5,000	5,000	5,000
Replacement of cat and rat hair snares	-	4,000	4,000	4,000
DNA analysis of collected hair from monitoring plots ($50/sample)	20,000	20,000	20,000	20,000
DNA samples from all the overseas ports ($50/sample)	20,000	20,000	20,000	20,000
Disease and parasite analyses	20,000	20,000	20,000	20,000
AQIS importation costs for biological materials (above)	1,000	1,000	1,000	1,000
Roconyx remote sensing cameras ($1000 x 20 + $500 freight, customs)	20,500	-	-	-
Camera batteries and maintenance	2,500	2,500	2,500	2,500
Repair costs	5,000	5,000	5,000	5,000
Safety Equipment				
Gun safe	500	-	-	-
First aid kits	1,000	-	-	-
GPS ($500 x 4)	2,000	-	-	-
Replacement of first aid equip./ batteries for GPS etc.	1,000	1,000	1,000	1,000
Satellite phones ($2500 x 2)	5,000	-	-	-
Satellite phone bill	1,500	1,500	1,500	1,500
Contingency	50,000	50,000	50,000	50,000

Sum/year:	$1,008,254	$792,534	$767,434	$764,334
Sum+ CPI (3%/annum)		$816,310	$813,480	$833,124

Total sum: $3,471,168