# **Threat Abatement Advice for the key threatening process**

## 'Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species'

This Threat Abatement Advice has been developed based on the best available information at the time of development (December 2015). This is not a statutory document. Will be updated as needed. Last updated August 2016 To provide information updates, please email invasivespecies@environment.gov.au

### **Contents**

1. Purpose	.2
2. Description of the key threatening process	.2
3. EPBC Act threatened parrot species	.4
4. Listing Status	.6
5. Documentation relevant to PBFD	.6
6. Priority EPBC parrot species1	0
7. Gaps in knowledge on PBFD1	1
8. Abatement actions for PBFD1	3
9. Information Sources1	7
10. Maps2	20

## **<u>1. Purpose</u>**

The purpose of this threat abatement advice (TAA) is to identify actions and research to abate the key threatening process (KTP): 'Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species' listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The document provides guidance for stakeholders on action and research that may abate the threat. It covers actions at the national, state and local level and is intended for the following audiences:

- individuals or organisations on recovery teams for recovery plans,
- government agencies,
- research organisations,
- avian veterinarians,

- natural resource management groups,
- local communities,
- wildlife carers, and
- interested individuals

Eradication of this ubiquitous disease is not possible at this stage, but further research and mitigation measures can assist in reducing its impact on threatened parrot populations. This TAA, used in partnership with parrot recovery plans, will consolidate the management of Psittacine Beak and Feather Disease (PBFD) impacts on native threatened parrots.

This threat abatement advice for 'Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species' does not necessarily encompass all actions that may abate the KTP, but highlights those that are currently of highest priority.

### 2. Description of the key threatening process

The nomination for listing 'Psittacine Circoviral (beak and feather) Disease' as a Key Threatening Process was originally submitted under the *Endangered Species Protection Act 1992* (ESP Act). Psittacine Beak and Feather Disease affecting endangered psittacine species (parrots and related species) was listed in April 2001 as a key threatening process under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

With beak and feather disease there are terms that describe the clinical disease, these are: psittacine beak and feather disease or psittacine circoviral disease. The terms that refer to the causative agent include: beak and feather disease virus or psittacine circovirus. This is an important distinction because not all birds that are infected with beak and feather disease virus (BFDV), will go on to develop psittacine beak and feather disease, so the terms should not be used interchangeably.

Many aspects of PBFD remain unknown. A categorised list of some of the gaps in our knowledge on PBFD can be seen further on in this document in section 7. PBFD is the most common and highly infectious viral disease among parrots. Its distribution is potentially Australia-wide, including Tasmania.

PBFD is most often seen in young birds up to three years of age; however birds up to 20 years of age have developed clinical signs after years of being clinically normal. PBFD can cause high juvenile mortality; long-term immunological suppression; and feather and beak abnormalities. Known methods of infection include: through crop secretions, fresh or dried excrement and feather and skin particles, as well as passed on through the mother to egg.

The seventeen species of threatened Australian psittacine parrots have small and sometimes isolated populations. They all face significant threats such as habitat loss and predation. Due to the continual

stresses from threats, they are more likely to be susceptible and therefore significantly threatened by a virus, such as beak and feather disease virus, particularly if it affects juveniles and fledging rates.

The time period in which the disease develops varies; it can appear very suddenly (peracute), suddenly (acute) or over a long term (chronic). Peracute or acute disease is most common in young birds. Affected birds rapidly develop non-specific clinical signs which may include crop stasis, regurgitation, weight loss, green diarrhoea and urates, dehydration, weakness, fluffed appearance and swollen or painful wing tips. Acutely affected birds may die suddenly prior to the development of feather abnormalities.

The most common and readily recognisable manifestation of PBFD is the chronic form, characterised by feather and beak abnormalities. Table 1 shows an array of clinical signs that mature parrots may display when affected by PBFD. The first signs in mature birds can occur in the powder down and contour feathers; then the primary, secondary, tail and, if they have them, crest feathers, which become abnormal progressing to total baldness if birds survive long enough.

Clinical Sign	Description
Feather dust absent	Swiping hand between feathers should result in your hand being covered
	with feather dust. PBFD reduces the amount of feather dust produced
	because the contour feathers are not normal.
Shiny beak and feet	Instead of beak and feet being covered in feather dust their true colour is
	revealed.
Abnormal feather	Emerging feathers are small, twisted and very abnormal. Some feathers lack
growth	colour or have a different than normal colour.
Grubby looking	Feather dust cover keeps feathers looking nice and clean, lack of feather dust
	makes birds look very dirty.
Crest loss	Crest feathers missing.
Blood in feather shafts	Developing feathers normally close off blood supply when mature. Feathers
	affected by BFDV do not close off or are fractured, and dried blood can be
	seen in the calamus.
Beak deformed	Deformed beaks and unstable beak integrity.
Tail feathers missing	Some or all tail feathers missing.
Symmetrical wing	After moult, new feathers do not grow. Moult occurs symmetrically.
feather loss	

Table 1: Clinical signs of chronic PBFD for some species

Birds with chronic PBFD may present with some, but not necessarily all clinical signs in Table 1. These clinical signs are variable between species, and as such it is important to be familiar with the appearance of healthy birds so as to accurately evaluate whether a bird has beak and feather disease by their appearance.

These clinical signs do not apply equally to all psittacine species. For example, the absence of feather dust is normal in white cockatoos and galahs; however most black cockatoos do not have powder on their feathers that is visible on your hand after handling. This would also be true of many lorikeets, rosellas and other small parrots. A shiny beak is also normal in some species. Beak deformities caused by PBFD are common in cockatoo species, but less common in other parrots. Images of healthy looking EPBC protected parrots and species information can be seen in Table 2.

## **<u>3. EPBC Act threatened parrot species</u>**

Table 2: The seventeen species of Australian threatened psittacines

Image				
<b>Threatened Parrot Species</b>	Baudin's cockatoo	Carnaby's cockatoo	Coxen's fig parrot	Forest red-tailed black cockatoo
Scientific name	Calyptorhynchus baudinii	Calyptorhynchus latirostris	Cyclopsitta diophthalma coxeni	Calyptorhynchus banksii naso
EPBC status	Vulnerable	Endangered	Endangered	Vulnerable

Image				
<b>Threatened Parrot Species</b>	Glossy black cockatoo	Golden shouldered parrot	Green Rosella	Night parrot
Scientific name	Calyptorhynchus lathami	Psephotus chrysopterygius	Platycercus caledonicus	Pezoporus occidentalis
	halmaturinus		brownii	
EPBC status	Endangered	Endangered	Vulnerable	Endangered

Image					
Threatened	Norfolk Island green parrot	Orange-bellied	Palm Cockatoo	Princess parrot	Red-tailed black
Parrot Species		parrot			cockatoo
Scientific name	Cyanoramphus	Neophema	Probosciger aterrimus	Polytelis alexandrae	Calyptorhynchus banksii
	novaezelandiae cookii	chrysogaster	macgillivrayi		graptogyne
EPBC status	Endangered	Critically	Vulnerable	Vulnerable	Endangered
		Endangered			

Image				
<b>Threatened Parrot Species</b>	Regent parrot	Superb parrot	Swift parrot	Western ground parrot
Scientific name	Polytelis anthopeplus	Polytelis swainsonii	Lathamus discolor	Pezoporus wallicus flaviventris
	monarchoides			
EPBC status	Vulnerable	Vulnerable	Critically Endangered	Critically Endangered

### 4. Listing Status

### A) Under Commonwealth legislation

Psittacine Circoviral (beak and feather) Disease was listed as a KTP under the EPBC Act, as it meets the requirements of sections 188(4) (b) and 188(4) (c) of the EPBC Act, specifically:

- Psittacine Circoviral Disease may cause native species to be listed in a threat category representing a higher degree of endangerment. For example, without preventative action Endangered species may become Critically Endangered.
- The disease adversely affects a number of listed threatened bird species, including the Orangebellied Parrot (*Neophema chrysogaster*) and the Norfolk Island Green Parrot (*Cyanoramphus cookii*), as well as other parrots listed in Table 2.

A *Threat Abatement Plan for Beak and Feather Disease Affecting Endangered Psittacine Species* was prepared in 2005. It contains useful background information, but is no longer considered the most feasible, effective and efficient way to address the key threatening process and is no longer current. Threat abatement will now be achieved through incorporating PBFD actions in individual species recovery plans or conservation advices, as well as the information provided in this advice.

### B) Under state and territory legislation

New South Wales is the only jurisdiction in Australia that has legislation related to PBFD. Beak and Feather Disease affecting endangered psittacine species and populations was listed as a key threatening process under Schedule 3 of the *Threatened Species Conservation Act 1995* on 6 December 2002.

### C) Under New Zealand legislation

In New Zealand, the Department of Conservation (DOC) introduced a national ban on moving parrots from areas with known PBFD exposure to areas of unknown or negative PBFD status in 2009. A nationwide programme investigating the presence of PBFD in native parrots is being led by the DOC with support from the Ministry of Agriculture and Forestry, and a long-term strategy is being developed to manage the risk of PBFD.

In the wild, PBFD is widespread in the North Island amongst exotic parrots, such as sulphur-crested cockatoos and eastern rosellas. The presence of the disease in the South Island is unknown. PBFD has been confirmed in native wild populations of red-crowned parakeets/kākāriki on Hauturu-o-Toi/Little Barrier Island, Tiritiri Matangi Island; and in yellow-crowned parakeets/kākāriki in Fiordland.

### 5. Documentation relevant to PBFD

A number of national and state based policies, strategies and plans have been adopted to provide information on the species threatened by PBFD, including recovery plans, listing assessments and conservation advices described below. There are also several other sources of information which are highly useful. See Table 3 for relevant documents.

1. Recovery plans define the research and management actions necessary to stop the decline of, and support the recovery of, listed threatened species or threatened ecological communities. The aim of a recovery plan is to maximise the long term survival in the wild of a threatened species or ecological community.

- 2. Listing assessments determine if a species or ecological community is eligible for listing as threatened in one of the categories under the EPBC Act, a rigorous scientific assessment of the species or ecological community's threat status is undertaken.
- 3. Conservation advices are developed to assist the recovery of a native species or ecological community when it is listed as threatened under the EPBC Act. They provide guidance on immediate recovery and threat abatement activities that can be undertaken to ensure the conservation of a newly listed species or ecological community. They include practical on-ground activities and may also include broader management actions.

Threatened Parrot Species	Scientific name	Information on PBFD included in documents			
Species with EPBC Act listing Recovery Plans as of 2016					
Baudin's cockatoo	Calyptorhynchus baudinii	Information on PBFD is not contained within this plan			
Carnaby's cockatoo	Calyptorhynchus latirostris	A study was conducted in the 2010 nesting season on prevalence of BFDV in Carnaby's cockatoo			
		nestlings. BFDV was detected in 8.5% of nestlings and in nest material from one nest (9%). The			
		clinical significance of PBFD remains unknown and long-term research of the epidemiology and			
		clinical significance in wild populations is required			
Coxen's fig parrot	Cyclopsitta diophthalma coxeni	Information on PBFD is not contained within this plan			
Forest red-tailed black cockatoo	Calyptorhynchus banksii naso	Information on PBFD is not contained within this plan			
Glossy black cockatoo	Calyptorhynchus lathami halmaturinus	Information on PBFD is not contained within this plan			
Golden shouldered parrot	Psephotus chrysopterygius	Information on PBFD is not contained within this plan			
Green Rosella: link for updates	Platycercus caledonicus brownii	This species does not yet have a Recovery Plan			
Night parrot: link for updates	Pezoporus occidentalis	This species does not vet have a Recovery Plan			
Norfolk Island green parrot	Cyanoramphus novaezelandiae	PBFD was probably responsible for the deaths of many green parrots on Norfolk Island in the 1970s			
	cookii				
Orange-bellied parrot	Neophema chrysogaster	PBFD caused a significant death event during the breeding program in 1991. The relocation of the			
		captive-bred stock to a warmer, more sheltered facility site in Hobart has prevented another outbreak.			
		The disease was detected in wild birds in 1993. A significant number of individuals are antibody			
		positive to PBFD. Sub-clinical effects of PBFD are unknown			
Palm Cockatoo: <u>link</u> for updates	Probosciger aterrimus macgillivrayi	This species does not yet have a Recovery Plan			
Princess parrot: <u>link</u> for updates	Polytelis alexandrae	This species does not yet have a Recovery Plan			
Red-tailed black cockatoo	Calyptorhynchus banksii graptogyne	Information on PBFD is not contained within this plan			
Regent parrot	Polytelis anthopeplus monarchoides	Information on PBFD is not contained within this plan			
Superb parrot	Polytelis swainsonii	Information on PBFD is not contained within this plan			
Swift Parrot	Lathamus discolor	PBFD could potentially have serious implications if the general health of the population is reduced			
		from stress. There may be an increased risk of PBFD through the rehabilitation and release of injured			
		birds back into the wild. There is no capacity to control the interaction of two wild bird populations			
		where their habitats overlap. The prevalence and pathogenicity of the disease is currently not known			
Western ground parrot	Pezoporus wallicus flaviventris	Information on PBFD is not contained within this plan			
	Species with E	PBC Act Listing Assessments as of 2016			
Forest red-tailed black cockatoo	Calyptorhynchus banksii naso	Information on PBFD is not contained within this advice			
Orange-bellied parrot	Neophema chrysogaster	PBFD caused significant death among captive Orange-bellied Parrots during the breeding program in			
		1986-1991. It has also been detected in the wild population. There is a threat of disease transmission			
		within the captive population and into the wild population, through the release of captive-bred birds			
Swift parrot	Lathamus discolor	PBFD is known to affect swift parrots in the wild and in captivity, however its prevalence and			
		pathogenicity is unknown			

### Table 3: Documents related to Australian threatened psittacines and PBFD

Threatened Parrot Species	Scientific name	Information on PBFD included in documents			
Species with EPBC Act Conservation Advices as of 2016					
Forest red-tailed black cockatoo	Calyptorhynchus banksii naso	Information on PBFD is not contained within this advice			
Green Rosella	Platycercus caledonicus brownii	Information on PBFD is not contained within this advice			
Night parrot	Pezoporus occidentalis	Information on PBFD is not contained within this advice			
Palm Cockatoo	Probosciger aterrimus macgillivrayi	Information on PBFD is not contained within this advice			
Princess parrot	Polytelis alexandrae	PBFD is considered one of the main potential threats to this species			
Orange-bellied parrot	Neophema chrysogaster	The species is threatened by stochastic factors such as diseases			
	Species with a state or	territory Threatened Species Information Sheet			
Princess parrot	Polytelis alexandrae	Northern Territory information sheet: PBFD is not contained within this plan			
		Background Documents			
The Australian Government Threat	Abatement Plan for Psittacine Beak and F	Seather Disease Affecting Endangered Psittacine Species and information webpage			
The Australian Government review	of the TAP, <u>Psittacine</u> Beak and Feather	Disease and other identified Threats to Australian threatened Parrots			
The Australian Government Psittacin	e Circoviral (beak and feather) Disease	Factsheet			
		Hygiene Protocols			
The Australian Government Hygiene	Protocols for the Prevention and Contro	l of Diseases (Particularly Beak and Feather Disease) in Australian Birds			
		Australian Bird Groups			
The Parrot Society of Australia Inc.					
Birdlife Australia					
Bird watch Australia					
	Psittacine (	Circoviral (beak and feather) Disease			
A source of general information on I	Sittacine beak and feather disease (PBFI	) by the Australian Government, Department of the Environment			
The key threatening process of Psitta	cine Circoviral (beak and feather) Diseas	se by the Australian Government, Department of the Environment			
The New South Wales Office of Env	ironment and Heritage information on Pl	<u>BFD</u>			
The New Zealand Department of Conservation (DOC) information on PBFD					
Health Resources					
Australian Registry of Wildlife Health was founded at Taronga Zoo in 1985 and has since grown into a diagnostic and resource centre					
Wildlife Health Australia has the head office in Sydney and provides research outcomes to the public					
Standardised Diagnostic Tests is an e	extremely technical document by Murdoc	ch University, an avian veterinarian should always be consulted regarding interpretation of test results			

## 6. Priority EPBC parrot species

A range of stakeholders are required to support and implement threat abatement work, including Australian, state, territory and local governments; researchers, avian veterinarians, natural resource management groups, recovery plan implementation team members, wildlife carers, interested individuals and community groups. Actions may be undertaken at a national, regional or local level.

Table 4 shows the current determined level of risk that the seventeen EPBC threatened psittacine species face in terms of being infected by PBFD. Most of this information was gathered during the PBFD Threat Abatement Plan review titled Psittacine Beak and Feather Disease and other identified Threats to Australian threatened Parrots. However, risk levels should be re-evaluated as new evidence comes to light.

Parrots	<b>Risk Level</b>	Based on
Orange-bellied parrot	Very high	Data shows that PBFD was a significant cause of
		death among captive population previously. The
		species is very vulnerable to PBFD because it occurs
		in a single population
Glossy black cockatoo	High	Data shows PBFD has been detected in this species,
		it could pose a risk to the small isolated Kangaroo
		Island population
Norfolk Island green parrot	High	Data shows that PBFD can limit the population
		recovery and set back conservation goals
Red-tailed black cockatoo	High	Expert Opinion states that with only a single
		population in a small area, a great impact could occur
Western ground parrot	High	Limited Data/Expert Opinion shows that wild-
		caught birds did not have PBFD, however with
		species current numbers and small range a great
		impact could occur
Carnaby's cockatoo	Moderate	Data shows the presence of PBFD virus infection in
		nestlings is sporadic, PBFD is present in wild
		populations but with species current numbers not
		great impact has been seen
Forest red-tailed black	Moderate	Data shows PBFD is present in wild populations but
cockatoo		with species current numbers not great impact has
		been seen
Regent parrot	Moderate	Limited Data/Expert Opinion shows with species
		current numbers not great impact has been seen
Superb parrot	Moderate	Limited Data/Expert Opinion shows PBFD could
		become a threat to the superb parrot in the future
		and it may pose a significant risk to the species.
Swift parrot	Moderate	Data shows the threat of PBFD is not as great as
		previously considered as seen from collected blood
		and feather samples
Coxen's fig parrot	Low	Limited Data/Expert Opinion shows there is no
		evidence that PBFD contributed to the decline of the
		species and no PBFD in the population currently
Night parrot	Low	Limited Data/Expert Opinion shows strict
		quarantine and tight security protocols are in place
		on known sites of habitation
Baudin's cockatoo	Unknown	To date, clinical evidence of PBFD has not been
		detected, the prevalence of PBFD is unknown.
Golden shouldered parrot	Unknown	PBFD testing has not occurred for species, and there

Table 4: Level of risk EPBC species are facing from potential infection of PBFD

Parrots Risk Level		Based on	
	is no data or expert opinion available		
Green Rosella	Unknown	No data or expert opinion currently available	
Palm Cockatoo	Unknown	No data or expert opinion currently available	
Princess parrot Unknown		Remoteness, low densities and highly dispersive	
		distribution of the species over various states and	
		territories hinders accurate knowledge.	

## 7. Gaps in knowledge on PBFD

Many aspects of PBFD remain unknown, and further knowledge will allow for better preventative measures to be put in place.

### Virus Characteristics

- The level of dosage required to establish infection and or cause disease
- Understanding the rate at which the virus evolves and recombination occurs (a process that creates genetic diversity)
- The dynamics of viral replication (growth of biological viruses) in naturally infected birds
- Understanding if there are any differences in the biological significance of BFDV between different psittacine lineages
- Understanding the potential for, and gathering information on occurrences for species infection with PBFD outside of the psittacines

#### Immunity

- Antibody concentration that provides protection for birds exposed to the virus
- Whether the antibodies in adult birds remain constant or drop over time allowing the birds to become vulnerable to the virus
- Protective effects of passive transfer of maternal antibodies to chicks, and its rate of decay in nestlings allowing the nestlings to become vulnerable to the virus
- Infection causing immunosuppression and creating a predisposition to other infectious disease and parasites
- Existence of any host-species co-evolving with the virus to attain natural safeguards or create an attenuation effect

#### Transmission

- Vertical transmission (the transfer of PBFD virus directly from mother to developing egg) could be an important element of virus maintenance within populations
- An established level of known excretion rates of the virus from diseased and carrier birds to help in the quantification of environmental contamination
- Horizontal infection methods (transfer of PBFD virus from one bird to another by direct or indirect means) help identify the process of virus transfer and importance of faecal-oral, feather-oral and ingestion via crop impacts
- Presence of clinically normal carriers and their role in disseminating the virus

#### Environment

- Identifying the role of nest hollows as sources of infection, and where possible acting on procedures to prevent the spread of the virus
- The timeframe of the persistence of the virus in nest hollows and other environments is required to gauge when the most appropriate actions are needed
- Confirming the roles that manmade feeding and watering stations play in disseminating the virus and where possible acting on procedures to prevent its spread

### **Population Dynamics**

- The effects of the virus on population viability of effected parrot species
- The effects of the virus on survivorship in common species and how this might change in fragmented populations or endangered species
- Current and continually updated mapping of both spatial and landscape dynamics of the infection would provide a clear record of its spread and allow for appropriate preventative actions
- The minimum population size required to maintain the infection, and what is the influence of spatial, temporal and landscape effects

#### **Reservoir Species**

- Examine if reservoir species exist naturally and determine their effect on threatened species
- Ability of non-psittacine species to carry and disseminate the virus
- Information on cross-species transmission, its rates, virulence, dynamics of infection and the interplay between different populations
- The serological responses (diagnostic identification of antibodies in the blood serum) & seroepidemiology (study of the patterns of infection by detecting antibody levels)

## **8. Abatement actions for PBFD**

The actions shown in Table 5 do not encompass all potential actions to abate the KTP, but highlights those actions considered to be of highest priority at the time of preparing the threat abatement advice.

 Table 5: Actions that may abate the threat from PBFD

Action	Priority/Timeframe	Output	Outcome	Responsibility		
1. Common species acting as a reservoir for PBFD coming into contact with threatened species	High priority & long term [Research]	Report	Limit disease transmission through preventative actions	Researchers, Recovery Planning teams		
The role of common species in dispersing PBFD we	buld be determined by this rese	arch, and will p	inpoint potential disease crossover from or	ne species to another.		
<b>2.</b> Exploring the role of stressor events	Medium priority & long term [Research]	Report	Ability to directly influence and change the environment for the better	Researchers		
There is evidence to suggest that there is a connecti psittacines) and the prevalence of PBFD in captive management actions for population of wild birds.	There is evidence to suggest that there is a connection between stressor events (such as inadequate construction of aviaries and excessive and unnecessary handling of psittacines) and the prevalence of PBFD in captive populations. Understanding the connections between stress and the disease expression may also help prioritise management actions for population of wild birds.					
<b>3.</b> Determining if there is any recurring pattern in the disease (e.g. declining natural immunity)	Low priority & long term [Research]	Informed actions	Potential ability to correctly predict the current and future evolution of PBFD	Governments, researchers, veterinarians		
By determining patterns in development and progre	ssion of PBFD we can advance	our ability to c	ombat its effects on psittacine species.			
4. Population information on the interaction of the virus with parrots	Low priority & long term [Research]	Informed actions	Potential ability to correctly respond to the threat at harmful levels			
The allocation of funds and resources can be placed more effectively by determining if PBFD can spread through a population at sub-threatening and sub-clinical levels, and thereby be undetected. It would also be useful if a natural decline in the disease can be distinguished from the absence of the disease in a population.						
5. Vaccine production or other means of preventing PBFD	High priority & long term [Research]	Vaccine or the like	Potential eradication of PBFD from populations of psittacines.	Researchers		
By producing a vaccine or other means of preventing PBFD which incorporates effective distribution methods, host specificity and the possibility for variable pathogenicity						

	Action	<b>Priority/Timeframe</b>	Output	Outcome	Responsibility
	there is the potential treatment of all infected parrot s	species.			
	6. Investigations of mortality and morbidity events	Low priority & long term [On-ground]	Source of data	Reveal the situations where psittacines are susceptible to PBFD	Researchers, Recovery Planning teams, community, NRM groups, veterinarians
	The knowledge of death and sickness events in a pop	pulation or individual parrots c	ould help reduc	e or recognise disease risks and improve the	ne management of a species.
agement	1. Waste biological material protocols	High priority & long term [In progress]	A set of protocols	Safer internal and external workplaces and environments	Researchers, veterinarians
tory Mana	Having protocols on transport, handling and disposal environment and potentially infecting wild parrots.	l procedures for dead birds and	l their tissues w	ould prevent PBFD infected biological ma	terial from entering the outside
Labora	2. Preservation of biological samples	Low priority & long term [In progress]	Source of data	A source of data to help in the understanding of PBFD	Researchers, Recovery Planning teams, veterinarians
	If there are insufficient resources for immediate testin existence of the PBFD in a population is essential. The	ng of suspected PBFD infected his data has the potential to inf	d birds, the colle form in the upda	ection and storage of biological samples to ating of distribution maps and the location	later confirm or disprove the of hotspots.
agement	1. Increased on-ground prevention actions	High priority & long term [On-ground]	Informed actions	Directly abate the threat from PBFD on the ground	Researchers, Recovery Planning teams, NRM groups
n-site Mana	Actions such as the sanitisation of equipment and persons between each handling of parrots, the implementation of isolation periods and testing for new birds introduced into a population, and sanitisation of artificial areas such as nest boxes and feeding stations will help limit the spread of PBFD. The use of feeding stations in bird recovery programs should be highly mindful of such hygiene requirements.				
Ō	2. Produce readily available material	High priority & long term [In progress]	Education materials	An increase in the overall professional collective knowledge of PBFD	Governments, Researchers, NRM groups, veterinarians
	Education material including clinical evaluations and work.	l post-mortem protocols would	l be of high valu	ue for field workers, wildlife managers and	l veterinarians to guide their
	3. Hygiene and disinfection protocols for Psittacines held in captivity	High priority & long term [In progress]	A set of protocols	Safer internal and external workplaces and environments	Researchers, veterinarians, Recovery Planning teams

Action	Priority/Timeframe	Output	Outcome	Responsibility		
De basis and a bis share there is an dead about		1				
By having protocols in place there is a reduced chance of PBFD infected psittacines being released into the wild after treatment or time in captivity. It also reduces the risk of transfer of PBFD when birds are being moved between captive facilities.						
1. Identifying and assessing hotspots where the disease occurs more frequently in Australia (noting that high levels of observation does not always equal high frequency, e.g. remote locations may have lower rates of detection because of fewer observers).	High priority & short term [Research]	Set of maps	Reveal situations and areas where psittacines are exposed to PBFD	Governments, researchers		
Once developed, these maps will provide a visual aid, created from data supplied from many sources, which will allow management improvements and responses. If kept updated, will be a highly useful tool to reduce the impact of PBFD.						
2. Localised distribution mapping showing non-threatened and threatened parrot species	Low priority & short term [Research]	Set of maps	Early warning systems for potential disease transmission	Governments, researchers		
The maps and link in section 10 provide a visual aid created from data supplied from many sources. If combined with the maps produced in the first action ( <b>Identifying and assessing hotspots where the disease occurs more frequently in Australia</b> ) they could help interested parties pinpoint areas of concern for potential disease transmission from one species to another. If kept updated, and if new maps are created as the need and resources become available, they will be a highly useful tool in reducing the spread of PBFD.						
3. An adopted definition of what level of disease constitutes an epidemic for PBFD	Low priority & long term [Research]	Definition & protocols	Unity and the potential ability to respond to a previously unmeasured threat	Researchers, Recovery Planning teams		
The agreement on a definition would allow for cohesive actions between interested parties. It would also help in the production of a set of protocols which would guide the identification of the initial indicators of a potential epidemic and allow for the proper actions to be taken.						
1. Community education	High priority & long term [On-ground]	Informed actions	An increase in the overall collective knowledge of PBFD	Governments, NRM groups, Recovery Planning teams, veterinarians		
PBFD hygiene protocols are unlikely to be in place at private feeding stations, which are commonly used in cities, rural and remote areas. These feeding stations can be used by EBPC listed species. By providing the public with advice and using educational tools to highlight the risks of private feeding stations, attention to high risk cross over						

Action	<b>Priority/Timeframe</b>	Output	Outcome	Responsibility			
points outside of discreet recovery programs can be considered. Citizen science initiatives, such as the <u>Australian Bird Feeding and Watering Study</u> , are also a good way to get the community thinking on these issues further							
get the community thinking on these issues further.							
2. Capture and share a greater amount of	High priority & long term	Collection	An increase in the overall collective	Wildlife Health Australia & the			
information on PBFD in a structured	[In progress]	of data	knowledge of PBFD	Australian Registry of Wildlife			
and coordinated way				Health			
The Australian Wildlife Health Network and the Australian Registry of Wildlife Health has previously and is currently supporting the sharing of information with interested							
parties to assist in the increase in the overall collective knowledge of PBFD.							

### 9. Information Sources

Information relevant to the above actions and research include:

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Page 19 of 24

## <u> 10. Maps</u>

Based on the best available information at the time of development, the full set of 22 maps can be viewed at: http://www.environment.gov.au/biodiversity/invasive-species/diseases-fungi-and-parasites/beak-and-feather-disease

1. Distributions - Threatened species which are known to be, or could be affected by PBFD



Threat Abatement Advice: Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species

Page 21 of 24

2. Observations – Spatial occurrence of non-listed parrots which may be affected by PBFD. Note this map is heavily influenced by where birdwatchers make observations, so bird observations from relatively remote areas will be substantially fewer, and confined to accessible areas (such as roadsides).



Threat Abatement Advice: Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species



3. Species – Spatial overlap of EPBC listed and non-listed parrots which may be affected by PBFD Threat Abatement Advice: Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species