List of Appendices

Appendix 1

Original Documentation for TSSC and Minutes of TSSC including recommendation to Minister

Threatened Species Scientific Committee

Out-of-Session Paper 30 January 2009

Christmas Island Pipistrelle Bat - advice on conservation

Background

1. The endemic Christmas Island Pipistrelle bat (*Pipistrellus murrayi*) is listed as 'critically endangered' under the EPBC Act. A national recovery plan is in place and is being implemented. The bat has been in serious decline over the last 14 years. Parks Australia has made significant efforts to undertake and support research into possible causes of decline and prevent this trend from continuing (Attachment 1). Despite best efforts, there are no clear causes of decline, and multiple factors are thought to be involved. A survey in January 2009 indicated there are possibly less than 20 bats remaining.

2. In May 2008, Dr Lindy Lumsden of the Arthur Rylah Institute, was contracted to provide advice on captive breeding and in situ management of the bats. A draft report was provided to Parks Australia in January 2009 (Attachment 2). Given the extremely low numbers of Pipistrelle bat now thought to be in existence, Dr Lumsden has recommended that an emergency response plan be initiated to capture remaining bats if possible, and initiate a ten-year captive breeding program on Christmas Island. The estimated cost of such a program is $4.9 million.

Issues

3. Options for captive breeding have been considered in the past. However with little knowledge about the species and the potential risks involved, particularly given the small remaining population, Parks Australia on behalf of the Minister is seeking further advice about this option, as well as other recommendations for conservation measures for the Pipistrelle.

4. Biodiversity generally on Christmas Island is facing several challenges. There are other species under pressure, besides the Pipistrelle, and in this context a landscape wide approach to biodiversity loss is essential. A Regional Recovery Plan will shortly be developed for the island. An issues paper (Attachment 3) was prepared as part of the development of the draft plan, and this provides an overview of the island species, the existing and potential threats to biodiversity, and management actions.

5. A Christmas Island Biodiversity Monitoring Program, funded by the Department of Finance and Deregulation, was implemented by Parks Australia between 2003 and 2007. Its primary purpose was to monitor the effects of the construction of the Immigration Detention Centre on Christmas Island, and it generated additional baseline biodiversity data for the island.

6. Prior to this it was widely thought that there were less than 50 endemic species of plants and animals on Christmas Island, but the figure is now estimated to be in excess of 250. The program also found a worrying loss of biodiversity. The program was unable to fully explore the causes of decline for particular species. The summary report (Attachment 4) found that attention needs to focus on addressing the root causes of biodiversity loss on Christmas Island. These causes are: invasive species that have entered the island due to poor quarantine procedures; poor land management practices that are historical and widespread which have allowed the spread of weeds and invasive animals; and global factors such as climate change.

7. As a matter of urgency the Minister is seeking advice from the Committee on the advisability and feasibility of undertaking ex-situ management of the species and any associated risks. Following discussion the Committee may wish to set up a small sub-committee to facilitate provision of this advice.

8. The Committee is also invited to provide expert participation in a broader dialogue on threats to biodiversity on Christmas Island.

Recommendation

That the Committee **agrees**:

1. To consider ongoing threats to the pipistrelle bat and provide urgent advice on the feasibility of a captive breeding program and any other appropriate conservation actions for the Pipistrelle bat;

2. To participate in and nominate representatives for an expert committee to consider threats to biodiversity on Christmas Island within the context of developing the Regional Recovery Plan and guiding conservation priorities.

Attachments

1. Chronology of research and actions for the Christmas Island Pipistrelle
2. "Captive breeding and future in situ management of the Christmas Island Pipistrelle *Pipistrellus murrayi"* Lindy Lumsden and Martin Schulz 2009, Arthur Rylah Institute for Environmental Research
3. Issues paper - Conservation status and threats to the flora and fauna of the Christmas Island Region - May 2008 (prepared for be development of a draft Regional Recovery Plan for Christmas Island)
4. " Christmas Island Biodiversity Monitoring Program: December 2003 to April 2007" report to the Department of Finance and Deregulation from the Director of National Parks, September 2008

Attachment 1:

Chronology of actions for the Christmas Island Pipistrelle (*Pipistrellus murrayi*):

Parks Australia January 2009

Background

- The Christmas Island Pipistrelle (*Pipistrellus murrayi*) is a small (weight 3-4.5g) insectivorous bat that is endemic to Christmas Island. The Pipistrelle was common on Christmas Island in the 1980's but has continued to decline over the last 14 years. The known population of bats has contracted to the North West end of the island.
- The remaining population is located in a small area in the NW part of the National Park, and may forage in an adjacent mine lease area
- Parks Australia has made significant efforts to research the Pipistrelle in order to determine causes of decline and prevent this from continuing including an ongoing monitoring program, DOFA Biodiversity Monitoring Program undertaken by DNP, and research commissioned through the Arthur Rylah Institute.
- Despite our best efforts, research efforts have not been able to determine the causes of decline. Our research advisers suspect that multiple factors are almost certainly involved. Contributing factors may be:
    - habitat loss
    - climatic conditions
    - introduced predators and pests (eg the Wolf Snake (Lycodon aulicus), Black Rat (Rattus rattus) and Giant Centipede (Scolopendra morsitans) and supercolonies of invasive yellow crazy ants
    - Disturbance at roost sites is probably important (Lumsden et al. 2007).
    - Neither habitat loss nor reduction in prey items appears to be a cause.
    - There is little evidence for disease as a cause but it cannot be ruled out (Lumsden et al. 2007).
- Without certainty regarding the cause of decline, our management strategies have focused on:
    - continuing research to improve our understanding of the decline; and
    - implementing mitigation measures against some potential causes of the decline (i.e. protection of roosts from predators).
    - Options for captive breeding have been considered in the past. However with such little knowledge about this species and potential risks involved, this has not been attempted in the past.

What have we done?

Summary

- Prepared recovery plans and implemented management actions in accordance with the recovery plan.
- Contracted bat scientists Dr Lindy Lumsden and Dr Martin Schulz to advise on how to manage the Pipistrelle.
- Undertaken numerous, extensive, island-wide surveys to gain understanding of bat distribution and abundance, habitat preferences, foraging habitats, roosting preferences.
- Undertaken research into potential causes of decline, including potential predators, disease, habitat changes (including mine lease), loss of roost trees.
- Undertaken management actions to prevent further decline, including installation of roosting boxes, predator proofings roost trees, identifying potential/possible predators through infra-red cameras.
- Investigated options for captive breeding.

Pipistrelle Management actions.

- A national recovery plan for the Christmas Island Pipistrelle was made under the EPBC Act in 2004. The Christmas Island Pipistrelle was upgraded from 'Endangered' to 'Critically Endangered' in 2006.
- A National Recovery Plan has been adopted. Recovery Plan Actions that have been implemented include:
    - installation of roosting boxes
    - predator guards around the remaining known roost tree
    - automatic cameras to monitor potential predators
    - control main potential predators including invasive ants, centipedes, rats and snakes and interaction between potential predators and bats.
    - monitoring of the bat's population and distribution– ultrasonic detectors, remote
    - cameras, harp trapping, radio-transmitter installation and tracking, and roost surveillance.

- Members of the Natural Resource Management team on Christmas Island have continued to monitor bat call detection, movements and distribution, predation/possible predators on roost trees and artificial roosts.
- In early 2007, Parks Australia's contractors, the Arthur Rylah Institute (the biodiversity research base for the Department of Sustainability and Environment in the Victorian Government) found:
    - Total estimated population of the Pipistrelle was only 500 to 1,000 individuals.
    - The Pipistrelle was found likely to become extinct in several years if current population decline trends continued.
    - Seven maternity roosts were located, all under loose bark on dead trees.
    - Blood tests showed no indication of disease, but further studies are required.
    - Predator cameras detected three potential predators on roost trees: Black Rats, Giant Centipedes and a Wolf Snake (though there was no evidence of any direct impact on the Pipistrelle). Ants and spiders may also have the potential to disrupt the roost.

- Seventeen months after the seven maternity roosts were located, five of the trees had collapsed and one had lost its bark. Only one former maternity roost tree is still inhabited.
- In 2008, additional monitoring and survey work was undertaken to determine if the Pipistrelles may have moved elsewhere on the Island, however it was found that the population has contracted to the north western end.
- In May 2008, Dr Lumsden of the Arthur Rylah Institute, was contracted to provide advice on captive breeding and in-situ management of the bats.
- In a Draft Report on the captive breeding and future in-situ management of the Christmas Island Pipistrelle (January 2009), Dr Lumsden reported that there were extremely low numbers of Pipistrelle bat.
- Parks Australia is considering her recommendation for a captive breeding program.
- PRL has engaged a bat expert, Dr Greg Richards, who is working closely with Dr Lumsden to develop a collaborative approach to accelerate efforts to save the pipistrelle.

Additional potential roost trees have been identified by parks staff and researchers, and work is underway to secure these as possible habitat for the remaining bats.

Supplementary Paper Prepared for the Deliberations of the TSSC

Bob Beeton Chair, January 2009

I apologise if this is a rather hasty document so please regard it as a first draft that members might improve when we meet by teleconference next week.

The Christmas Island Pipistrelle has been considered by the Committee on four occasions. It was listed as endangered at the fifth meeting, a recovery plan was approved at the 18th meeting (2004), a report was received on the recovery plan and action was commenced on up listing at the 26th meeting. At the 28th meeting the species was recommended for up listing to its current status.

Below is an extract from the minutes of the 28th meeting and members will note that there were significant concerns expressed by the Committee about the possible fate of species. Additional conservation advice was offered especially with respect to priorities.

In the papers that have been provided for us by the Department we are requested to provide urgent advice for the Department and Minister on actions that should now be taken. Specifically the Department is requesting that we consider the following two recommendations for the Minister.

Recommendation

*That the Committee **agrees**:*

1. *To consider ongoing threats to the pipistrelle bat and provide urgent advice on the feasibility of a captive breeding program and any other appropriate conservation actions for the Pipistrelle bat;*

2. *To participate in and nominate representatives for an expert committee to consider threats to biodiversity on Christmas Island within the context of developing the Regional Recovery Plan and guiding conservation priorities.*

This advice would formally be offered to the Minister who would then direct the Department in its actions. I understand that the Minister has requested such advice.

A careful reading of all the documentation provided and the comments made by the Committee at the 28th meeting lead me to the conclusion that treating the symptoms, namely the decline in the Pipistrelle, is unlikely to reverse either the dramatic decline in biodiversity on Christmas Island in general and Pipistrelle in particular. I would be interested in the opinion of members on the threat to the Pipistrelle of trying to implement what could only be described as a highly experimental capture of wild

animals followed by a captive breeding program. We do have to make a recommendation on this and what the conservation outcome might be of a multi-million-dollar exercise.

I ask members to focus particularly on the second recommendation and consider the following.

Would the expert committee achieve anything?

If yes then what terms of reference should be recommended for the operation of the expert committee?.

My first reaction is that it should:

- be given a very short time to report,
- have access to all available material,
- get on the ground,
- consist of people who are expert in the recovery of declining islands and with a practical understanding of on ground management,
- be small
- be directed towards the recommendation of very specific and immediately implementable actions in addition to longer term actions and
- be asked to continue to serve as an oversight committee for what I see as the first action.

The first action should be the establishment of rigorous monitoring with an appropriate system for evaluating its results on short and long time cycles.

Overview

Our consideration of this matter should be considered as strategic as well as immediate and tactical. I believe the time has arrived where we have to seriously consider whether spending large amounts of money on highly targeted single species recovery is an appropriate use of resources when clearly it is system decline that is driving the process.

If members are of this view then we should regard our recommendation to the Minister as contextualising the way these matters should be dealt with in the future. This would be consistent with our recommendation to the Hawke review of the necessity to focus more on threats and ecological communities and less on species after the damage has been done. This would also be consistent with the Committee's long held view about the need for multi- threat, multi-species, multi-community planning in the regional context.

Extract from the minutes of the 28th meeting of TSSC September 2006

7.1 *Pipistrellus murrayi* (Christmas Island Pipistrelle)

The Committee **requested** that the following amendments be made to the draft listing advice:

- The following additional sentence be included under criterion 3: ‘These results, in addition to data from capture numbers and detector passes, suggest that an estimate

- The discussion under criterion 3 be amended to reflect the fact that of the seven roost trees recorded, four have since fallen and are therefore lost as roost sites.
- The last sentence of the second paragraph in the conclusion on page 5, be replaced with: 'Indicative modelling suggests that if the current rate of decline continues, the Christmas Island Pipistrelle will become extinct in the near future.'

The Committee discussed population size in the context of the decline predicted by the graph on page 23, and whether the species might be considered critically endangered under criterion 3. The Committee **noted** that only estimates of relative abundance were available and therefore **agreed** that the species remains eligible for listing as endangered under criterion 3.

The Committee **noted** that it would be useful to have an aerial photograph of the location where the species occurs on the island.

The Committee **agreed** to recommend to the Minister that *Pipistrellus murrayi* (Christmas Island Pipistrelle) is eligible for transferring from the endangered category to the critically endangered category of the threatened species list.

The Committee **agreed** not to provide advice to the Minister on Critical Habitat for the species at this time.

The Committee **noted** that whilst the 2004 recovery plan had identified key threats for the species, it had not yet succeeded in determining the cause of, or arresting the population decline of the species.

The Committee discussed whether exotic animal reduction on the island had been successful under the 2004 recovery plan. The Committee **noted** that a regional recovery plan for Christmas Island (currently in preparation) would provide an opportunity to revisit such species recovery actions.

The Committee **requested** that the following amendments be made to the draft conservation advice:

- The following sentence be added to the disclaimer note: 'The Threatened Species Scientific Committee recognises that a Recovery Plan exists for the species under its previous conservation status. Given the change in conservation status for the species to critically endangered the Committee provides the following conservation advice'.
- Under priority recovery and threat abatement actions:
    - that the fifth dot point 'eradicate exotic animals' become the first action.
    - the now second dot point be amended to 'monitor known sites to identify key threats'.

- the third dot point be amended to ‘monitor known sites to identify any amendments in indicators used to estimate relative abundance’.
- the fifth dot point be amended to ‘ensure any amendments in land use do not have direct adverse impacts on known sites important to the species or indirect impacts on the species in other ways’.

- Under regional priority recovery and threat abatement actions:
  - that the third dot point ‘ Develop a management plan for the control and eradication of introduced species such as the Common Wolfsnake and feral cat in the local region’ become the first action.
  - the last sentence be amended to ‘Priority for the development of recovery plan: ‘The Committee recognises that Christmas Island has a number of threatened species requiring recovery actions and continues its support for multi-species plans. The priority for a multi-species recovery plan for Christmas Island is high. For this species the Committee believes that resources should initially be directed towards Action One of the current recovery plan, namely determining or arresting the cause of population decline. The Committee believes that if necessary, the development of radical conservation action may be required. Radical conservation action could include translocation, captive breeding, habitat sterilization, and reintroduction or population supplementation by means yet to be determined’.

In considering the conservation advice the Committee **noted** that given the history of species extinction on Christmas Island, the futility of existing measures may need to be recognised and *ex situ* conservation measures may need to be considered.

The Committee **approved** the amended conservation advice for *Pipistrellus murrayi* (Christmas Island Pipistrelle).

Threatened Species Scientific Committee

MINUTES

Extraordinary Meeting on Christmas Island Pipistrelle

Teleconference – 3 February 2009

Present

Threatened Species Scientific Committee
Associate Professor Bob Beeton (Chair)

Dr Guy Fitzhardinge

Dr Gordon Guymer

Professor Peter Harrison

Dr Bill Humphreys

Dr Rosemary Purdie

Dr John Woinarski

Associate Professor Keith Walker

Department of the Environment, Water, Heritage and the Arts

Ms Kerry Smith

Mr Mark Flanigan

Mr Peter Latch

Mr Saravan Peacock

Mr Matthew White

Ms Meryl Triggs

Ms Anne Marie Delahunt

Mrs Leanne O'Donohue

Apologies

Dr Andrea Taylor

Dr Tony Lewis

Agenda Item 1

WELCOME

The Chair welcomed Committee members and Departmental officers to the teleconference.

Agenda Item 2

Christmas Island PIPISTRELLE

The Chair noted the attachments sent to the Committee and asked for preliminary comments from the members on the Supplementary Paper prepared by the Chair, Associate Professor Bob Beeton.

- A summary of the comments from members are as follows:
    - There are a variety of concerns for biodiversity in general on Christmas Island
    - There are some questions about the taxonomic status of the Christmas Island Pipistrelle, and its distinctiveness from other similar bats
    - The reasons for the decline of the Christmas Island Pipistrelle are unknown
    - A captive breeding program may be an option
    - There are risks involved in a captive breeding program
    - A mainland captive breeding program could be used to test a Christmas Island Pipistrelle program
    - Funding could be usefully directed to conserving Christmas Island biodiversity in general rather than a large investment in just one species
- Anne-Marie Delahunt introduced the Departmental Paper and discussed the following issues:
    - Decline in biodiversity on Christmas Island
    - There are a variety of threat abatement, recovery and management programs already operating on Christmas Island eg to abate threats from Yellow Crazy Ants
    - Dealing with existing and historical mining impacts on the Island
    - Christmas Island is outside the Australian quarantine zone, so moving bats to the mainland is difficult
    - Singapore Zoo is not currently interested in a breeding program for the Christmas Island Pipistrelle

The Committee then discussed the following:

- Mining dust and the effects on the species
- Impacts of Detention Centre lighting on food sources (insects) for the Christmas Island Pipistrelle

- Survey efforts in areas other than known sites
- Questions about reliability of population data
- Questions on the methodology of surveys
- Analysis of old roost sites for possible reasons for decline
- Need to determine more about the generation time of the species
- Captive breeding facility on Christmas Island may be an opportunity to benefit other species
- There seem to be a low number of pipistrelles for a captive breeding program and there are potential capture risks associated with such a program
- Although there are some captive micro-bats knowledge of husbandry is seems to be insufficient to base a captive breeding program of such sensitivity on
- The use of baiting for Crazy Ants and the effects of this on other species
- Other invasive species on Christmas Island
- Reduction of available options due to small numbers left
- Mortality issues and possibility of gaining more information via autopsies/droppings before anything else is done
- Possibility of having a dedicated Biologist on Christmas Island
- Make-up of Expert Committee

Conclusion

The Committee **assessed** the information provided on the condition of biodiversity on Christmas Island, including the Christmas Island Pipistrelle, and formed the opinion that there is no realistic chance, in the timeframe available, that management of the Christmas Island environment will improve the chances of survival of the Christmas Island Pipistrelle in the wild. Consequently, extinction in the wild of the Christmas Island Pipistrelle is almost inevitable.

The Committee **discussed** the options for the Christmas Island Pipistrelle and concluded that there were two options, either to allow the current trend to continue, probably to extinction, or consider a captive breeding program which, of itself, may not prevent extinction.

The Committee **assessed** the proposed captive breeding program based on all the information provided to it. The Committee was concerned about the risk of failure of a highly experimental program in the absence of key information. An additional concern was the likely small founder population that would be involved.

The Committee **discussed** a five stage process which would address the continued decline of Christmas Island biodiversity in general and minimize the risks associated with an immediate Christmas Island Pipistrelle captive breeding program and increase the probability of success of such a program if undertaken.

The Committee **recommends**:

1. **An immediate review by an expert committee of threats to biodiversity on Christmas Island, including the Christmas Island Pipistrelle, and the development of priority setting protocols by the expert committee. This should inform the development of the Regional Recovery Plan currently under way.**
2. An intensification of threat identification and abatement for all island biodiversity based on priorities identified by the expert committee at its first meeting.
3. The immediate implementation of a test captive breeding program on *Pipistrellus westralis* on the mainland. This is an abundant and secure mainland species closely related to the Christmas Island Pipistrelle and occupying similar habitat. The objectives, within three months, should be to prove that the safe capture of individuals is possible and to identify optimal husbandry requirements for the species. Subsequently, captive breeding should be tested, along with other relevant threat management strategies.
4. The immediate intensification of survey work on the island under rigorous protocols which minimise the threats of this work to the Christmas Island Pipistrelle and other threatened species. This should be oversighted by the expert committee referred to above.
5. The immediate commencement of preparations for a possible Christmas Island Pipistrelle captive breeding program on Christmas Island with a decision on whether to proceed being dependent on the outcomes of the mainland proof of concept study and the results of further survey work on Christmas Island. This decision should be recommended to the Minister by the Department following an appropriate risk assessment.

The Committee agreed **that the advice would be checked by the Department and sent to the Minister.**

Agenda Item 3

Brief update on submission to EPBC Act review

The Committee **agreed** to discuss the EPBC Act Review at the 38th TSSC meeting.

Close of Meeting

The Chair thanked Committee members and Departmental staff for a successful teleconference.

I declare, on behalf of the Committee, that these Minutes are a true and accurate record of the teleconference.

Associate Professor Bob Beeton *AM FEIANZ*

Chair

Ministerial Press release

MEDIA RELEASE

The Hon Peter Garrett MP

Minister for the Environment, Heritage and the Arts

PG /211 16 February 2009

MINISTER TAKES FURTHER ACTION ON PIPISTRELLE DECLINE

Environment Minister Peter Garrett has accepted the recommendations of Australia's leading

threatened species experts - the Threatened Species Scientific Committee (TSSC) – for further

urgent action on the Christmas Island pipistrelle bat.

The Committee has recommended actions to address the continued decline of Christmas Island

biodiversity and to minimise the risks associated with a captive breeding program for the pipistrelle.

"Sadly, the Committee has confirmed what we feared, that the pipistrelle is in severe decline and that extinction in the wild is almost inevitable," Mr Garrett said.

"We are now at a critical stage. Despite some $470,000 spent over the last five years under the recovery plan and around $4 million spent slashing the numbers of yellow crazy ants which are the biggest threat to biodiversity on the island, combined with the huge efforts by park managers and independent scientists, these actions have so far failed to reverse its rapid decline.

"Unfortunately, the Threatened Species Scientific Committee has also advised me that there is a high risk associated with a proposed captive breeding program for the pipistrelle with so few left on the island. The bats are also very difficult to catch and no-one knows how to keep them alive for breeding.

"The Committee have informed me that they are aware of no captive breeding program for microbats undertaken anywhere in the world – we are on new ground here.

"I therefore accept that there are unacceptably high risks involved in embarking on an immediate captive breeding program .

"However, on the Committee's recommendation, a trial program on a closely related species, *Pipistrellus westralis*, will begin as soon as possible. This bat is abundant and secure in the top end of the Northern Territory and I am pleased the Northern Territory Government will work with us on this project.

“The objective, within three months, is to demonstrate safe capture methods and to identify optimal

husbandry requirements of the species.

“At the same time, the Director of National Parks is preparing for a potential captive breeding program on Christmas Island, in the event that the mainland trial is successful.”

Mr Garrett said TSSC chair Associate Professor Bob Beeton had agreed to chair an experts group, which will meet on island within the next few weeks to review the threats to biodiversity across the entire of Christmas Island.

“These experts will identify priorities to protect all the island’s biodiversity, so that actions to intensify threat identification and abatement feed into the Regional Recovery Plan that is currently under development.

”We will do whatever is practical and feasible to save the pipistrelle, even though it is the case that bat numbers on the island have been in rapid decline for around 14 years now for reasons that are not clear. I am deeply concerned by the fact that its prospects do not appear bright on the basis of our current understanding of the situation.”

Media contact: Ben Pratt 0419 968 734

Appendix 2

Expert Working Group – Program of on-island meeting

March 30th – April 3rd 2009

Date	Time	Venue	Item	
Mon 30th March	2.30 *pm*	-	Flights arrive from Perth	Marjorie Gant, Park Manager
	3.30 *pm* to 5.30 *pm*		Orientation drive around island Landscape scale overview including Margaret Knoll, Blowholes, DIAC lookout, North East Point, South point and mined sites. Pipistrelle site area (start of Winfred Track)	Parks staff to guide
	6.30 *pm*		Working Dinner - EWG (Rumah Tingi)	EWG and relevant Park staff
Tues 31st March	8.30 – 9.30 am	Recreation Centre	Staff meeting and discussion Introduction of EWG to park staff EWG meeting aims & anticipated outcomes Brief overview of Park (e.g. native and invasive species, YCA, CIMFR, Tourism, marine areas, GIS, management arrangements)	Relevant Park staff
	9.30am – 9.45 am	Recreation Centre	Morning Tea	
	9.45-12.30 pm	Field Trip	Crazy ant super-colony site visits and discussions IWS methodology YCA program	Relevant Park staff.
	12.30-1.30 pm	Recreation Centre	Working Lunch	

Date	Time	Venue	Item	
Tues 31st March	1.30–4.30	Recreation Centre	EWG meeting Threats to Biodiversity discussion of data, and theories	Relevant Park staff.
	4.30-9.00 pm	Field Trip Picnic dinner provided	*P. murrayi* foraging area L22 from 1745 to 2100 hrs *Nocturnal search for geckos and centipedes*	Norm, Andrew & others with relevant Park staff
Wed 1 April	3.30-7.00 Am	Field Trip	*P.murrayi* roost 565 to assess roost condition, record echolocation and assess numbers Predawn head torching	Norm, Gordon and Ric
	8.30 - 10.30	Shire training room	EWG meeting General discussion with staff about threats to biodiversity on island	Relevant Park staff
	10.30 am - 11.00 am	Shire training room	Morning Tea	
	1.30–4.30		EWG meeting	Relevant Park staff
	4.30-9.00 pm	Field Trip Picnic dinner provided	Pipistrelle spotlighting and echolocation survey in 'The Dales' and around the detention centre	Relevant Park staff
Thursday 2 April	8.30am – 12.30 am	Recreation Centre	With Staff - key issues	Relevant Park staff
	1300 to 4.00		Island Ecology	Relevant Park staff then EWG
	4:00 6:00		Community meeting	
	6.30 -	Final dinner	EWG with key staff	Relevant Park

Date	Time	Venue	Item	
	9.00 pm			staff
Friday	8:30 12:00	Recreation centre	Discussion of issues and report framework	EWG

Appendix 3

Introduced biota of Christmas Island

Introduced fauna found on Christmas Island

Species name	Common name	Comments
MAMMALS – 4 species		
Rattus rattus	Black rat	arrived 1899
Mus musculus/domesticus	House mouse	
Felis catus	Feral cat	widespread
Canis familiaris	Dog (feral and domestic)	few remaining around settlement
REPTILES – 7 Species		
Hemidactylus frenatus	Asian House (Barking) Gecko	
Gehyra mutilata	Pacific Gecko/House Gecko	
Ramphotyphlops braminus	Flowerpot Snake	primarily fossorial
Lycodon aulicus capucinus	Asian Wolf Snake	arrived ~1987
Ramphotyphlops braminus	Black Blind Snake	
Lygosoma bowringii	Grass skink	
	terrapins ? species	in the tank at Ross Hill Gardens
BIRDS – 4 Species		
Gallus gallus	Domestic fowl	
Anas platyrhynchos	Domestic duck	
Meleagris gallopavo	Domestic turkey	
Padda oryzivora	Java sparrow	arrived 1908-1923
Passer montanus	Tree sparrow	arrived 1980s
FRESHWATER FISH – 6 Species		
Scleropages formosus	Asian Bony Tongue	
Eleotris fusca	Brown Gudgeon	
Oreochromis sp.	Tilapia	
Poecilia reticulata	Guppy	
Gambusia affinis	Mosquito fish	

Species name	Common name	Comments
Xiphophorus maculatus	Swordtail	
ARTHROPODS– 70+ Species		
Ants– More than 50 species listed in following table		
Other insects		
Apis mellifera	honeybee	
Periplaneta americana	cockroach	
	termites (2 species)	
	fruit fly (4 species)	
	scale insects (at least 4 species)	
Centipedes and Millipedes		
Scolopendra morsitans	giant centipede	
Asiomorpha coarctata	a millipede	
Prosopodesmus jacobsoni	a millipede	
Cylindrodesmus hirsutus	a millipede	
Solaenaulus butteli	a millipede	
Leptogoniulus sorornus	a millipede	
Trigoniulus corallinus	a millipede	
Hypocambala exocoeti	a millipede	
Spiders (incomplete list)		
Oecobius navus Blackwall, 1859 *Artema atlanta* Walckenaer, 1837 *Crossopriza lyoni* (Blackwall, 1867) *Smeringopus pallidus* (Blackwall, 1858) *Heteropoda venatoria* (Linnaeus, 1767) *Achaearanea tepidariorum* (C.L. Koch, 1841) *Latrodectus geometricus* C.L. Koch, 1841 **Schizomids** *Schizomus lunatus* Gravely, 1911		
Molluscs – 22 Species		
Achatina fulica	Giant African Land	

Species name	Common name	Comments
	Snail	
Bradybaena similaris		
Cecilioides sp.		
Discocharopa cf. *aperta*		
Elasmias manilensis		
Georissa williamsi		
Gulella (*Huttonella*) *bicolor*		
Lamellaxis gracilis		
Liardetia (*Belopygmaeus*) *doliolum*		
Liardetia (*Liardetia*) *scandens*		
Melampus castaneus		
Melampus fasciatus		
Melampus luteus		
Opeas pumilum		
Paropeas achatinaceum		
Pupisoma orcula		
Pupisoma sp.		
Rhachis punctata		
Semperula sp.		
Subulina octona		
Succinea listeri		
Tornatellinops sp.		

Non-indigenous ant species recorded on Christmas Island

(Framenau & Thomas, 2008)

Indo-Aust = widespread in the Indo-Australian region

Invasive = considered one of the most ecologically damaging introduced ants

Tramp = widespread distribution around the globe

Amblyoponinae	**Myrmicinae**	**Ponerinae**
Amblyopone zwaluwenburgi (Tramp)	*Cardiocondyla kagutsuchi* (Indo-Aust)	*Anochetus* sp. (Indo-Aust, Tramp)
Cerapachyinae	*C. wroughtonii* Tramp)	*Hypoponera confinis* (Indo-Aust)
Cerapachys biroi (Tramp)	*Monomorium destructor* (Tramp)	*H. opaciceps* (Tramp)
C. longitarsus (Indo-Aust)	*M. floricola* (Tramp)	*H. punctatissima* (Tramp)
Dolichoderinae	*M. latinode*	*Leptogenys falcigera* (Tramp)
Ochetellus sp. (Tramp)	*M. orientale*	*L. harmsi* (Indo-Aust)
Tapinoma melanocephalum (Tramp)	*M. pharaonis* (Tramp)	*Odontomachus simillimus* (Indo-Aust)
Tapinoma sp. (Indo-Aust)	*M. cf. subcoecum*	*Pachycondyla* (*Brachyponera*) *christmasi* (Indo-Aust)
Technomyrmex vitiensis (Tramp)	*Pheidole megacephala* (Invasive)	*Brachyponera christmasi*
Formicinae	*Pheidole* sp. (*variabilis* group) (Indo-Aust)	*Pachycondyla* (*Trachymesopus*) *darwinii* (Indo-Aust)
Anoplolepis gracilipes (Invasive)	*Pheidole* sp. (Indo-Australian)	*Platythyrea* sp. (Indo-Aust)
Camponotus sp (Indo-Aust)	*Pyramica membranifera* (Tramp)	*Ponera swezeyi* (Tramp)
C. melichloros (Indo-Aust)	*Solenopsis geminata* (Invasive)	
Camponotus sp. (Indo-Aust)	*Strumigenys emmae* (Tramp)	
Paratrechina bourbonica (Tramp)	*S. godeffroyi* (Tramp)	
P. longicornis (Tramp)	*Tetramorium bicarinatum* (Tramp)	
Paratrechina sp. (Tramp)	*T. insolens* (Tramp)	
Paratrechina sp. (Tramp)	*T. lanuginosum* (Tramp)	
P. vividula (Tramp)	*T. pacificum* (Indo-Australian, Tramp)	
Plagiolepis alluaudi (Tramp)	*T. simillimum* (Tramp)	
P. exigua	*T. cf simillium*	
Leptanillinae	*T. smithi*	
Leptanilla sp	*T. walshi*	

Introduced plants of Christmas Island

Weeds grouped as trees, shrubs, vines and herbs, and ranked in 3 classes of risk (where 1 is the highest) for each of 3 vegetation types on Christmas Island. The shaded species are those that are high risk in all forest types (From CINP Draft Weed Strategy).

Species and Life-form	**Risk Rating**		
Trees	**Tall Evergreen forest**	**Semi-deciduous forest & deciduous scrub**	**Disturbed/regenerating areas**
Adenanthera pavonia	1	1	1
Aleurites moluccana	1	1	1
Barringtonia asiatica	2	1	1
Castilla elastica	1	1	1
Ceiba pentandra	2	1	1
Clausena excavata	1	1	1
Delonix regia	1	1	1
Ficus elastica	2	2	2
Hevea brasiliensis	1	1	1
Jatropha curcas	2	2	1
Leucaena leucocephala	2	1	1
Manihot glazvoii	2	1	1
Melia azaderach	1	1	1
Muntingia calabura	2	2	1
Piper aduncum	2	1	1
Pithocellobium dulce	2	2	1
Psidium spp.	1	1	1
Pterocarpus indicus	1	1	1
Senna sulphurea	3	2	1
Spathodea campanulata	1	1	1
Syzygium spp.	1	1	1
Shrubs			
Cordia curassavica	2	1	1
Hyptis capitata	3	1	1
Tecoma stans	2	1	1
Tithonia diversifolia	2	1	1
Pluchea indica	3	2	1
Vines			
Antigonon leptopus	1	1	1
Calopogonium spp.	3	2	1
Centrosema pubescens	2	1	1
Ipomoea cairica	3	2	1

Ipomoea nil	3	2	1
Macroptilium atropurpureum	2	1	1
Mikania micrantha	2	2	1
Mucuna albertisii	1	1	1
Paederia foetida	2	2	1
Herbs			
Parthenium hysterophorus	3	1	1
Cenchrus echinatus	3	1	1
Mimosa spp.	3	2	1

Appendix 4

Native biota of Christmas Island

Native and endemic fauna found on Christmas Island

Species Name	Common Name	Status	Abundance
RESIDENT LAND, FRESHWATER AND SHOREBIRDS			
Accipiter fasciatus natalis	Christmas Island Goshawk	endemic	uncommon
Amaurornis phoenicurus	White-breasted Water-hen	self-introduced	uncommon
Chalcophaps indica natalis	Emerald Dove (Christmas Island)	endemic	common
Collocalia esculenta natalis	Christmas Island Swiftlet	endemic	abundant
Ducula whartoni	Christmas Island Imperial Pigeon	endemic	common
Egretta novaehollandiae	White-faced Heron	self-introduced	rare
Egretta sacra	Eastern Reef Egret	native	rare
Falco cenchroides	Australian Kestrel	self-introduced	common
Gallus gallus	Feral Fowl	introduced	common
Ninox natalis	Christmas Island Hawk-owl	endemic	uncommon
Passer montanus	Tree Sparrow	self-introduced	common
Turdus poliocephalus erythropleurus	Christmas Island Thrush	endemic	common
Zosterops natalis	Christmas Island White-eye	endemic	abundant
BREEDING SEABIRDS			
Anous stolidus	Common Noddy	native	common
Fregata andrewsi	Christmas Island Frigatebird	endemic	uncommon
Fregata ariel	Least Frigatebird	native	rare
Fregata minor	Great Frigatebird	native	common
Papasula abbotti	Abbott's Booby	endemic	uncommon
Phaethon lepturus fulvus	Golden Bosun	endemic	common
Phaethon rubricauda	Silver Bosun	native	common
Sula leucogaster	Brown Booby	native	common
Sula sula	Red-footed Booby	native	common
REGULAR MIGRANTS AND OCCASIONAL VISITORS			
Actitis hypoleucos	Common Sandpiper	regular migrant	
Apus pacificus	Fork-tailed Swiflet	regular visitor	
Ardea alba	Great Egret	occasional visitor	
Arenaria interpres	Ruddy Turnstone	regular migrant	

Species Name	Common Name	Status	Abundance
Bulweria bulwerii	Bulwer's Petrel	occasional visitor	
Charadrius leschenaultii	Greater Sand Plover	rare migrant	
Charadrius veredus	Oriental Plover	rare migrant	
Chlidonias hybrida	Whiskered Tern	occasional visitor	
Cuculus saturatus	Oriental Cuckoo	rare migrant	
Gallinago stenura	Pin-tailed Snipe	occasional visitor	
Glareola maldivarum	Oriental Pratincole	rare migrant	
Gorsachius melanolophus	Malay Night-heron	occasional visitor	
Hirundo rustica	Barn Swallow	common migrant	
Motacilla cinerea	Grey Wagtail	common migrant	
Motacilla flava	Yellow Wagtail	common migrant	
Pluvialis fulva	Pacific Golden Plover	regular migrant	
Stiltia isabella	Australian Pratincole	occasional visitor	
Tringa glareola	Wood Sandpiper	rare migrant	
Tringa nebularia	Greenshank	rare migrant	
MAMMALS			
Crocidura attenuata trichura	Christmas Island Shrew	endemic	rare, possibly extinct
Pipistrellus murrayi	Christmas Island Pipistrelle	endemic	rare
Pteropus melanotus natalis	Christmas Island Flying-fox	endemic	uncommon
Rattus macleari	Maclear's Rat	endemic	extinct
Rattus nativitatis	Bulldog Rat	endemic	extinct
REPTILES			
Chelonia mydas	Green Turtle	native	uncommon
Cryptoblepharus egeriae	Blue-tailed Skink	endemic	rare, declining
Cyrtodactylus sadleiri	Giant Gecko	endemic	common
Emoia atrocostata	Foreshore Skink	native	rare, declining
Emoia nativitatis	Forest Skink	endemic	rare, declining
Eretmochelys imbricata	Hawksbill Turtle	native	rare
Lepidodactylus listeri	Tree Gecko	endemic	rare, possibly extinct
Typhlops exocoeti	Pink Blind Snake	endemic	rare, possibly extinct
LAND AND SHORELINE CRABS			
Birgus latro	Robber Crab	native	
Chiroantes obtusifrons	Yellow-eyed Crab	native	

Species Name	Common Name	Status	Abundance
Coenobita brevimanus	Purple Hermit Crab	native	
Coenobita perlatus	Red Hermit Crab	native	
Coenobita rugosus	Tawny Hermit Crab	native	uncommon, widespread, arboreal
Cyclograpsus integer	Sandy Rubble Crab	native	common, crevices high in seacliffs beyond tidal or salt spray, around coast
Discoplax hirtipes	Blue Crab	native	common, beaches and shore terraces
Epigrapsus politus	Brown Crab	native	common, rubble beaches
Gecarcoidea lalandii	Purple Crab	native	common, beaches and shore terraces
Gecarcoidea natalis	Red Crab	endemic	rare, restricted to rubble buried in sand at Greta and Ethel beaches
Geograpsus crinipes	Yellow Nipper	native	uncommon, moist areas with water seepages
Geograpsus grayi	Little Nipper	native	rare, beach sand/rubble boundary on forest soil, usually under rocks
Geograpsus stormi	Red Nipper	native	rare, distributed island-wide
Grapsus tenuicrustatus	Grapsus Crab	native	abundant, distributed island-wide
Labuanium rotundatum	White-striped Crab	native	uncommon, lower terraces, seacliff and beaches
Metasesarma rousseauxi	Mottled Crab	native	common,

Species Name	Common Name	Status	Abundance
			distributed from shore terrace to plateau
Ocypode ceratophthalma	Horn-eyed Ghost Crab	native	rare, under shoreline rocks and in crevices on the seacliff near water
Ocypode cordimanus	Smooth-handed Ghost Crab	native	common, sandy beaches
Ptychognathus pusillus	Freshwater Crab	native	uncommon, restricted to fresh running water
Sesarmoides jacksoni	Jackson's Crab	endemic	rare, cool moist areas on lower terraces, in caves
TERRESTRIAL SNAILS			
Assiminea andrewsiana		endemic	uncommon, isolated small colonies near coast
Assiminea sp.		endemic	associated with permanent springs
Charopa sp.		endemic?	rare
Georissa aff. *williamsi*		unknown	presumed extinct
Georissa sp.		unknown	common in rainforest on plateau, partly arboreal
Japonia wallacei		native	common in central plateau and upper terraces, on palms, pandanus and trees with smooth bark
Kaliella cruda		native?	unknown

Species Name	Common Name	Status	Abundance
Lamprocystis mabelae		endemic?	unknown
Lamprocystis mildredae		endemic	restricted distribution, common in primary rainforest, leaf litter and under logs
Lamprocystis normani		endemic	restricted distribution, rare in primary rainforest, leaf litter and under logs
Nesopupa proscripta		endemic	common, partly arboreal, on trees with smooth bark
Pythia scarabaeus		native?	common in moist leaf litter near the coast and springs
Succinea solidula		endemic	common in rainforest on central plateau and upper terraces
Succinea solitaria		endemic	rare, limestone boulders and cliffs in open or partially shades on lower eastern slopes
Truncatella guerinii		native	abundant in gravel and leaf litter

Plant species that are endemic to CI, listed as threatened under the EPBC Act, and/or are considered to be of concern

Species Name	Common Name	Endemic	Conservation status	Threats
Abelmoschus manihot var. *pungens*	a shrub			weeds
Abutilon listeri	Lantern Flower	endemic		
Amaracarpus pubescens	a shrub			none known
Arenga listeri	Christmas Island Palm	endemic	not of concern	
Asplenium listeri	Christmas Island Spleenwort	endemic	CR	disturbance (mining)
Asystasia alba	a herb	endemic		predation by crabs; weeds
Balanophora abbreviata	a herb			none known
Blumea balsamifera	Camphor Bush			
Blumea lanceolaria	a herb			predation by crabs; weeds
Brachypeza archytas	an epiphytic orchid	endemic	not of concern	
Bryobium pubescens	an epiphytic herb			
Cinnamomum iners	Wild Cinnamon			
Cleome gynandra	an annual herb			
Colubrina pedunculata	a shrub	endemic		none known
Commicarpus chinensis ssp. *chinensis*	a subshrub			
Cycas rumphii	Cycad			weeds
Cynometra ramiflora	Wrinklepod Mangrove			stress during dry periods
Dendrocnide peltata var. *murrayana*	Stinging Tree	endemic		none known
Dicliptera maclearii	a herb	endemic		predation by crabs; weeds
Didymoplexis pallens	an orchid		possibly extinct	

Ficus saxophila	a fig tree			
Flickingeria nativitatis	an epiphytic orchid	endemic		
Grewia insularis	a tree	endemic		none known
Hibiscus vitifolius	a herb		possibly extinct	
Hoya aldrichii	Hoya Vine	endemic	not of concern	
Huperzia phlegmaria	Common Tassel Fern			none known
Illigera elegans	a vine	endemic		none known
Ischaemum nativitatis	Christmas Island Duck-beak	endemic		none known
Jacquemontia paniculata	a twining herb			
Leptochilus decurrens	a fern			none known
Leucas zeylandica	a herb			none known
Lycianthes biflora	a herb			
Meullerargia timorensis	a climber			none known
Momordica charantia	an annual climber			
Mucuna pruriens	Velvet Bean			
Pandanus christmatensis	Pandanus, Screw-pine	endemic	not of concern	
Pandanus elatus	Pandanus, Screw-pine	endemic	not of concern	
Peperomia laevifolia	an epiphytic herb			
Peperomia rossii	an epiphytic herb	endemic	possibly extinct	
Phreatia listeri	an epiphytic orchid	endemic		
Pneumatopteris truncata	a fern		CR	predation by crabs
Pteridrys syrmatica	a fern			
Remusatia vivipara	an epiphytic herb		possibly extinct	
Selaginella alutacia	a fern-ally		possibly extinct	
Setaria clivalis	a grass		possibly extinct	
Spermacoce mauritana	an annual herb			
Spondias cytherea	Great Hog Plum			predation by crabs
Strongylodon lucidus	a climbing shrub			none known
Taeniophyllum hasseltii	an epiphytic orchid			none known
Tectaria devexa var. *minor*	a fern		EN	disturbance (mining); weeds
Tectaria dissecta	a fern			

Tectaria sp.	a fern			
Thelasis capitata	an epiphytic orchid			none known
Thrixspermum carinatifolium	an epiphytic orchid			
Triphasia trifolia	Limeberry			none known
Triumfetta suffruticosa	a shrub			
Vitis flexuosa	a climber			weeds
Zehneria alba	a vine	endemic		
Zeuxine exilis	a terrestrial orchid	endemic	possibly extinct	

Conservation status: CR=listed as Critically Endangered; EN=Endangered; possibly extinct=not recorded on Christmas Island for >100 years.

Threats: modified from Parks Australia (2008). Where no threat is given, no account of the species was presented in Parks Australia (2008).

Population Estimates of Christmas Island Birds

Species	**Population estimate**			
	by van Tets (1975) [pairs]	by Garnett & Crowley (2000)	by Corbett et al. (2003)	Johnstone and Darnell (2004)
Golden Bosunbird	10 - 100	20,000	-	
Christmas Island goshawk	10 - 100	150	-	
Christmas Island imperial pigeon	10 - 100	1,000	35,000 – 66,000	
Christmas Island emerald dove	100 - 1000	5,000	900 – 3,500	about 1000 pairs
Christmas Island swiftlet	100,000 – 1,000,000	5,000	-	
Christmas Island thrush	100,000 – 1,000,000	4,000	20,000 – 50,000	
Christmas Island white-eye	100,000 – 1,000,000	20,000	80,000 – 170,000	

List of extinct Australian birds

(noting that all but one of these are island species)

Scientific name	Common name	Former distribution
Dromaius novaehollandiae diemensis	Emu (Tasmanian subsp.)	Tasmania
Dromaius ater	King Island emu	King Island
Dromaius baudinianus	Kangaroo Island emu	Kangaroo Island
Gallirallus philippensis macquariensis	Buff-banded rail (Macquarie subsp.)	Macquarie Island
Rallus pectoralis clelandi	Lewin's rail (Western Australian subsp.)	Western Australia
Porphyrio albus	White gallinule	Lord Howe Island
Columba vitensis godmanae	White-throated pigeon (Lord Howe subsp.)	Lord Howe Island
Gallicolumba norfolciensis	Norfolk Island ground-dove	Norfolk Island
Hemiphaga novaezelandiae spadicea	New Zealand pigeon (Norfolk subsp.)	Norfolk Island
Psephotus pulcherrimus	Paradise parrot	Queensland
Cyanoramphus cookii	Tasman parakeet	Lord Howe Island, Norfolk Island
Cyanoramphus novaezelandiae erythrotis	Red-crowned parakeet	Macquarie Island
Nestor productus	Norfolk Island kaka	Norfolk Island
Ninox novaeseelandiae albaria	Southern boobook (Lord Howe subsp.)	Lord Howe Island
Dasyornis broadbenti litoralis	Rufous bristlebird (western subsp.)	Western Australia
Gerygone insularis	Lord Howe gerygone	Lord Howe Island
Rhipidura fuliginosa cervina	Grey fantail (Lord Howe subsp.)	Lord Howe Island
Lalage leucopyga leucopyga	Long-tailed triller (Norfolk subsp.)	Norfolk Island
Zosterops strenuus	Robust white-eye	Norfolk Island
Zosterops albogularis	White-chested white-eye	Norfolk Island
Turdus poliocephalus poliocephalus	Grey-headed blackbird	Norfolk Island
Turdus poliocephalus vinitinctus	Vinous-tinted thrush	Lord Howe Island
Aplonis fusca fusca	Tasman starling (Norfolk subsp.)	Norfolk Island
Aplonis fusca hulliana	Tasman starling (Lord Howe subsp.)	Lord Howe Island

Appendix 5

Map of phosphate exploration gridlines bulldozed in 1960

Appendix 6

Documentation list

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Claussen (pers. comm.)

Retallick (pers. comm.)

Woodside (pers. comm.)

Australasian Bat Society (pers. comm.)

Fisher (pers. comm.)

Duffy (pers. comm.)

Appendix 7

Ecophysiology of Pipistrellus murrayi

Table 1 Airframe parameters, flight muscle-mass and heart-mass fractions, and field metabolic requirements of *Pipistrellus murrayi* (Pm) compared to other small tropical bats of similar design, P. westralis,(Pw) *Vespedalus caurinus* (Vc), and known foraging ecology (N.McKenzie & R.Bullen measurements and modelling).

--	relevance	Pm	Pw	Vc	Kimberley fauna
Aspect Ratio		6.24	6.08	6.29	5.8 – 8.4
Wing Loading (g/cm^2)		3.83	3.77	3.96	4.0 – 11.5
TEAR	agility	13.3	13.6	15.0	2.8 – 41.8
Flight muscle ratio (%)	flight cost	10.1	10.1	14.3	10 – 22
Heart mass ratio (%)	aerobic	0.98	0.98	0.72	
F_{peakC} (kHz)	optimum prey length	48.5*	46.0	62.0	
Model Results:					
Max aerobic flight speed (cruising, kph)	foraging	14.0	14.5	14.7	13 – 29
Max sustainable anerobic speed (max cruise, kph)	maximum commuting (marathon)	23	23.9	25.8	
Optimum prey-length or -wingspan (mm)		7.0	7.4	5.5	
Assumed prey capture rate		1 per 64 sec	1 per 70 sec	1 per 32 sec	
FMR (lactating, pre-weaning) (kJ/day)		25.4	27.5	24	

* measured 1 April 2009

Table 1 Daily time-energy budget to meet metabolic requirement

	Pm, Pw & Vc same		
Reproductive condition	normal	early preg	lactating
Day roosting inactive hrs	12	12	9.5
Day roost active hrs	8.5	8.5	8
Night roosts	1	1	0.5
Time commuting	0.5	0.5	0.5
Time foraging	2	2	5.5

Appendix 8

Pipistrelle Detector Database records

The working group interrogated Christmas Island Pipistrelle data collected on acoustic bat detectors that have been deployed around Christmas Island over recent years. This is in the form of a large spreadsheet of 3972 datapoints and is available on request.

Appendix 9

Comments on captive breeding of Pipistrellus murrayi

Bat scientist supportive of captive breeding

The working group received advice from Dr Dedee Woodside who introduced bat husbandry and bat breeding to the zoo community in Australia. This has included insectivorous bats of four species that are now to F3 with two re-introduction programs for *Nyctophilus gouldi* and *Macroderma gigas* now about F5 or F6. Dr Woodside wrote many bat husbandry protocols, and offered to arrange for Australian zoos to assist with captive breeding for *P. murrayi*. She also suggested that some genetic material should be stored in the wildlife registry in case of surrogate breeding opportunities, and as part of an insurance strategy while working on protecting habitat and augmenting the in-situ population. Recommendation: genetic material should be collected and stored.

Bat scientist not supportive of captive breeding

Dr Chris Tidemann, in an email to the working group, reported that he had considerable difficulty hand-feeding *P. murrayi* during his visit to the island during the 1980s, when he held individuals in captivity. He commented that, weighing barely 3 g, *P. murrayi* is minute, with extremely fine teeth that are well-suited to a diet of soft-bodied insects, like mosquitoes, but unsuited to dealing with hard-bodied insects, such as mealworms.

Working group's consideration

The working group considers that advice received from the Australasian Bat Society bears on this issue. Dietary studies on this species have revealed 26% of their diet is beetles, with mosquitoes representing only 0.1% (Table 1). The exoskeleton of beetles is considerably harder than the exoskeleton of mealworms, and so as long as relatively small mealworms are used (as recommended by Lumsden and Schulz 2009), the Christmas Island Pipistrelle should be able to readily consume mealworms. Other similar sized species of pipistrelles (*P. westralis* and *P. adamsi*) also consume a substantial proportion (approximately 50%) of hard-bodied insects such as beetles, bugs and cockroaches (see below). There are no physical issues that would prevent the mastication of mealworms by *P. murrayi*

Summary of available dietary information for the Christmas Island Pipistrelle. 1984 data is from Tidemann (1985); 1994 is from Lumsden and Cherry (1997); and 2004 is from DNP unpublished data. (From Lumsden & Schulz 2009).

Prey type	1984	1994	2004
Moths (Lepidoptera)	Present	51.5%	Present
Beetles (Coleoptera)	Present	25.8%	Present
Flying ants (Hymenoptera)	–	21.5%	–
Bugs (Hemiptera)	–	1.1%	Present
Flies (Diptera)	Present	0.1%	Present
Micro-wasps (Hymenoptera)	Present	0	–
Thrips (Thysanoptera)	Present	0	–
Bark lice (Psocoptera)	–	0	Present

Appendix 10

Chronology of Pipistrelle Bat Management Actions and Outcomes

Date	Action	Outcome
1984	First study by Dr Tidemann	Was widespread and common in primary and secondary rainforest. Common in settlement.
1994	Surveys- Dr Lumsden	42 sites sampled Species present at 31% of sites Widespread but patchy in distribution and low numbers Uncommon in NE Indicated that species had declined and contracted
1998	Surveys- Dr Lumsden	Anabat ultrasonic bat detectors used to assess distribution and relative abundance along driven transects. 84 sites sampled Further decline and westward range contraction Disappeared from NE Uncommon in centre of the island Indicated that species had declined and contracted
2002	Christmas Island Phosphate surveys.	Corbett, L, Crome F and Richards G. 2003. Fuana survey of mine lease applications and national park reference areas, Christmas Island, August 2002. Appendix G in CIP (ed). *Drafty Environmental Impact Statenment for the Proposed Christmas Island Phosphate mines (9 sites),* Christmas Island Phosphates, Perth. Undertook a brief study with detectors at 22 sites. They found a further westward contraction of the range and 33% decline since 1998.
2003-2007	Christmas Island Biodiversity Monitoring Program Funded by the Department of Finance and Deregulation and implemented by Parks Australia.	A summary report (with a series of reports on individual species, a species inventory, databases and GIS maps). 2004- 97 fixed stations sampled (44 previously used by Lumsden and 53 new stations) and driving transect largely repeated. Decline in relative abundance.
2004	A national recovery plan for	The primary objectives of the Recovery Plan are:

Date	Action	Outcome
	the Christmas Island Pipistrelle was made under the EPBC Act	a) determine the threatening processes responsible for the decline in the species b) maximise the opportunity for the viability of the species in the wild c) clarify its taxonomic status.
2004-2009	Monitoring- Stationary detectors	Stationary detector monitoring undertaken to assess changes in relative abundance at prime foraging areas. This sampling has been critical in improving understanding of the continuing decline. 2006 Re-sampled 44 of the 1998 sites Recorded at 8 sites Disappeared from >80% of the former range Common in only one area
2005	The Australian Mammal Society and the Australasian Bat Society wrote to the Minister raising concerns about the decline of the Pipistrelle bat and implementation of the recovery plan.	Response by Minister Campbell *"The cause of the rapid decline of the Pipistrelle is not well understood. To reverse the trend requires identification of the actual threat(s) so that mitigating actions can be implemented. Funding was recently allocated under the Natural Heritage Trust to the Arthur Rylah Institute so that research can be carried out into the Pipistrelle's decline. That research will be commencing in December 2005. Ongoing monitoring will also continue as part of the Biodiversity Monitoring Programme together with ongoing implementation of the National Recovery Plan"*
2005	$100,000 Funding has been allocated from the Natural Heritage Trust to researchers at the Arthur Rylah Institute in Victoria to investigate the Pipistrelle's decline.	
2005	*"An interim assessment of the Conservation status and threats of the Pipistrelle"*- one of the internal species reports that fed into the summary report of the Biodiversity Monitoring Report.	It declined in abundance and range by about 75% between 1994 and 2004, and if those trends continue it will be extinct by 2008. The cause(s) of the decline are not known. The BMP has been mapping the distribution and relative abundance of Christmas Island Pipistrelle using bat detectors placed at fixed stations overnight. It appears that the Pipistrelle has declined further since 2004 and is now restricted to the western 10-

Date	Action	Outcome
		15% of Christmas Island..
		The only significant population of Pipistrelles located during 2005 is an area little over 1 km^{-2}, centred on the top of Winifred Beach Track within the National Park boundary (the Winifred Gate).
		The main feeding area is in secondary growth on old mine stockpiles, in mine leases. This area is known as ML 140 and/or field 26.
2005	Test for presence of disease and parasite loading.	A very low white blood cell count was recorded, but the significance of this is not yet understood. Otherwise the population was found to be healthy and free of disease and parasites.
2005-06	Monitoring	9 roosts with 30-40 individuals in each
2005	Meeting between IRPC Project Manager (Department of Finance and Administration) and Department of Immigration and Multicultural and Indigenous Affairs (DIMIA) over potential threats to the Pipistrelle bat and concerns arising from the supply of soil from stockpiles in the area currently used by the bat for feeding (mining leases 138-140).	95% of the remaining population feeds in a small area which is centred on ML 140 and adjacent sections of National Park, and extends to parts of ML139 and eastern edge of ML138.
2006	Fly By Night Bat Surveys contracted by Parks Australia to undertake radiotelemetry surveys.	Trapping undertaking at 3 sites. A total of 14 individuals were captured 2males and 12 females. Transmitters were attached to 6 females. 4 of the females tracked to diurnal roosts all under decorticating bark on dead stags. Trees were all located in Sydney Dale.
2006	The Christmas Island Pipistrelle was upgraded from 'Endangered' to 'Critically Endangered'.	
2006	Remote cameras were established on roost trees to look for potential predators.	Up to four infra-red cameras have been used on roost trees in the Sydney Dale areas- shifted in early 2008.
		By April 2006, only three roost sites at two locations remained.
		Cameras identified giant centipede (3 occasions) and black rat (1 occasion) scaling roost trees in

Date	Action	Outcome
		April-May 2006.
2006	Population monitoring using bat detectors continues. The design has been changed in order to set a baseline and monitor trends on finer spatial and temporal scales.	
May 2006	Installation of roost boxes	Parks staff experimentally installed 14 bat roost boxes at 7 locations near known roost trees and former roost trees in the Sydney Dale area.
2007	Arthur Rylah Institute studies	• Total estimated population of the Pipistrelle was only 500 to 1,000 individuals. • The Pipistrelle was found likely to become extinct in several years if current population decline trends continued. • Seven maternity roosts were located, all under loose bark on dead trees. 17 months after they were located, five of the roost trees had collapsed and one had lost its bark. • Only one former maternity roost tree is still inhabited. • Blood tests showed no indication of disease, but further studies are required.
2007	Predator proof known roosts	Protective sleeves were fitted around the remaining roost trees and their adjoining trees and saplings. Infrared cameras were stationed at some of these trees for extended periods. Predator cameras detected three potential predators on roost trees: Black Rats, Giant Centipedes and a Wolf Snake. The sleeves significantly reduced access by potential predators.
2007	Investigation into captive breeding	Parks staff contacted Singapore Zoo and Territory Wildlife Park (Darwin) to make initial investigations into the feasibility and facilities/expertise required for a captive breeding program.
2008	Captive breeding investigations	Parks staff member visited Singapore for further discussions on captive breeding, further advice received from Territory Wildlife Park. As a result of initial discussions, it was determined further information was required on captive breeding options, including quarantine, transport and husbandry issues. Dr Lumsden from the Arthur Rylah Institute was commissioned to provide detailed advice on captive breeding options and in-

Date	Action	Outcome
		situ management of the bats.
2008	Additional monitoring and survey work was undertaken to determine if the Pipistrelles may have moved elsewhere on the Island (every track checked by parks staff)	It was found that the population has contracted to the north western end. 1 detector pass/site/night 99% decline in 14 years.
May 2008	Dr Lumsden of the Arthur Rylah Institute, was contracted to provide advice on captive breeding and in-situ management of the bats.	Report received January 19, 2009 Given the extremely low numbers of Pipistrelle bat now thought to be in existence (less than 20), Dr Lumsden has recommended that a emergency response plan be initiated to capture remaining bats if possible, and initiate a 10 year captive breeding program on Christmas Island. Estimated cost of such a program is $4.9m.
June 2008	Driving detector monitoring	Dr Shultz sampled a total of 66 person hours over 3 nights across the whole island driving every accessible track at <20km/hr. No Pipistrelle were recorded.
July 2008	Driving detector monitoring	Targeted driving and walking surveys were undertaken over 3 nights in the west of the island to focus on areas where the species has been recorded in recent years, A total of 52 person hours and 91km covered by either foot or car. Only 2 Pipistrelle calls were recorded- one pass at the Sydney Dale car park and one within 50m of the Winifred Beach Track gate.
September 2008	Island Wide Survey	84 stationary sites sampled (driver detector sampling). No Pipistrelles were recorded.
2008	PRL engaged Dr Richards who has been working closely with Dr Lumsden, to develop a collaborative approach to accelerate efforts to save the Pipistrelle.	
2008	Application for Caring for Country funding	Unsuccessful.
January 2009	PRL funded Dr Lumsden's field trip to Christmas Island with Dr Richards	
January	Surveys	Bat detectors set at 2 apparently abandoned roosts

Date	Action	Outcome
2009		to determine if they were being re-used. No calls were recorded. Likely that the population comprises less than 20 individuals.
January 2009	Report received on captive breeding options	Dr Lumsden provided her draft report

Appendix 11

Additional information on Fipronil

Fipronil is in a new phenylpyrazole class of neurotoxic insecticides, and disrupts normal nerve function by targeting the γ-aminobutyric acid type A (GABA) receptor system of animals, particularly invertebrates (Kidd and James 1991). It is registered for use in Australia, and the fish-meal bait formulation is permitted for use on Christmas Island by Parks Australia North under emergency permit PER 4091 issued by the Australian Pesticides and Veterinary Medicines Authority.

Fipronil is used to control ants on Christmas Island. Some toxins can concentrate through food chain effects to kill individuals, reduce reproductive success and/or impair sensory system. Following hand-dispersal of baits in 1999-2001, it was found that Fipronil was extremely effective at killing crazy ants; a knock-down effect of at least 99% mortality in forager ants is achieved within a matter of days, and queens begin dying one to two weeks after application. “Super colonies have not re-formed in any areas where the entire infestation was baited, including those baited in October 2000, some 18 months after treatment. However, there are signs of super colony re-formation in some infestations that were only partly baited – crazy ants have reinvaded these sites from adjacent, unbaited areas.”

Consequently, a widespread program of delivery by helicopter was undertaken in Sept 2002, along with plot surveys for subsequent monitoring (aerial drops of a fish-meal based bait over two weeks, with Fipronil at 0.1g / kg as the active ingredient, and commercially named Presto 01®, was broadcast to cover infested areas of forest. In addition the trial tested the use of an ultra-low concentration bait formulation with a view to using it in the future, particularly in areas where ant densities are low). The aim of the trial was to establish that the technique is effective at killing greater than 95% of ants. Presto® 01 Ant Bait is a small, uniform pellet (2 mm x 2 mm x 6 mm).

According to ‘Christmas Island Aerial Baiting Assessment’ (2002), most vertebrates are not affected by fipronil (Rhône-Poulenc 1996), and the compound is classed as a WHO Class II moderately hazardous pesticide (WHO, 1998-1999). Fipronil degrades (without volatility) in the environment in four ways; reduction in the soil produces a sulphide, hydrolysis in soil or water produces an amide, oxidation in the soil produces a sulfone, and direct sunlight slowly degrades fipronil into a desulfinyl photodegradate in either water or soil (Bobe et al. 1998a, Belayneh 1998). The photodegradate is about 10 times more toxic than fipronil itself (U.S. EPA 1998), and reputedly longer lived in the environment. The sulfide, sulfone and desulfinyl photodegradate are known to act at the GABA receptor site and are

biologically active, but the amide elicits no reaction at the GABA receptor site and is not considered to be a biologically active metabolite (Dange 1993).

Peveling (2000a) found severe non-target impacts of fipronil against several species of spiders, bugs, ants, termites, beetles, crickets and grasshoppers. The same study also found severe non-target impacts on a skink (Mabuya elegans) and an iguana (Chalarodon madagascariensis), and it concluded that these impacts were indirect, being the result of a treatment-induced population reduction in termites and other invertebrates, the principal food of these reptiles. The non-target impacts were considered so severe that Peveling (2000a) recommended against the widespread use of fipronil for controlling locusts in Madagascar. The potential impact of the proposed baiting operation on Christmas Island reptiles, both through direct ingestion and indirectly through impacts on their invertebrate prey, is of considerable concern and the feasibility of assessing the impact of the aerial baiting operation on terrestrial reptiles is being considered (Christmas Island Aerial Baiting Assessment 2002).

Fipronil applied as a spray for locust control in Madagascar (at 7.5 g/l) had no impact on the mammal *Geogale aurita* (a tenrec), but did have an adverse impact on another tenrec *Echinops telfairi* due to food chain links (Peveling 2000a).

Toxin load from YC Ant control: "…the chemical option remains controversial in natural areas because of potential persistence in the environment and non-target impacts. This is of special concern on islands that have many endemic species with high conservation value." (O'Dowd, Green & Lake 1999).

"Toxic bait was used to exclude *A. gracilipes* (Yellow Crazy Ants) from large (9-35 ha) forest patches [on CI]. Within 11 weeks, ant activity on the ground and on trunks had been reduced by 98-100%, while activity on control plots remained unchanged" (Abbott and Green 2007).

"Assuming an application rate of 6 kg/ha of high concentration bait over all infested forest (c. 2500 ha), then 1.5 kg of fipronil will be dispersed over sections of the Christmas Island National Park and adjacent vacant crown land ..." (Aerial baiting Referral Document 2002). At no time was the bait be dispersed over forest less than 1 km from the nearest residential dwellings. The work was supervised by a steering committee. Following the baiting trials, a Steering Committee that included the CRC Tropical Rainforest team including Nigel Stork & chaired by CSIRO's Alan Anderson met by teleconference to review progress.

This was followed by plot-monitoring in April 2003 to assess collateral affects on abundance of sub-canopy arthropods (by family) and a sub-set of 5 vertebrate species (2 diurnal fruigivore birds, 2 diurnal mainly insectivorous birds and the Christmas Island gecko) (see Stork et al. 2002). The overall plot sample numbers were relatively small; only the Christmas Island Imperial

Pigeon showed any reduction in numbers at treated vs control plots. Acute fipronil toxicity has been extensively studied in a number of avian species, and so far, only certain groups of gallinaceous birds (pheasants, partridges and quails) have proved to be susceptible to fipronil. The direct risk of the proposed aerial baiting operation to the land-bird community on Christmas Island was rated as extremely low – none are gallinaceous, and all are unlikely to ingest the bait (Aerial baiting Referral Document 2002). In the decade prior to the baiting, the Christmas Island Pipistrelle, which was previously common and widespread on the island, had declined markedly in distribution and abundance, and by 2002 had been classified as Endangered. It was not fully understood what has caused this rapid decline.

Although Stork et al. were aware that there might be immediate (behavioural) or “substantially delayed (via food chain)” effects from insecticides such as Fipronil, neither vertebrate nor invertebrate tissues have been assessed for Fipronil concentrations since the baiting.