Australian Government

Department of the Environment

Psittacine Beak and Feather Disease

and other identified Threats to Australian threatened Parrots

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A paper to the TSSC on the analysis of the relative degree of threat from beak and feather disease compared to other threats for threatened psittacine species

Contents

Purpose of document

This paper will provide the Threatened Species Scientific Committee (TSSC) with an analysis of the relative degree of threat from Psittacine Beak and Feather Disease (PBFD) compared to other threats to threatened psittacine species. It will also highlight available options to most feasibly, effectively, and efficiently address PBFD as a key threatening process.

Readers Guide

This second review provides additional advice to TSSC on the *Threat Abatement Plan for Beak and Feather Disease Affecting Endangered Psittacine Species*. It summarises the threats to identified threatened psittacine species. It consists of the following parts:

Part A – Psittacine Beak and Feather Disease (PBFD): current known information about the disease, including: how it affects parrot populations; its adaptability between species; physical clinical symptoms and outcomes; and methods of control and treatment of the disease.

Part B – The threatened parrots: a legislative basis under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Details of documents on parrot species and PBFD protection as well as characteristics of parrots generally and detail on the 16 species of threatened parrots.

Part C – Recovery Plans: the main point of reference used to explore threats to Australian psittacine species from PBFD relative to other threats. The information is summarised in tables, graphs and figures.

Part D – Parrots without Recovery Plans: details on the two parrots that do not have Recovery Plans, and the threats to these species through the use of Conservation Advice.

Part E – Consultation with parrot and disease experts: the experts who participated in this paper and information on the parrot species they focus on. It includes: suggestions for funding projects; management actions; current projects; PBFD as a significant threat and also, in table form, PBFD compared to other threats. This section concludes with a table of important publications.

Part F – Final Statements & Conclusions: this section offers suggestions for the threat abatement plan once it sunsets in 2015 and makes concluding statements.

Part A – Psittacine Beak and Feather Disease (PBFD)

Description

Psittacine Beak and Feather Disease (PBFD) is also known as psittacine circovirus (PCV) or Psittacine Circoviral Disease (PCD). It 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 (92%), however birds up to 20 years of age have developed clinical signs after years of being clinically normal. PBFD can cause high juvenile mortality, have long-term immunological suppression, as well as cause feather and beak abnormalities. It can be spread through crop secretions, fresh or dried excrement and feather and skin particles (Department of the Environment, 2005).

The circovirus is the smallest group of described disease-causing viruses. Previously it was thought that there was only one strain of the PBFD virus; however there has been debate in the literature over the existence of a Beak and Feather Disease Virus (BFDV) strain genetically adapted to lorikeets and parrots, and the evolution of species-specific BFDV genotypes such as cockatoo, budgerigar, lorikeet and lovebird lineages (Khalesi *et al*. 2005).

Subclinical BFDV infections are well known in wild rainbow and scaly breasted lorikeets in Australia which rarely develop chronically progressive lesions characteristic of PBFD in cockatoos. Evidence that this is solely due to less virulent genotypes rather than host defence factors have yet to be resolved (Khalesi *et al*. 2005).

Symptoms

The time period in which the disease develops varies; it can appear very suddenly (peracute), suddenly (acute) or over a long term (chronic). The peracute stage occurs in hatchlings. They suffer septicaemia, pneumonia, enteritis, weight loss and death even before feathers start emerging. The acute stage happens in chicks at about four weeks of age, showing symptoms of depression followed by sudden changes in the developing feathers, crop stasis, diarrhoea, anaemia and death. Birds that survive the acute phase can be classified as chronic and go on to show signs of symmetrical feather deformities after the next moult and become progressively worse with each subsequent moult (Peachy [no date]).

Table 1 shows an array of clinical symptoms that parrots display when infected by PBFD. The first symptoms in older birds occur in the powder down and contour feathers; then the primary, secondary, tail and, if they have them, crest feathers, become abnormal progressing to total baldness if birds survive long enough (Department of the Environment 2005).

Beak lesions are relatively common in sulphur-crested Cockatoos, galahs and little corellas, particularly those under one year of age. The upper beak is generally more severely affected and necrosis extends from the tip towards the base (Peachy [no date]). Figure 1 shows examples of chronic feather and beak anomalies

Death occurs largely due to secondary infections associated with immunosuppression thought to be from PBFD. It is unclear whether the BFDV causes immunosuppression or merely favours it. It is known that starvation is also common in parrots infected by PBFD as they

cannot use their deformed break to successfully gather food (Department of the Environment 2005).

Table 1: Clinical symptoms of PBFD (Peachy [no date])

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 growth	Emerging feathers are small, twisted and very abnormal. Some feathers lack 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	BPDV causes deformed beaks and unstable beak integrity.
Tail feathers missing	Missing tail feathers.
Symmetrical wing feather loss	After moult new feathers do not grow. Moult occurs symmetrically.

Figure 1: Shane Raidal et al (2005) Sulphur crested cockatoos and galah chronically infected. They are displaying gross clinical signs of feather loss and the galah is also displaying gross clinical signs of beak fracture.

Control and Treatment

Prevention is the best method of control as there is no effective treatment for PBFD. It is extremely difficult, if not impossible, to remove the virus once it has been introduced into a captive or wild population; many parrots may need to be destroyed to achieve this. Some parrots survive the initial infection via supportive treatments, including maintaining body temperature and giving supplements which support the immune system. These successful treatments can allow clinically recovered birds to remain latently infected, becoming carriers, with the virus persisting in the liver (Department of the Environment 2005).

The virus is extremely stable in the environment and it is possible that it may remain viable in nest hollows for many years. Testing of the virus at an incubation temperature of 80°C for thirty minutes fails to inactivate it. A disinfectant that has been shown to be effective is the peroxygen compound, Virkon S (Australian Wildlife Health Network 2009).

Virkon S is safer to use than other similar disinfectants as it has low toxicity to humans and birds. It is effective against all viruses when used on an organic matter-free surface at the higher recommended concentration (2%) for a contact time of 10 minutes. It will inactivate any viable PBFD virus that might be present on the surface (Department of the Environment and Heritage 2006).

Captive parrots can be protected from the virus by maintaining good hygiene and avoiding stressful situations. Preventing contact with infected wild parrots via good aviary design and no free-flying of captive parrots is also essential (Department of Conservation 2004). Quarantining and testing new parrots before releasing them into an aviary is necessary as control of PBFD is best achieved by identifying carrier birds and isolating these individuals (Department of the Environment and Heritage 2006). A quarantine period of at least 63 days is recommended, with testing for BFDV at day 0, day 28 and day 56, leaving a week for results to be delivered (Department of the Environment and Heritage 2006).

Not all beak or feather abnormalities of parrots are caused by the PBFD virus. For this reason, correct diagnosis of the disease is an important factor in its management. While there are distinctive clinical signs, confirmation of diagnosis should be carried out using techniques that detect either the virus or the parrot's antibody response to the virus (Department of the Environment 2005). The most useful diagnostic tests are the HI (antibody) and PCR (viral DNA) tests.

In Australia, HI has been the diagnostic test most widely used because of its simplicity, the small sample volume required, and the fact that it is quantitative. However, since it is an antibody test it does not provide information about whether the individual bird is currently infected (Department of the Environment 2005). A PCR test will detect the presence of viral DNA; however, it is not a quantitative test. A combination of HI and PCR tests is most useful, but when resources are limited, judgement is required on which tests provide relevant information and are also cost effective for population management. A consistent, practical and cost effective approach to diagnosis is required for Australia-wide management of the disease in threatened wild populations of parrots (Department of the Environment 2005).

The main action identified in a stakeholder workshop in 2009 is the development of a vaccine for the PBFDV. The development of a vaccine is of high priority and research action needs to be undertaken. A number of different research projects have studied the virus and started exploring the potential for the development of a vaccine. However, there are still significant gaps in the knowledge about virus characteristics, apparent immunity by some birds, and transmission factors including host factors, environment factors, population dynamics and other species as reservoirs of the virus (Department of Sustainability, Environment, Water Population and Communities 2012).

One major challenge in the development of a vaccine was the production of a vaccine by more traditional methods of antigen production – a method that is considered ethically unacceptable and immoral as BFDV infected birds would need to be bred and maintained for the sole purpose of antigen production. Also cell culture systems for amplification of the virus were unsuccessful (Bonne *et al*. 2009). A different technique of using a recombinant BFDV capsid protein was developed and trialled on a limited number of galahs and long-billed corellas. This appeared to be successful and showing promise. However, a large amount of additional research needs to occur before a vaccine is developed and considered

for use in a captive breeding program for threatened species. This work is currently unfunded and not underway (Department of Sustainability, Environment, Water, Population and Communities 2012).

A major challenge if a successful vaccine is produced, is the problem of a reservoir of the virus in common psittacine species. In order to be fully successful, a method of delivery for a vaccine for both captive and wild populations of threatened species would need to be developed. The vaccine would need to be capable of passing on the antibodies to offspring or to be able to be delivered regularly to the threatened species so that new hatchlings are also vaccinated (Department of Sustainability, Environment, Water, Population and Communities 2012).

Part B – The threatened parrots

Documents

Psittacine Beak and Feather Disease was listed in April 2001 as a key threatening process under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). A key threatening process is defined as a process that threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community.

Once a key threatening process is adopted, the Minister decides if a threat abatement plan (TAP) is a feasible, effective and efficient means to abate the threat. If so, a threat abatement plan is written. The Australian Government implements a TAP as it applies on Commonwealth land and seeks the cooperation of the states and territories to implement the plan within their jurisdictions. The Australian Government may also support national implementation through financial assistance for key national level actions in the plan, such as research and demonstration model projects to develop tools to address the threatening process.

The *TAP for Beak and Feather Disease Affecting Endangered Psittacine Species* provides for the research, management, and any other actions necessary to reduce the impact of the key threatening process. The implementation of the plan should assist the long term survival in the wild of the affected native species (Department of the Environment 2015).

Under section 279 of the EPBC Act, the Minister must review each TAP at intervals of no longer than five years. The *TAP for Psittacine Beak and Feather Disease Affecting Endangered Psittacine Species* was made by the Minister in 2005, and reviewed in 2012 (Department of Sustainability, Environment, Water, Population and Communities 2012).

The Department's previous review of the threat abatement plan in 2012 included an assessment of the plan's performance in meeting its goals and objectives. The Department has followed up the 2012 review with this second review paper to the Threatened Species Scientific Committee (TSSC). It analyses the relative degree of threat from beak and feather disease relative to other threats on the identified threatened parrot species.

Recovery plans have also been developed by the Department of the Environment in accordance with the Department's Conservation Policy Statements (numbers 44 and 50) and other relevant EPBC Act statutory documents (i.e. TAPs). These recovery plans outline the

recovery actions that are required to address those threatening processes most affecting the ongoing survival of threatened taxa or ecological communities, and begin the recovery process.

Table 2 shows a summary of the available (or soon to be available) advices that will have a positive impact on the survival of psittacines. For this paper, recovery plans were determined to be the most reliable source of information regarding the Australian species of threatened parrots, and as thus heavily referenced in this paper. The recovery plans are visited in more detail later in this paper. The princess parrot and night parrot do not have recovery plans so information regarding these species has been gathered from other publications like conservation advices and State or Territory plans, as well as advice from bird or disease experts.

Recovery Plans set out the research and management actions necessary to stop the decline, 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 (Department of the Environment, 2015b).

Recovery Plans state what must be done to protect and restore important populations of threatened species and habitat, as well as how to manage and reduce threatening processes. Recovery plans achieve this aim by providing a planned and logical framework for key interest groups and responsible government agencies to coordinate their work to improve the plight of threatened species and/or ecological communities (Department of the Environment, 2015b).

Table 2: A summary of the advices available or soon to become available

Threatened Parrot Species	**Scientific name**	**Recovery plan period**	***Status**	**Listing advice**	**Conservation advice**	**State & territory plans**
Baudin's cockatoo	*Calyptorhynchus baudinii*	2008-18	Plan adopted in 2011; not due for review.	-	-	-
Carnaby's cockatoo	*Calyptorhynchus latirostris*	2013-23	Plan adopted in 2014; not due for review.		-	-
Coxen's fig parrot	*Cyclopsitta diophthalma coxeni*	2002 only	Original plan was adopted in 2001; reviewed in 2007.	-	-	-
Forest red-tailed black cockatoo	*Calyptorhynchus banksii naso*	2008-18	Plan adopted in 2011; not due for review.	2009	2009	-
Glossy black cockatoo	*Calyptorhynchus lathami halmaturinus*	2005-10	Original RP adopted in 2005; reviewed in 2008. Plan is due to "sunset" in April 2016.	-	-	-
Golden shouldered parrot	*Psephotus chrysopterygius*	2003-07	Original RP adopted in 2002; reviewed in 2011.	-	-	-
Muir's Corella	*Cacatua pastinator pastinator*	2008-18	Original RP adopted in 2009; due for review.	-	-	-
Night parrot	*Pezoporus occidentalis*	-	Recovery plan not yet adopted.	-	2008	-
Norfolk Island green parrot	*Cyanoramphus novaezelandiae cookii*	2002-06	Adopted under the Norfolk Island Regional plan adopted in 2010.	-	-	-

			Due for review this year.			
Orange-bellied parrot	*Neophema chrysogaster*	2006-11	Original plan adopted in 2006; a new plan is in preparation.	2006	2006	-
Princess parrot	*Polytelis alexandrae*	-	Recovery plan not yet adopted.	-	2008	2006
Red-tailed black cockatoo	*Calyptorhynchus banksii graptogyne*	2007-12	Plan adopted in 2011; not due for review	-	-	-
Regent parrot	*Polytelis anthopeplus monarchoides*	2011-15	Original RP was adopted in 2011; not due for review.	-	-	-
Superb parrot	*Polytelis swainsonii*	2011-15	Original RP was adopted in 2011; not due for review.	-	-	-
Swift parrot	*Lathamus discolor*	2001-06	Original RP was adopted in 2011; not due for review.	2011	-	-
Western ground parrot	*Pezoporus wallicus flaviventris*	2009 only	Is included in the RP for South Coast Birds which was adopted in 2014.	-	-	-

*The Minister may adopt a recovery plan made by a state or territory provided that it meets the requirements for adoption under the EPBC Act

Description

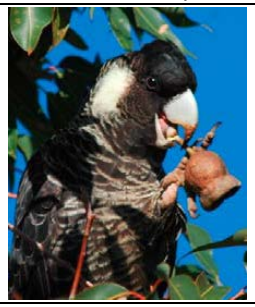
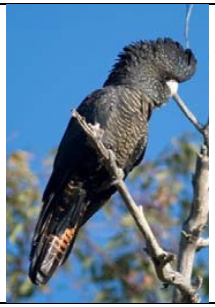
Parrots (scientific name: psittacines) have roughly 370 species and 80 genera that make up the order Psittaciformes. There is much debate over the grouping of families. Originally all birds in the order Psittaciformes were grouped into one family, but in light of recent research the parrots could be classified into three superfamilies: Strigopoidea, the New Zealand parrot super family; Cacatuoidea, the family of cockatoos; and Psittacoidea, the true parrots (Joseph *et al*. 2012).

Two characteristics that set psittacines apart from other birds include their strong, hooked beak (maxilla) which has a hinge-like flexible attachment to the skull and fits over the mandible. The other unique characteristic is their zygodactyl toes, meaning they have four toes on each foot, two pointing forward and two projecting backward. The positioning of the toes is especially useful for climbing and prehension. Psittacines are reportedly the only birds that hold their food in one foot to eat it. This arrangement of beak and toes allow psittacines to easily manoeuvre among many types of vegetation (Foster and Smith Inc 2015).

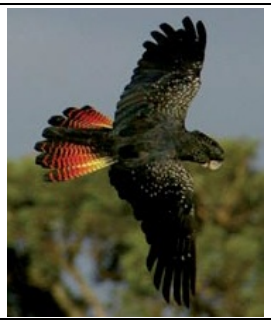
Parrots are thought of as rainforest inhabitants; however, in Australia, they have expanded out of the wetter forests and have evolved to fill many different niches, reaching their highest diversity in open woodlands. Parrots in the Australasian region have attained the greatest ecological and morphological diversity. The plumage of most parrots around the world are variants of green due to their rain forest habitat, however, in Australia, parrots are found with multiple colours including black, white, red, yellow, grey, and pink, due to their colonisation of a wide variety of habitats (Chambers 2009).

There are over 50 species of parrot in Australia, with over 40 endemic. At present, 16 parrot species are classified as threatened under the EPBC Act (see Table 3). These species have the potential to be gravely affected by PBFD as numerous past and present stresses affect them, causing small population sizes. Further information, including effects of PBFD, on these threatened parrots is at Appendix A.

Table 3: The 16 species of Australian threatened psittacines

Picture				
Threatened Parrot Species	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

Picture				
Threatened Parrot Species	Glossy black cockatoo	Golden shouldered parrot	Muir's corella	Night parrot
Scientific name	*Calyptorhynchus lathami halmaturinus*	*Psephotus chrysopterygius*	*Cacatua pastinator pastinator*	*Pezoporus occidentalis*
EPBC status	Endangered	Endangered	Vulnerable	Endangered

Picture				
Threatened Parrot Species	Norfolk Island green parrot	Orange-bellied parrot	Princess parrot	Red-tailed black cockatoo
Scientific name	*Cyanoramphus novaezelandiae cookii*	*Neophema chrysogaster*	*Polytelis alexandrae*	*Calyptorhynchus banksii graptogyne*
EPBC status	Endangered	Endangered	Vulnerable	Endangered

Picture				
Threatened Parrot Species	Regent parrot	Superb parrot	Swift parrot	Western ground parrot
Scientific name	*Polytelis anthopeplus monarchoides*	*Polytelis swainsonii*	*Lathamus discolor*	*Pezoporus wallicus flaviventris*
EPBC status	Vulnerable	Vulnerable	Endangered	Endangered

Locations

PBFD is known to affect threatened psittacine species and is widespread in parrots such as galahs, corellas and sulphur crested cockatoos, which are prominent to most niches in Australia. The potential for threatened species to come into contact with PBFD through common species is high. This could lead to significant losses of individuals within a species, resulting in devastating impacts on already constricted populations. Threatened parrot species encompass areas all across Australia (see Table 4).

Table 4: A broad description on the locations of the threatened parrots

Species	Scientific name	Location	Detailed locations
Baudin's cockatoo	*Calyptorhynchus baudinii*	WA	It is endemic to a 2,000 square km area of the humid and sub-humid zones of south-west Western Australia, (Chapman *et al*. 2008).
Carnaby's cockatoo	*Calyptorhynchus latirostris*	WA	It is endemic to the south-west of Western Australia, with a widespread distribution, (Department of Parks and Wildlife 2013).
Coxen's fig parrot	*Cyclopsitta diophthalma coxeni*	NSW, Qld	Is currently only known in the wild from less than 20 reliable sightings in NSW since 1970 and from several clusters of contemporary sightings in south-east Queensland, (NSW Parks and Wildlife Service 2002).
Forest red-tailed black cockatoo	*Calyptorhynchus banksii naso*	WA	It is endemic to the south-west humid and sub-humid zones of Western Australia, (Chapman *et al*. 2008).
Glossy black cockatoo	*Calyptorhynchus lathami halmaturinus*	Kangaroo Island near SA	Is currently restricted to Kangaroo Island in SA, it is considered to be present throughout the area on Kangaroo Island (Mooney and Pedler 2005).
Golden shouldered parrot	*Psephotus chrysopterygius*	Qld	Found in Cape York in the headwaters of the Morehead River and adjacent westward flowing streams (Morehead population) and the upper tributaries of the Staaten River (Staaten population), (Garnett and Crowley 2002).
Muir's Corella	*Cacatua pastinator pastinator*	WA	Is confined to a small region in WA from Boyup Brook, McAlinden and Qualeup, south to Lake Muir and the lower Perup River, and east to Frankland and Rocky Gully, (Department of Environment and Conservation 2008).
Night parrot	*Pezoporus occidentalis*	WA, NT, SA, Qld	There are accepted historical records from remote arid and semi-arid inland regions of Western Australia, Northern Territory, South Australia and Queensland (Department of the Environment 2008a).
Norfolk Island green parrot	*Cyanoramphus novaezelandiae cookii*	Norfolk Island east of QLD & NSW	It is restricted to Norfolk Island (Hill 2002).
Orange-bellied parrot	*Neophema chrysogaster*	SA, Vic, Tas, NSW	It is endemic to south-eastern Australia including SA, VIC, NSW and Tasmania, preferring coastal habitat. It is now rarely recorded in large numbers from west of the Murray River in South Australia or east of Jack Smith Lake in South Gippsland, Victoria (Orange-bellied Parrot Recovery Team 2006).
Princess parrot	*Polytelis alexandrae*	WA, NT, SA	Has a patchy and irregular distribution in arid Australia, including WA, NT and SA, (Department of Natural Resources, Environment and the Arts 2006)
Red-tailed black cockatoo	*Calyptorhynchus banksii graptogyne*	SA, Vic	It occurs as a single population in a small area of south-eastern Australia, delimited by Keith to Lucindale to Mt Gambier in South Australia and Portland to Casterton, Toolondo, Natimuk, Dimboola, Nhill, and Kaniva in Victoria, (Commonwealth of

			Australia 2007).
Regent parrot	*Polytelis anthopeplus monarchoides*	SA, NSW, Vic	Found in the lower Murray-Darling basin region of South Australia, New South Wales and Victoria (Baker-Gabb and Hurley 2011).
Superb parrot	*Polytelis swainsonii*	NSW, ACT, Vic	Is endemic to inland south-eastern Australia, where it occurs from south-eastern Queensland through the inland slopes and plains of New South Wales (including the Australian Capital Territory) to northern Victoria, (Baker-Gabb 2011).
Swift parrot	*Lathamus discolor*	Tas, Qld, NSW, ACT, Vic, SA	It breeds in Tasmania during the summer and the entire population migrates north to mainland Australia, found in Qld, NSW, ACT, Vic and SA for the winter, (Saunders and Tzaros 2011).
Western ground parrot	*Pezoporus wallicus flaviventris*	WA	Is found in WA at Fitzgerald River National Park, and Cape Arid National Park and nearby parts of Nuytsland Nature Reserve, (Department of Environment and Conservation 2009).

Part C – Recovery Plans

Description

Recovery plans delineate, justify and schedule management actions and research necessary to support the recovery of threatened species and ecological communities through halting their decline. The aim of a recovery plan is to maximise the long term survival in the wild of a threatened species or ecological community. The attainment of objectives and the provision of funds necessary to implement actions are subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities (Department of the Environment 2015b).

Explanation of threats

The following information, tables and diagrams show threats to Australian threatened psittacine species from PBFD relative to other threats found within the recovery plans. The information sourced from the recovery plans is the most relevant on hand data available to us at this time. It highlights those threats that are considered to be of highest priority at the time of their publication.

This information was deconstructed and compiled for 14 of 16 of the parrot species; as recovery plans have not been developed for the princess parrot and night parrot as yet, information on these species has been gathered through other publications and the advice of bird or disease experts.

Due to the limited knowledge and information surrounding both the night parrot and the princess parrot, these species have been excluded from the tables and figures of threats in this paper, until a more solid collection of research has been conducted. Much of the collective knowledge on these parrots can be classified as unreliable (unconfirmed reports and best guesswork).

Table 5 shows the number of threats mentioned for each species in their recovery plan. This table does not indicate the degree of threats to parrots or individual threats, or threats in combination. It only counts the number of threats mentioned within their recovery plans. For instance, theoretically each species of parrot could be at risk of climate change however a

tally was only given to those parrots whose recovery plans mentions climate change as a threat.

The lowest number of threats was in the Western ground parrots' recovery plan with four threats. The Carnaby's cockatoo and the regent parrot have the largest number of threats at ten threats. Baudin's cockatoo and the forest red-tailed black cockatoo are grouped together as they share a recovery plan and occur in single populations, with the entire populations affected by the same threats.

Table 5: Total number of threats for threatened parrot species (as per their recovery plans)

Threatened Parrot Species	Threats Total
Western ground parrot	4
Baudin's cockatoo and Forest red-tailed black cockatoo	5
Coxen's fig parrot	6
Golden shouldered parrot	6
Glossy black cockatoo	7
Muir's Corella	7
Norfolk Island green parrot	7
Red-tailed black cockatoo	7
Superb parrot	8
Swift parrot	8
Orange-bellied parrot	9
Carnaby's cockatoo	10
Regent parrot	10

Table 6 lists all the threats and their assigned rankings as determined by the information given in Recovery Plans. There are 18 individual threats in all the recovery plans, each assigned a ranking through the level of impact each threat would have to the psittacine species as a whole. For instance habitat loss was assigned the highest threat as it was mentioned, usually in great detail, in every recovery plan and often stated as being the greatest threat to the individual species. By contrast, lighting was assigned the lowest threat as it was only mentioned briefly in one recovery plan, and posed a very limited threat to the species survival.

Table 6: Threats and threat level

Threat level	The types of threats	Description of threat
1. Highest threat	Habitat loss	Encompassing several manmade methods which affect birds breeding, foraging, migratory, movement and wintering areas. For example, inappropriate fire and water regimes. Agricultural, residential, urban, industrial, forestry, mining and recreational developments. The clearing, fragmentation and degradation of habitat. Flora and fauna species incursions. Grazing species preventing tree growth.
2.	Predation	Death by native and/or non native fauna species.
3.	Trade	Taking wild birds at any point in their life including adults, young or eggs, with the intention of selling them.
4.	Nest hollow shortage	Availability of natural or manmade nest hollows is low.
5.	Nest hollow competition	Nest hollows used by other native or non native species, which can prevent nesting or result in injury and death of

		eggs, young and female birds while nesting.
6.	Illegal kills	Poisoning, shooting and other intentional methods which result in the death of birds.
7.	Collisions	Birds flying into manmade objects, or being hit by them.
8.	Diseases	Known sicknesses for species.
9. Mid threat	Climate change	Future changes to biodiversity and ecosystem function.
10.	Competition	Resources are used by other native or non naive species.
11.	PBFD	Specific disease, of interest in this paper.
12.	Stochastic events	Uncontrollable events. For example, hail storms, drought and wildfire.
13.	Tree health	The sickness and/or death of trees used by parrots.
14.	Loss of genetic diversity	Population reducing significantly in size.
15.	Inadequate knowledge	Not enough known about species.
16.	Disturbance around nesting colonies	Parrots changing behaviour with negative outcomes when humans present.
17.	Food shortages	Food sources being removed.
18. Lowest threat	Lighting	Attracting migrating parrots.

An individual look at the threats of each psittacine species with a recovery plan is explored below in figure 2. It shows the species, their threats as mentioned in recovery plans and the ranking of these threats as interpreted from the recovery plans. The level of threat was determined by the deconstruction of statements made in the recovery plans. These threats and their threat level are ranked with 1 being the highest and 10 being the lowest.

Figure2: Threats and individual threat level for each species

TAP Species	Recovery plan Threats	ranking of threat level	TAP Species	Recovery plan Threats	ranking of threat level
Western ground parrot	Habitat loss	1	Baudin's cockatoo **and** Forest red-tailed black cockatoo	Habitat loss	1
	Predation	2		Illegal kills	2
	Climate change	3		Nest hollow competition	3
	Loss of genetic diversity	4		Nest hollow shortage	4
				Climate change	5

TAP Species	Recovery plan Threats	ranking of threat level	TAP Species	Recovery plan Threats	ranking of threat level
Golden shouldered parrot	Habitat loss	1	Coxen's fig parrot	Habitat loss	1
	Predation	2		Trade	2
	Food shortages	3		Competition	3
	Nest hollow shortage	4		Diseases	4
	Diseases	5		Stochastic events	5
	Trade	6		Predation	6

TAP Species	Recovery plan Threats	ranking of threat level	TAP Species	Recovery plan Threats	ranking of threat level
Red-tailed black cockatoo	Food shortages	1	Glossy black cockatoo	Habitat loss	1
	Habitat loss	2		Loss of genetic diversity	2
	Nest hollow shortage	3		Predation	3
	Nest hollow competition	4		Nest hollow competition	4
	Predation	5		Nest hollow shortage	5
	Inadequate knowledge	6		Diseases	6
	Trade	7		Trade	7

TAP Species	Recovery plan Threats	ranking of threat level	TAP Species	Recovery plan Threats	ranking of threat level
Muir's Corella	Habitat loss	1	Norfolk Island green parrot	Habitat loss	1
	Nest hollow competition	2		Predation	2
	Competition	3		Nest hollow competition	3
	Loss of genetic diversity	4		Diseases (including PBFD)	4
	Nest hollow shortage	5		Illegal kills	5
	Illegal kills	6		Nest hollow shortage	6
	Climate change	7		Collisions	7

TAP Species	Recovery plan Threats	ranking of threat level	TAP Species	Recovery plan Threats	ranking of threat level
Swift parrot	Habitat loss	1	Superb parrot	Habitat loss	1
	Climate change	2		Nest hollow shortage	2
	Collisions	3		Disturbance around nesting colonies	3
	Competition	4		Trade	4
	PBFD	5		Collisions	5
	Trade	6		Illegal kills	6
	Tree health	7		Nest hollow competition	7
	Predation	8		Predation	8

TAP Species	Recovery plan Threats	ranking of threat level
Orange-bellied parrot	Habitat loss	1
	Competition	2
	Predation	3
	Collisions	4
	Diseases (including PBFD)	5
	Lighting	6
	Trade	7
	Inadequate knowledge	8
	Stochastic events	9

TAP Species	Recovery plan Threats	ranking of threat level
Carnaby's cockatoo	Habitat loss	1
	Tree health	2
	Illegal kills	3
	Trade	4
	Collisions	5
	Disease (including PBFD)	6
	Nest hollow shortage	7
	Nest hollow competition	8
	Stochastic events	9
	Climate change	10

TAP Species	Recovery plan Threats	ranking of threat level
Regent parrot	Habitat loss	1
	Nest hollow competition	2
	Nest hollow shortage	3
	Tree health	4
	Illegal kills	5
	Predation	6
	Competition	7
	Disturbance around nesting colonies	8
	Trade	9
	Collisions	10

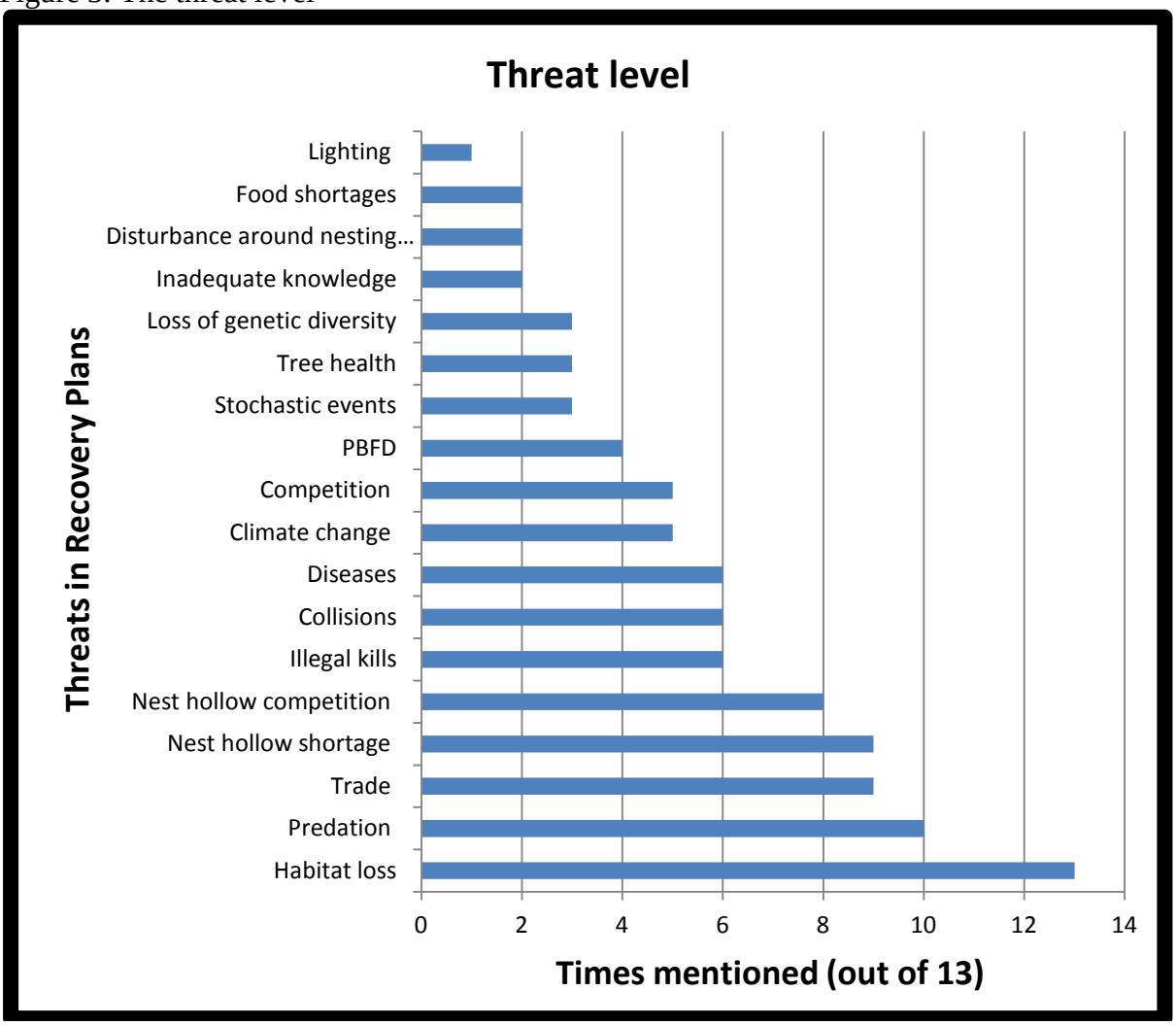
Common groupings and variability of threats

Table 7 and Figure 3 show the number of threats mentioned in the Recovery Plans and their determined rankings. The table indicates the degree of threat to parrots from individual threats as determined by the information given in Recovery Plans. There are 18 threats total in all available Recovery Plans, each assigned a ranking through the level of impact each threat would have to the psittacine species as a whole. Those threats that were mentioned equal times were assigned a threat level determined by the deconstruction of statements made in the Recovery Plans.

Table 7: Assignment of threat level

Threats in Recovery Plans	Times mentioned (out of 13)	Threat level
Habitat loss	13	1. Highest threat
Predation	10	2.
Trade	9	3.
Nest hollow shortage	9	4.
Nest hollow competition	8	5.
Illegal kills	6	6.
Collisions	6	7.
Diseases	6	8.
Climate change	5	9. Mid threat
Competition	5	10.
PBFD	4	11.
Stochastic events	3	12.
Tree health	3	13.
Loss of genetic diversity	3	14.
Inadequate knowledge	2	15.
Disturbance around nesting colonies	2	16.
Food shortages	2	17.
Lighting	1	18. Lowest threat

Figure 3: The threat level



Part D – Parrots without Recovery Plans

Conservation advice

As it currently stands, the night parrot and the princess parrot do not have recovery plans due to the lack of reliable knowledge and information on these parrots including life history, taxonomic relationships, distribution and population, habitat and movements, biology and ecology, threats, as well as management requirements.

In the absence of a recovery plan, the next most available and reliable source of information, other than statements from parrot specialists, is conservation advices. Conservation advices 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. When a native species or ecological community is listed as threatened under the Commonwealth EPBC Act, a conservation advice is developed to assist its recovery (Department of the Environment 2015d). The conservation advices for the night parrot and the princess parrot have been used in gathering information on their threats.

Threats

The conservation advice for the night parrot lists predation, habitat loss, competition and reduced maintenance of waterholes by Indigenous communities as the threatening processes to the species (Department of the Environment 2008a). The princess parrot conservation advice lists habitat loss, food shortages, competition, PBFD and trade as the threatening processes to the species (Department of the Environment 2008b).

Part E – Consultation with parrot and disease experts

Experts

Table 8 outlines the experts consulted on PBFD and their main topics of advice.

Table 8: Sharing of expertise

Name/Title	Position/Organisation	Parrot/BFD Information
Dr Debra Saunders	Australian National University	Swift/BFD
Prof Robert Heinsohn	Australian National University	Swift/BFD
Dr Paul Eden	Senior Veterinarian at Australian Wildlife Health Centre	Orange-bellied/BFD
Dr Michael Magrath	Senior Scientist at Zoos Victoria	
Dr Cathy Shilton	Berrimah Veterinary Laboratories	Princess & Night/BFD
Bronwyn Perryman	Project Coordinator at Birdlife Australia	Red-tailed black cockatoo/BFD
Dr Leo Joseph	CSIRO	General - All species/BFD
Dr Denis Saunders	Retired CSIRO Research Scientist	Carnaby's cockatoo/BFD
Michael Pyne	GM and Senior Vet at Currumbin Wildlife Sanctuary	Coxen's fig/BFD
Katherine Buchanan	Deakin University	BFD
Withheld	Project Officer at Department of Environment and Heritage Protection	Coxen's Fig/BFD
Dr Victor G. Hurley	Senior Biodiversity Officer at Department of Environment, Land Water and Planning	Regent/BFD
Richard Hill	Department of Environment, Land, Water and	Red-tailed black cockatoo/BFD

	Planning	
Chris Hedger	Department of Environment, Water and Natural Resources	Regent/BFD
Renate Velzeboer	Ecologist at Department of Environment, Water and Natural Resources	BFD
Karleah Berris	Department of Environment, Water and Natural Resources Kangaroo Island	Glossy black cockatoo/BFD
Dr Annie Philips	Wildlife Veterinarian at Department of Primary Industries, Parks, Water and Environment	Orange-bellied/BFD
Sheryl Hamilton	Latitude 42 Environmental Consultants; previously OBP Recovery Program Coordinator (2012-2014)	Orange-bellied/BFD
Dr Luis Ortiz-Catedral	Massey University	Norfolk Island green/BFD
Abi Smith	Natural Resource Manager at Parks Australia	Norfolk Island green/BFD
Dr Stephen Murphy	Self-employed consultant	Night/BFD
Pam Whiteley	University of Melbourne	General - All Vic species/BFD
David McLelland	Veterinarian at Zoos South Australia	Regent/BFD
Stephen Garnett	Charles Darwin University	Golden shouldered/BFD
Dr Alisa Wallace	Perth Zoo	Western ground parrot, Carnaby's cockatoo, Forest red-tailed black cockatoo & Baudin's cockatoo/BFD
Dr Kris Warren	Murdoch University	
Dr Simone Vitali	Perth Zoo	
Dr Anna LeSouef	Murdoch University	
Dr Mathew Berg	Deakin University	Glossy black cockatoo & Orange-bellied/BFD
Dr Dejan Stojanovic	Australian National University	Orange-bellied & Swift/BFD
Sam Gilchrist	Wildlife Health Australia (WHA)	As seen in Appendix B: General - All species/BFD
Ron Johnstone	WA Museum	Baudin's Cockatoo, Carnaby's Cockatoo, Forest Red-tailed Black Cockatoo & Muir's Corella/BFD
Dr Bethany Jackson	Murdoch University	BFD
Adrian Manning	Australian National University	Superb parrot/PFD

The total topics shared by experts on threatened parrot species and PBFD is shown in table 9.

Table 9: Focus topics as mentioned by experts

Threatened Parrot Species	Tally
Baudin's cockatoo	2
Carnaby's cockatoo	3
Coxen's fig parrot	2
Forest red-tailed black cockatoo	2
Glossy black cockatoo	2
Golden shouldered parrot	1
Muir's Corella	1
Night parrot	2
Norfolk Island green parrot	3
Orange-bellied parrot	3
Princess parrot	1
Red-tailed black cockatoo	2
Regent parrot	2
Superb parrot	1
Swift parrot	3

Western ground parrot	1
PBFD	29

Potential Future Projects: Department of the Environment support

Table 10 presents possible future funding projects on threatened parrot species and PBFD suggested by experts.

Table 10: Summarises suggestions for investment in PBFD research and actions.

Person	Organisation in need	Funding project summary
Pam Whiteley	Wildlife Health Surveillance Victoria	• Need financial support for fixed costs • Health surveillance and research of psittacines for perhaps 5 years in needed to start providing important information on PBFD
Drs Alisa Wallace, Kris Warren, Simone Vitali & Anna LeSouef	Perth Zoo and Murdoch University	• Routine PBFD testing is cost prohibitive; hence molecular testing is only undertaken if there is a clinical suspicion of disease • The interaction between avian polyomavirus and PBFD in wild populations and the effect of concurrent infection on disease expression is unknown and warrants further investigation • The degree of threat posed by PBFD relative to other threats is difficult to assess because data is lacking. Long term studies are needed to assess the effects of PBFD • A long term study is needed to make a meaningful assessment of the prevalence of PBFD and effect on nestling survival.
Sheryl Hamilton	Orange Bellied Parrot Recovery Program	• Funding is needed to help achieve actions from the National Recovery Plan for the Orange Bellied Parrot (2006)
Dr Leo Joseph	CSIRO	• Research and monitoring is needed to determine whether PBFD can be present in populations at subclinical, sub-threatening levels while spreading and creating issues
Paul Eden & Michael Magrath	Zoos Victoria	• More research needs to be undertaken to understand the significance and impact of PBFD on captive and wild populations of Orange Bellied Parrots. • Developing a vaccine for the PCV could be an important development in the captivity management of species
Richard Hill	DELWP, Victoria	• If we can find funding, we could do some surveillance type monitoring around the frequency of the virus in nest hollows.
Chris Hedger & David McLelland	Zoos SA & DEWNR	• At a minimum, samples for PBFD surveillance will be collected opportunistically when trapping of regent parrots is conducted. Resources available will dictate whether these samples are tested or archived. • Monitoring of nests and nestlings may be performed in the future, in which case the impact or otherwise of PBFD on nestling birds could be investigated.
Dr Bethany Jackson	Murdoch University	• Ongoing surveillance of PBFD, including full genome sequencing of any positives, in all threatened species (both captive breeding programs and in the wild, including sympatric reservoir species if they exist in the region of concern). This would inform not only the presence of the

		virus, it would also indicate if there are any changes in the viral genome, or spikes in incidence/prevalence that might indicate an outbreak situation that requires a more urgent response.
Adrian Manning	Australian National University	• Many key threats to the superb parrot continue essentially unmanaged. • Colleagues and I at the ANU are planning further fieldwork on the species. This could present an opportunity to better quantify the prevalence of PBFD in the species.

Management actions

This section provides an outline of the management actions suggested by experts for species of threatened parrots. These management actions address all threats for species not just PBFD. No management actions details were provided by experts pertaining to the following species:

- Coxen's fig parrot
- Golden shouldered parrot
- Princess parrot

PBFD in New Zealand – Dr Bethany Jackson
In response to the initial detection of PBFD, the Dept of Conservation (NZ) placed a ban on all native parrot movements. However since then, movements have been allowed, usually with the requirement for PBFD testing prior to a translocation. There is ongoing passive surveillance through submission of opportunistic samples to the University of Canterbury for PBFD testing by PCR. These are mostly from Kakapo (*Strigops habroptilus*) as part of a management plan in that species, and occasionally from other species such as Orange-fronted Parakeets (*Cyanoramphus malherbi*).

General information for Baudin's Cockatoo, Carnaby's Cockatoo, Forest Red-tailed Black Cockatoo & Muir's Corella – Ron Johnstone
Data generated from project in the WA museum has been used by both State and Federal Government agencies especially information on distribution, status, movements, breeding sites and important habitats to enable the conservation of critical areas. There has been concern on the release of birds back into the wild after a stint in captivity as a possible threat of PBFD. We believe there is beak and feather disease on some Carnaby's Cockatoos in Western Australia but predominantly with rainbow lorikeets.

General information for all Victorian species (potentially the Red-tailed black cockatoo, Swift, Orange-bellied, Superb and Regent Parrot) – Pam Whiteley

There is a desire to improve health knowledge in species to inform management and reduce disease risks. Faculty of Vet & Ag Sciences at the University of Melbourne have expertise in wildlife pathology, parasitology, epidemiology and avian disease (including virology and microbiology) but need to find some financial support for fixed costs. Faculty of Vet & Ag Sciences can assist with pathological investigations of any dead birds, and test samples from these and nest hollow swabs and faeces for Circovirus, polyoma virus and Chlamydia infections by polymerase chain reaction (PCR). It is also valuable to have knowledge of these infections in other psittacine species they may have contact with.

Wildlife Health Surveillance Victoria (part of The University of Melbourne Vet Faculty) investigate mortality and morbidity events in free ranging wildlife to provide improved knowledge of baseline wildlife health, to detect changed patterns and factors responsible. Wildlife Health Surveillance Victoria is currently completing two small pilot projects to investigate circovirus, polyomavirus and Chlamydia in dead psittacines (all species) in Victoria. The outcomes of this research will be valuable to understand how these infections behave in other psittacine species that may have contact with EPBC threatened species.

WA Black cockatoos (potentially the Baudin's, Carnaby's & Forest red-tailed black cockatoo) – Drs Alisa Wallace, Kris Warren, Simone Vitali & Anna LeSouef

When hospitalised at Perth Zoo, wild black cockatoos are housed in isolation from collection birds and serviced with equipment dedicated to black cockatoos. If there is a clinical suspicion of PBFD, the bird is isolated from all other black cockatoos while molecular testing is undertaken. Once transferred from the zoo hospital to rehabilitation facilities, black cockatoos are housed separately from other species to minimise risk of cross-species disease transmission. During nestling fieldwork, disinfectants F10 and Trigene are used to disinfect equipment and personnel during sampling to reduce the risk of disease spread between nest sites.

Glossy black cockatoo – Karleah Berris

The current aims of the Recovery Program, which are being implemented:

1. Maintain or improve nesting success rates on Kangaroo Island
    a. Protecting all known nest trees from possum access with corrugated iron collars and trimming branching canopies.
    b. Carrying out maintenance on artificial hollows to keep them functional (i.e. feral bee hive removal, repairs, removing old eggs)
2. Protect, enhance and increase habitat on Kangaroo Island
    a. Planting trees for habitat (i.e. Allocasuarina feed trees)
    b. Protecting (i.e. fencing) existing habitat
3. Improve knowledge of ecology in order to refine management strategies
    a. Conducting annual nest success monitoring and an annual population census.
    b. Recording band re-sightings throughout the year.
    c. Vegetation studies in response to management actions.
4. Improve community awareness and stewardship of the Recovery Program
    a. Publicising the work of the program through our website, Friends of the Glossies group, local and national media and our newsletter.
    b. Seek, support and maintain a volunteer group to help with nest and population monitoring.

5. Implement a monitoring, evaluation, reporting and improvement (MERI) framework for the Recovery Program

Red-tailed black cockatoo – Richard Hill

- Managing /minimising impact of fire on Stringybark feeding habitat
- Reducing rate of legal clearing through regulation
- Reducing rate of illegal clearing through compliance/referral to Commonwealth EPBC

Glossy black cockatoo – Dr Mathew Berg

No significant management actions in relation to PBFD in glossy black cockatoos have been undertaken.

Night parrot – Dr Stephen Murphy

General threat abatement:

1. Feral cat management
2. Stock/grazing impact management in certain habitats
3. Fire management to prevent single, large-scale fire events
4. Management of unauthorised access by people to occupied sites

Specific to PBFD:

1. Development and implementation of surveillance and security to control unauthorised access to sites known to be occupied
2. Strict quarantine protocols relating to research equipment being used at the site. E.g. no equipment being used for the current research project is being used for work involving other species.

Norfolk Island green parrot – Dr Luis Ortiz-Catedral

- Provisioning of nesting sites
- Monitoring of nests and intervention (egg swapping, supplementary feeding)
- Control of rats and cats via trapping and baiting

Orange-bellied parrot – Dr Annie Philips

In the captive population there is health and disease screening, breeding to provide robust insurance population and birds for release into the wild. In the wild population there is also health and disease screening, as well as provision of artificial nest boxes, provision of supplementary feed during breeding season, monitoring of wild population and released captive bred birds, assessment of productivity and survival, monitoring and management of impacts of predator and competitors.

There is biosecurity and disease management of both captive and wild populations in accordance with recent DPIPWE Biosecurity and Disease Management Protocols for Captive and Wild Orange-bellied Parrots in Tasmania (DPIPWE 2015). DPIPWE is also convening a small ad hoc expert group to further consider PBFD considerations as they relate to both captive and wild orange-bellied parrots.

Orange-bellied parrot – Paul Eden & Michael Magrath

Zoos Victoria currently houses a captive breeding colony of Orange Bellied Parrots as an insurance population and a source of birds to release to the wild. These birds are housed at Healesville Sanctuary in dedicated facilities with strict biosecurity management. A small

group of Orange Bellied Parrots are also housed on display for visitors to educate public about the plight of this species. The display birds are not involved in the breeding program.

At times, Zoos Victoria is required to import Orange Bellied Parrots into our breeding colony for maintaining genetic diversity, as determined through the Species Co-ordinator/Studbook Manager. On arrival, these birds are placed into quarantine and undergo two screening periods for PBFD with one month between tests. The tests undertaken are PCR, Haemagglutination, and Haemagglutination Inhibition. Only birds that are negative on all three tests on both occasions are cleared to join our breeding colony. Incoming OBPs are also screened for *Chlamydophila psittaci* using Clearview testing and Immunocomb, and also undergo faecal examination for internal parasites.

Orange-bellied parrot – Dr Mathew Berg
Management actions for PBFD in orange bellied parrots are coordinated through the recovery team and currently include testing samples from wild nestlings and captive bred adults for BFDV, and genetic sequencing of virus isolates. Future actions will add testing nest box and artificial feeder samples for the presence of virus, with improved hygiene protocols for these accordingly, and surveying PBFD in co-occurring species to test the potential for cross-species transmission.

Regent parrot – Chris Hedger & David McLelland

- Increasing landscape connectivity across the floodplain and Mallee to encourage free movement of the species – largely targeted at identifying and prioritising protection of current flyways, whilst also encouraging development of new paths (i.e. through development of new parks or Heritage agreements etc).
- Increasing breeding habitat, by aiming to increase tree health in River Red Gums (primary nesting tree) – largely conducted through tree or floodplain health assessments followed up by targeted environmental watering.
- Public education to reduce instances of persecution around orchards and targeted compliance regimes to discourage illegal culling.

Regent parrot – Dr Victor G. Hurley
The Living Murray project has installed environmental watering infrastructure to return wetting and drying cycles to the 16,000ha of the Hattah lakes icon site. This is intended to improve the health of the River Red Gums required for breeding and to more generally improve the healthy functioning of the lakes and floodplain system. 30 nest-boxes were installed in part as compensation for the loss of known nest trees.

Superb parrot – Adrian Manning
At the ANU we are not aware of any management actions specific to control of PBFD for the superb parrot.

Swift parrot – Prof R Heinsohn
Actions are now being centred on:

1. Monitoring high levels of predation by introduced predators
2. Mapping highly variable use of breeding habitat (Tasmania) and non-breeding habitat (SE mainland Australia)
3. Mapping distribution of introduced predators
4. Identifying high value breeding habitat in forest production landscapes
5. Monitoring breeding success

6. Trialling methods of predator control

Western Ground Parrots – Drs Alisa Wallace, Kris Warren, Simone Vitali & Anna LeSouef
A disease risk analysis was conducted in 2014 when the captive population was relocated from Albany to Perth Zoo. A number of contagious diseases, including PBFD, avian polyomavirus and chlamydiosis were identified as risks, particularly from contact with free-ranging psittacines inhabiting the zoo grounds. As a consequence of disease risk concerns, the Western ground parrots are housed under enhanced biosecurity conditions which include dedicated equipment, clothing and footwear.

Summary
This section's outline of management actions for species of threatened parrots shows the varied approaches to management actions. It clearly shows the differing levels of concern surrounding PBFD as a management action. In some cases it is not considered while in others it is identified as a serious problem or future risk, and there are extensive management protocols to combat it. Unfortunately no detail on management actions were provided by experts for the Coxen's fig parrot, Golden shouldered parrot, Muir's Corella, Princess Parrot or the Superb parrot so no conclusions can be drawn on management actions for these species.

Current projects

This section provides a brief outline of the work being conducted currently on species of threatened parrots. It address all types of projects not just PBFD related ones. No project details were provided by experts pertaining to the following species:

- Golden shouldered parrot
- Princess parrot

PBFD – Dr Bethany Jackson
A 5 year cross-sectional study on Tiritiri Matangi Island by Auckland Zoo in collaboration with Murdoch University, and with advice/support from Dr Luis Ortiz-Catedral at Massey University is occurring. Also capturing adult Red-crowned Parakeet *Cyanoramphus novaezelandiae* (approx. 60-70) annually for surveillance of BFDV prevalence. An annual nesting study is also testing chicks and nests for BFDV incidence/prevalence in this age-class.

PBFD – Katherine Buchanan
At Deakin University we have been assessing the potential role of the common parrot species crimson rosella (*Platycercus elegans*) in acting a reservoir for beak and feather disease. We have not worked on the 16 threatened parrots, but our work has implications for disease transmission to these species.

General information for Baudin's Cockatoo, Carnaby's Cockatoo, Forest Red-tailed Black Cockatoo & Muir's Corella – Ron Johnstone
There is work currently in the WA museum on the breeding biology of these birds including distribution, status, relative abundance, habitat preferences, food, migration and movements etc.

General information for all species – Dr Leo Joseph

The CSIRO is involved in general phylogenetic studies and population genetics/ phylogeographical studies of parrots and some oversight of Night Parrot work. At present several papers are in the works, such as one on lorikeet systematics, another on the phylogeography of the Galah. Also a collaborative study is just beginning looking at patterns of relationships among parrot species worldwide based on genomic methodologies.

WA Black cockatoos (potentially the Baudin's, Carnaby's & Forest red-tailed black cockatoo) – Drs Alisa Wallace, Kris Warren, Simone Vitali & Anna LeSouef
Monitoring of black cockatoo health in WA by veterinarians at Perth Zoo and Murdoch University has been undertaken for over 10 years and will continue into the foreseeable future. Perth Zoo vets are heavily involved in the black cockatoo rehabilitation program, which is a collaborative effort between the Department of Parks and Wildlife (DPaW), Perth Zoo and several cockatoo rehabilitation centres. A comprehensive health assessment of each bird is undertaken by Perth Zoo veterinarians on admission to the program, with ongoing veterinary involvement as required during the rehabilitation process. This program enables monitoring of disease issues in the wild population, as well as management of biosecurity risks associated with releasing rehabilitated birds.

The Black Cockatoo Health and Demographics Project operated through the Conservation Medicine Program at Murdoch University currently have a number of research projects underway in collaboration with DPaW and Perth Zoo. Current projects include:

- Carnaby's cockatoo nestling health study – investigating PBFD, avian polyomavirus (APV), chlamydiosis and adenovirus
- Forest red-tailed black cockatoo health and disease study – investigating PBFD and APV
- Investigation of paralysis syndrome in Carnaby's cockatoos
- Satellite tracking of Baudin's cockatoos, Carnaby's cockatoos and forest red-tailed black cockatoos

Baudin's Cockatoo – Drs Alisa Wallace, Kris Warren, Simone Vitali & Anna LeSouef
A small number of Baudin's cockatoos (10-20 individuals) are admitted to the Perth Zoo rehabilitation program annually. To date, clinical evidence of PBFD has not been detected, and molecular screening has not been undertaken in this species. The prevalence of PBFD in Baudin's cockatoos is unknown.

Carnaby's Cockatoo – Drs Alisa Wallace, Kris Warren, Simone Vitali & Anna LeSouef
Approximately 120 adult and juvenile Carnaby's cockatoos are examined annually via the rehabilitation program. Routine PBFD testing is cost prohibitive; hence molecular testing is only undertaken if there is a clinical suspicion of disease. Occasional birds have presented with abnormal feathering but have been found to be negative for PBFD on molecular testing.

A research project investigating Carnaby's cockatoo nestling health commenced in 2010 (chief investigator Anna Le Souef). PBFD viral DNA was detected in 8.5% of nestlings in 2010 but has not been found in subsequent breeding seasons (2011-2013). Results thus far suggest that the presence of PBFD virus infection in nestlings is sporadic and a long term study is needed to make a meaningful assessment of the prevalence of PBFD and effect on nestling survival.

Forest Red-tailed Black Cockatoo (FRTBC) – Drs Alisa Wallace, Kris Warren, Simone Vitali & Anna LeSouef

In 2013, the first cases of PBFD were recorded in two wild juveniles that developed clinical signs during rehabilitation. Molecular testing confirmed that these birds were shedding large quantities of PBFD virus with no immune response. We believe that these birds were infected in the wild, though overt clinical signs were not evident for some months after admission. No further cases were detected upon diagnostic testing of 27 in-contact birds at the rehabilitation centres (Carnaby's cockatoos and FRTBCs).

These cases were the catalyst for a postgraduate research project which commenced in July 2013 (chief investigator Alisa Wallace) investigating the prevalence of PBFD and avian polyomavirus in FRTBCs admitted to the rehabilitation program. Preliminary results indicate a very low prevalence of both PBFD and avian polyomavirus infection in the wild population. This research is ongoing (expected completion July 2016) and the effect of PBFD at a population level is uncertain. Results will be made available to the Forest Black Cockatoo Recovery Team once the study is completed.

It is speculated that movement of FRTBCs into the Perth metropolitan area over the past 5 years may be increasing their exposure to introduced psittacines carrying PBFD virus. Analysis of blood and feather samples obtained from invasive psittacines during culling operations are also being used to search for molecular evidence of transmission of PBFD virus from invasive species to FRTBCs. Comparative phylogenetic analysis can reveal valuable information about the origins and evolution of the virus within and between populations. Results will be used to assess the PBFD threat posed by introduced psittacines in WA, and determine whether population control is likely to significantly impact this threat.

Carnaby's cockatoo – Dr Denis Saunders
Staff from the Vet School at Murdoch University and Perth Zoo accompanies myself and WA Department of Parks and Wildlife during field work to collect blood and swabs from every nestling we band. They are interested in the incidence of PBFD.

Coxen's fig parrot - Michael Pyne
The Currumbin Wildlife Sanctuary has worked with the Coxen's recovery team for over 10 years; they have been active in breeding the analogue Double eyed fig parrot throughout this time. There are 4-5 breeding pairs at any time and they manage their breeding as required.

Glossy black cockatoo & orange-bellied parrots – Dr Mathew Berg
Deakin University have been studying PBFD using crimson rosellas (*Platycercus elegans*) as a study model since 2009. As part of this project they have investigated genetic diversity and phylogenetics of PBFD virus samples from rosellas and several other species, including the Kangaroo Island glossy black cockatoo (Eastwood et al 2014).

This year they are commencing an ARC Linkage funded project "Threats of avian pathogens to endangered parrots and human health: developing and utilizing tools for risk reduction" (2015-2018) which aims assess the threat of BFDV in orange-bellied parrots and Australian psittacine species more generally (including species not currently considered threatened). This project focuses on:

1. The effects of PBFD of breeding success and survival in wild populations,
2. The roles of environmental reservoirs (e.g. nest hollows) in virus transmission, and their potential utility for disease surveillance, and
3. The importance of genetic diversity and inbreeding in susceptibility to virus infection and PBFD.

Collaborators on this project are:

- Deakin University: Prof Andy Bennett, Prof Marcel Klaassen, A/Prof Kate Buchanan, Prof Ken Walder and Prof Martyn Jeggo
- Charles Sturt University: Prof Shane Raidal
- Zoos Victoria: Der Michael Magrath

Glossy black cockatoo (GBC) – Karleah Berris
A GBC Recovery Program for DEWNR began in the mid-1990s when the estimated GBC population size was 188 individuals; although a survey conducted in 1993 recorded only 136 birds (Pepper 1997). At that time, recruitment into the population was low, mainly because of poor breeding success (c. 23%) resulting from egg and nestling predation by brush-tailed Possums (*Trichosurus vulpecula*) (Garnett et al. 1999).

Management was initiated to protect nest trees from Possums and other threats, and since then breeding success rates have generally been over 45%. Artificial nest boxes have also been installed in suitable breeding habitat where a shortage of natural tree hollows exists (Garnett et al. 1999) to increase reproductive output. Currently, nesting has been observed at 174 known natural tree hollows and 100 artificial nest boxes; these nests are monitored each breeding season. As a result of management initiatives, the number of GBCs counted during the annual census has increased at an average rate of 2.4% per annum from 1995-2014.

In addition to promoting breeding success, research on the behavioural ecology of the GBC has been carried out to increase knowledge of breeding biology, demography, survival rates and movements of birds. This has been achieved by nest monitoring, banding studies, and conducting an annual census. Restoration of GBC habitat, particularly plantings of drooping sheoak, has also increased the extent of GBC foraging and nesting habitat.

Night parrot – Dr Stephen Murphy
Currently there is an intensive field-based research project under contract to Fortescue Metals Group, which is satisfying an EPBC Condition.

Norfolk Island green parrot – Abi Smith
Parks Australia has an extensive recovery program underway that involves many aspects of threat abatement, research and active recovery work.

Norfolk Island green parrot – Dr Luis Ortiz-Catedral
Since 2013 Massey University has a collaborative project with Norfolk Island National Park. This project is aimed at increasing the population size of the species and documenting aspects of its ecology that will improve its conservation status. The different components of this project include: analysis of diet according to season, development of a survey method, PBFD virus testing, and development of demographic models under hypothetical conservation scenarios.

Orange-bellied parrot – Dr Annie Philips
The DPIPWE recognises that there is a need to implement priority recovery actions for the critically endangered Orange-bellied parrot in Tasmania. Manage and maintain captive Orange-bellied insurance population at Taroona, Tasmania, managed to improve genetic quality and size of existing population, and provide individuals that are suitable for release into the wild to augment the wild population. Maintain the stud book and provide species coordination for the captive metapopulation (in association with Zoo Aquarium Association).

Population monitoring and management of the single wild population, at Melaleuca in the Tasmania Wilderness World Heritage Area needs to be undertaken. Actions include provision and monitoring of artificial nest boxes, supplementary food, measurement of demographic parameters (breeding effort, success, survival rates), genetic and disease screening of wild population, competitor and predator interactions monitored at select nest boxes by camera trapping. Implement translocations of captive bred birds into the wild population, monitor survival and productivity of released birds, within and between seasons.

Orange-bellied parrot – Dr Paul Eden & Dr Michael Magrath
Zoos Victoria has research projects run through Shane Raidal/Andrew Peters (Charles Sturt University). Zoos Victoria is also Partner Investigator on an ARC Linkage grants entitled "Threats of avian pathogens to endangered parrots and human health: developing and utilizing tools for risk reduction". The project commenced in early 2015 and is being lead by Deakin University (Prof Andrew Bennett) and also involved Charles Stuart University and the Victorian Department of Environment, Land, Water and Planning.

Current work – Zoos Victoria is involved in captive breeding of birds and release to the wild as part of Recovery Team efforts to improve the conservation status of this species. Pre-release health screening of birds includes testing for PBFD – samples are collected on three occasions, with a month between each, and are tested using PCR, Haemagglutination and Haemagglutination Inhibition. Currently, only birds with negative results for all three tests on all three occasions are released to the wild.

Among other objectives, the ARC project aims to

1. Determine the prevalence and fitness consequences of PBFD in wild Australian parrots, including the long-term model species (*Platycercus elegans*) and orange-bellied parrot
2. Determine the role of artificial feeders and nest boxes as fomites for PBFD, and from this develop a nest audit tool to monitor avian host populations and pathogen evolution, a tool which can then be applied to improve management of threatened parrot species worldwide.

Zoos Victoria will facilitate the collection of samples from captivity and the wild to support these objectives.

Orange-bellied parrot – Sheryl Hamilton
Actions from the National Recovery Plan for the OBP (2006) are being implemented where funding is available. For 6-7 months (Oct-April) each season, volunteers and Tas DPIWE staff undertake monitoring and management (including daily supplementary feeding) of the breeding population at Melaleuca, SW Tasmania. There is a captive breeding program across 6 institutions (all registered with Zoo and Aquarium Association). At the beginning of the past two breeding seasons (i.e. in Nov 2013 and in Oct 2014) a number of captive-bred adults were released at Melaleuca. During the winter months, there are coordinated as well as opportunistic surveys to locate and record OBPs at their winter feeding grounds in Victoria and South Australia.

Orange-bellied parrot – Dr Dejan Stojanovic
The Orange-bellied parrot undergoes captive breeding and release at Melaleuca. Maintenance of nest boxes at Melaleuca, and banding of wild bred nestlings (both programs run by DPIPWE).

Red-tailed black cockatoo – Richard Hill
Through DELWP there is population monitoring, research into fire impacts on food availability and analysis of existing data to better understand threatening processes.

Regent parrot – David McLelland & Chris Hedger
In South Australia, the Regent Parrot Recovery Team has undertaken a range of population monitoring activities - including efforts to identify survivorship and site fidelity; preliminary health monitoring and disease surveillance/investigation; attempting to track movements and roosting habits, including those of crèche flocks (largely fledged juveniles); nesting success and competition research; and public outreach/education programs. The Recovery Team is currently reviewing past activities, and prioritising projects for the next 5 – 10 years.

Regent parrot – Dr Victor G. Hurley
DELWP notes that annual surveys for active nests are being conducted at Hattah-Kulkyne NP in response to an EPBC Act compliance permit following the removal of known nest trees during the construction of environmental water infrastructure under the Living Murray Project.

Superb parrot – Adrian Manning
Colleagues and I at the ANU are currently working on two papers: (1) on the risk of climate change to the superb parrot (2) data on a significant decline in the species in a core breeding area. We are also planning some further fieldwork on the species. This could present an opportunity to better quantify the prevalence of PBFD in the species.

Swift parrot – Dr Debra Saunders
The ANU notes that there is a recovery program for this species and currently there are three aspects being implemented: Breeding biology, population monitoring and conservation in Tasmania, winter habitat use dynamics and conservation on mainland Aust and coordination of volunteer monitoring surveys.

Swift parrot – Prof R Heinsohn
The ANU notes that there is a major conservation program aimed at conservation of wild swift parrots including three post-doctoral research fellows. Funded by two ARC grants and two mining offset grants.

Swift parrot – Dr Dejan Stojanovic
A research program is led by ANU on breeding biology, settlement patterns and resource availability.

Western Ground Parrots – Drs Alisa Wallace, Kris Warren, Simone Vitali & Anna LeSouef
Perth Zoo and Murdoch University note that the wild-caught founders (8 individuals) of the Western ground parrot captive management program were tested for PBFD and APV when the program commenced, with no positive results on PCR, and haemagglutination assay titres of <1:20 in all birds. Opportunistic retesting of several individuals over the past 12 months has also found no evidence of either disease. It is not possible from this limited data to make any meaningful assessment of PBFD threat to the wild population.

Summary

This section outlines the work being conducted on species of the threatened parrots. It clearly shows the differing levels of time, effort and funding being applied to PBFD projects. In some cases it is not considered while in others it is identified as a serious problem or future risk, and there are extensive projects to combat it. Unfortunately the epxerts supplied no information about work on Baudin's cockatoo, Coxen's fig parrot, Forest red-tailed black cockatoo, Golden shouldered parrot, Muir's Corella, Princess Parrot, Superb parrot and the Western ground parrot so no conclusions can be drawn about the focus on PBFD for these species.

PBFD as a threat

The subsequent section provides a description of PBFD as a significant threat to threatened parrot species. It describes the resources and work being conducted to address it. No information of PBFD was provided by experts pertaining to the following species:

- Coxen's fig parrot
- Western ground parrot

PBFD – Dr Bethany Jackson

As per the PhD findings from Red-crowned Parakeets (RCP) and the paper published in Achives of Virology (Jackson et al 2015), we at Murdoch University feel that the threat posed by this virus to Red-crowned Parakeets specifically has been downgraded, as our findings suggest this species has specific life history traits that would enable it to recover from periodic outbreaks, as well as there being evidence that the virus cannot sustain itself at high prevalence in this species, rather it is likely maintained in a reservoir (either abiotic such as nest sites or biotic such as the Eastern Rosella). However, we maintain that BFDV is a mutagenic and recombinant virus, meaning it can theoretically become more virulent and therefore there may be future situations where more 'virulent' forms emerge with greater mortalities and the threat status changes. We also maintain that species with small populations, low reproductive potential, and other threats such as predation etc, are more likely to be significantly threatened by a virus such as BFDV, particularly if it is affecting juveniles and fledging rates. Thus in the NZ context, we would be most concerned about protecting Orange-fronted Parakeets and the Kakapo.

We at Murdoch University would recommend ongoing surveillance of this pathogen, including full genome sequencing of any positives, in all threatened species (both captive breeding programs and in the wild, including sympatric reservoir species if they exist in the region of concern). This would inform not only the presence of the virus, it would also indicate if there are any changes in the viral genome, or spikes in incidence/prevalence that might indicate an outbreak situation that requires a more urgent response. However we would also recommend that managers are aware of the range of other pathogens that exist in captive and wild populations of parrots, and take the opportunity to use samples to screen for a range of pathogens, for two reasons. Firstly, there are other pathogens known in captivity that should not be introduced to wild populations, and should be screened for and monitored. Secondly, there is a risk if we only monitor for 'known' or popular diseases, we will miss other pathogens/diseases that may be more significant.

General information for Baudin's Cockatoo, Carnaby's Cockatoo, Forest Red-tailed Black Cockatoo & Muir's Corella – Ron Johnstone

The WA museum considers PBFD a threat to cockatoo and parrot populations. Introduced populations of the Rainbow Lorikeet in the Perth region appear to have PBFD, but it's rarely recorded in other parrots.

WA threatened species (potentially the Baudin's, Carnaby's & Forest red-tailed black cockatoo as well as Muir's Corella, Princess parrot & Night parrot) – Drs Alisa Wallace, Kris Warren, Simone Vitali & Anna LeSouef

Perth Zoo and Murdoch University consider PBFD to be an ongoing insidious threat to endangered psittacine species in Western Australia for the following reasons:

- A reservoir of PBFD virus is likely to exist in wild populations of invasive parrot species resulting in a continual risk of spill over into threatened species, as has been documented in orange-bellied parrots (Peters et al. 2014). Invasive species of concern in WA include sulphur-crested cockatoos (*Cacatua galerita*), galahs (*Eolophus roseicapillus*), Eastern long-billed corellas (*Cacatua tenuirostris*), little corellas (*Cacatua sanguinea*) and rainbow lorikeets (*Trichoglossus haematodus*) introduced from the Eastern states where PBFD is widespread.
- PBFD virus is known to be highly recombinant, with potential for rapid changes in virulence and epidemiology. This has been documented in the endangered Echo parakeet, in which a recombination event resulted in a sudden and devastating disease outbreak with a 50% mortality rate in nestlings (Kundu et. al 2012, Richards 2010). Our research indicates that PBFD is present in wild populations of Carnaby's cockatoos and FRTBCs with unknown consequences should a more virulent PBFD virus manifest in the future.
- PBFD virus is very stable in the environment and can contaminate nest sites for many years. This is particularly relevant in black cockatoo species which demonstrate high nest-site fidelity, and compete with invasive psittacines for nest hollows.

The degree of threat posed by PBFD relative to other threats is difficult to assess because data is lacking. Long term studies are needed to assess the effects of PBFD over time.

Avian polyomavirus (APV) is a significant infectious disease of a variety of avian species, and all psittacine birds are considered susceptible. Clinical disease usually manifests as acute death in nestlings, with subclinical infection occurring in older birds. Concurrent infection with PBFD virus and APV is frequently reported in the literature in captive psittacines. A number of reports suggest that cockatoos are relatively resistant to disease caused by APV, except when they are immunosuppressed by concurrent PBFD. The interaction between these viruses in wild populations and the effect of concurrent infection on disease expression is unknown and warrants further investigation.

General information for all Victorian species (potentially the Red-tailed black cockatoo, Swift, Orange-bellied, Superb and Regent Parrot) – Pam Whiteley

The University of Melbourne notes that there is not enough knowledge to answer questions on PBFD. Funding of health surveillance and research of psittacines for perhaps 5 years is needed to start providing this important information. There is little baseline knowledge of PBFD prevalence or impacts in Victorian species, but The University of Melbourne have the expertise (pathological to detect disease processes and diagnostic PCR tests and microbiology in our Avian Disease program and Pathology Department at The University of Melbourne). As circovirus can affect immune function, it may have secondary effects on the impact of other infections (Chlamydia, polyoma virus etc) on psittacine health. In general, there is a

lack of scientific evidence about health impacts and risks of PBFD/circovirus for most psittacine species.

PBFD – Katherine Buchanan
Deakin University notes that the threat which PBFD poses to threatened parrot species is unknown. Potentially it could be very important. We have developed diagnostic tools and have been surveying local parrot populations for the last 5 + years. This has led to recent funding to test the risk of this disease to the surviving orange bellied parrots. ARC Linkage LP140100691 2014 – 2017 Threats of avian pathogens to endangered parrots and human health: developing and utilizing tools for risk reduction Bennett, Raidal, Klaassen, Buchanan, Walder, Magrath, Seggo, Jeggo. This work has recently started and seeks to investigate routes of transmission and key modes of threat to declining parrot species.

BFD – Dr Leo Joseph
The CSIRO notes that PBFD seems to be a potentially serious threat. It is somewhat unclear as to when, where, how and why prevalence of PBFD in natural populations reaches "clinical" and thus conservation significance, although its presence at all is arguably of conservation significance. The other side of that coin is whether it can be present in populations at subclinical, sub-threatening levels while spreading all the while. Research and monitoring is clearly needed.

BFD – Renate Velzeboer
DEWNR states that PBFD is a significant threat to threatened species now and in the future.

Carnaby's cockatoo – Dr Denis Saunders
I understand that it occurs in Carnaby's cockatoo, but I have never handled an adult or nestling that showed symptoms of PBFD. Since 1969 I have handled several thousand Carnaby's cockatoo.

Glossy black cockatoo & Orange-bellied parrot – Dr Mathew Berg
As a representative of Deakin University I consider PBFD a significant potential threat, on the basis of its high pathogenicity known from captive birds, and the increasing knowledge that the causative virus is highly prevalent in many Australia parrot species in the wild (Eastwood et al. 2015) and can be transmitted from reservoirs to threatened species (Sarker et al. 2014, Eastwood et al. 2015). Work to reveal the incidence of PBFD in a wider range of species in the wild (including species that may act as reservoirs), the role of genetic diversity in PBFD emergence, and to better understand the transmission of the virus and the effects of PBFD on breeding success and survival in wild populations, is being commenced to address the issue of PBFD.

Glossy black cockatoo – Karleah Berris
PBFD has been raised and discussed at some length in Recovery Team Meetings for this species. It is believed that this disease could pose a risk to the Kangaroo Island GBC population as we have such a small isolated population. 22 samples from next hollows were suitable for tested for presence of PBFD in nest hollows. All samples tested negative for presence of PBFD and avian polyomavirus.

This was followed up in 2014, with the collection of blood samples from 10 nestlings during the breeding season. These samples also all returned a negative result. Staff working on the Recovery Program have been provided with information are aware of the external symptoms

of the disease, and as yet there has not been any unexplained deaths of chicks or juveniles investigated.

Golden shouldered parrot – Stephen Garnett
As an employee for Charles Darwin University I can say that no beak and feather has been detected, but nor, have any birds been tested. Yellow feather anomalies were noted in the crown feathers of two adult males out of about 600 observed during the 1990s. Both were breeding with one having two clutches in one year. Neither appeared to be in any way discomfited or had other signs of morbidity that might have been associated with disease. The only dead parrots found were the subject of predation; no sick fledged parrots were encountered. Some dead chicks were found in nests for unknown reasons but most nest failure was due to predation or egg failure, usually abandonment of incomplete clutches.

Night parrot – Dr Stephen Murphy
As a QLD consultant I would suggest that PBFD has a low probability of affecting Night Parrots. Potential and most likely sources of introduction could be from people who have contact with infected captive parrots who then attempt to capture individual night parrots illegally for aviculture. However, I suggest that the likelihood of such events occurring remains low given tight security that is being developed and implemented at sites known to be occupied.

Norfolk Island green parrot – Abi Smith
Norfolk Island National Park staff notes PBFD and it will be considered a significant threat if found to be present in the population. Birds show symptoms of PBFD such as deformed feathers, long sheaths covering mature feathers and discoloured feathers. Currently we spend time assisting juvenile birds to remove the long sheaths from the feathers.

Blood samples are being collected from all juvenile birds prior to fledging their nest. These blood samples will be analysed by Massey University under a collaborative research agreement. If PBFD is found to be present in the population management decisions will have to be made around the establishment of a translocated population that could potentially be free of the disease.

Orange-bellied parrot – Dr Annie Philips
As an employee of DPIPWE I can say that PBFD is known to be present in the wild OBP population, two distinct PBFD genotypes have been isolated (Peters et al., 2014). Development of robust disease screening and biosecurity protocols for Orange-bellied parrots has recently been completed (DPIPWE 2015). Disease screening remains a high priority for both captive and wild population.

Orange-bellied parrot – Paul Eden & Michael Magrath
Zoos Victoria notes that PBFD may result in nestling mortality, impacting on success of breeding birds to maintain captive insurance populations or to release to the wild. We have a number of wild parrots around the grounds at Healesville Sanctuary – the design of the OBP facilities is such to minimise the risk of contamination of OBP aviaries by waste products from wild birds. We also have keepers dedicated to the OBP colony (i.e. these keepers do not care for other parrots while working with OBPs).

Zoos Victoria is contributing funding and samples to support the ARC Linkage project. We will also be contributing to a working group that aims to establish guidelines, in relation to

the PBFD status of birds, to aid the management of the captive population and release to the wild of orange-bellied parrots.

There is limited understanding on the significance and impact of PBFD on populations of Orange Bellied Parrots. More research needs to be undertaken to understand this issue, however it has been very limited by the lack of available funding. Many questions around PBFD and OBPs come up repeatedly in discussions/meetings around captive management and wild populations; however decisions are often hampered by this limited understanding. Included among these discussions have been the merits of developing a vaccine for the PCV, which could be an important development in the captivity management of this and other parrot species.

Orange-bellied parrot – Sheryl Hamilton
PBFD is a significant threat to wild population of OBPs. In 2012, the OBP Recovery Team commissioned Charles Sturt University to undertake some work on the isolates of PBFD found in the wild and in the captive population of OBPs. This has not been formerly written up.

Red-tailed black cockatoo – Richard hill
DELWP are not undertaking any work currently on this threat. We have little understanding of the role of disease *per se* in population regulation or as a threat to this taxon. If we can find funding, we could do some surveillance type monitoring around the frequency of the virus in nest hollows.

Regent parrot – Chris Hedger & David McLelland
Zoos SA and DEWNR find it difficult to determine if PBFD is a threat with the available data. We have trapped two regent parrots with active PBFD infection. We have not recognised clinical beak or feather lesions in these or other trapped birds. There is a paucity of data on hatchling survival in the SA population, and it is unknown what impact PBFD is or isn't having on nestlings.

It is unknown whether or not there are any subclinical effects of PBFD (such as immunosuppression) in adults that could increase susceptibility to other threatening processes. It may be that, historically, robust populations of eastern regent parrot populations were able to withstand potential impacts of PBFD, but we are conscious that such impacts could become significant at a population level as the population declines.

Zoos SA and DEWNR are currently identifying and prioritising how best to utilise available resources to best understand the key threatening processes to eastern regent parrots. At a minimum, samples for PBFD surveillance will be collected opportunistically when trapping of regent parrots is conducted; resources available will dictate whether these samples are tested or archived. Monitoring of nests and nestlings may be performed in the future, in which case the impact or otherwise of PBFD on nestling birds could be investigated.

Regent parrot – Dr Victor G. Hurley
DELWP note that if a more virulent strain were to impact on this population it has the potential to be very significant. During a recent (un-submitted) PhD study of this species a Parvo-virus was detected in over half of the adult males mist-netted. The exact impact of this on the longevity of individuals is unknown.

Superb parrot – Adrian Manning
I believe that PBFD will become an increasing threat to the superb parrot in the future and, due to synergies between nest tree decline, climate change and hollow competition-related transfer of PBFD, it may pose a significant risk to the species. There are two reasons for this (1) ongoing loss of hollow-bearing trees without replacement (2) projected reduction and shift of range due to climate change. I am not aware of any work on PBFD in relation to the Superb Parrot currently.

Swift parrot – Professor Robert Heinsohn
ANU notes that we have made screening for PBFD a major aim and have thus far screened blood samples from over 200 individuals. No live virus has been detected and only one individual shows evidence of having been infected. We do not consider PBFD a major threat but will continue screening blood samples gained for other purposes.

Summary
PBFD is known to be a current significant threat to only the Orange bellied parrot, as seen in table 11. However even amongst the group of Orange Bellied Parrot experts there are differences in opinion about the level of threat. PBFD does however have the potential to become a threat in the future to other threatened parrot species. Unfortunately there seems to be a major gap in our knowledge on PBFD and more research will be needed to draw conclusive observations. No PBFD details were provided for Baudin's cockatoo, Golden shouldered parrot, Superb parrot, Red-tailed black cockatoo and Princess parrot so no conclusions can be drawn about the impact of PBFD on these species.

Table 11: Experts Summary on PBFD

Threatened Parrot Species	PBFD concern
Orange-bellied parrot	Very high
Glossy black cockatoo	High
Norfolk Island green parrot	High
Western ground parrot	High
Forest red-tailed black cockatoo	Moderate
Carnaby's cockatoo	Moderate
Regent parrot	Moderate
Coxen's fig parrot	Low
Muir's Corella	Low
Night parrot	Low
Swift parrot	Low
Baudin's cockatoo	Unknown
Golden shouldered parrot	Unknown
Princess parrot	Unknown
Red-tailed black cockatoo	Unknown
Superb parrot	Unknown

Advice on Threats

Table 12: Information from experts on species threats and PBFD as a threat

Threatened Parrot Species	Species threats, excluding PBFD	PBFD
1. Baudin's cockatoo	Declining hollow availability and habitat quality.	Unknown
2. Carnaby's cockatoo	Land clearing for agricultural and urban development with resultant loss of breeding and feeding habitat. Deterioration of extant tree hollows used for breeding and extant foraging habitat.	Identified in nestlings.
3. Coxen's fig parrot	Lack of knowledge.	PBFD is not a threatening process for these critically endangered parrots. There is no evidence that PBFD contributed to the decline of the species and no PBFD in the very small population now. PBFD has never been diagnosed and there have never been any clinical signs. PBFD has not been tested for through DNA or HA/HI.
4. Forest red-tailed black cockatoo	Declining hollow availability and habitat quality.	There have been 2 clinical cases.
5. Glossy black cockatoo	Overabundant possums predating on eggs and nestlings, habitat loss, stochastic events that could affect small isolated populations, disease.	PBFD has been detected in a glossy black cockatoo, and is a genetic variant that is normally specific to rosellas and distinct from variants found in other cockatoos. This suggests that cross-species transmission from Adelaide rosellas to glossy black cockatoos is possible and may threaten populations (Eastwood et al, 2014).
6. Golden shouldered parrot	Inappropriate fire regimes	Unknown
7. Muir's Corella	Declining hollow availability and habitat quality.	Unknown
8. Night parrot	Difficult to locate the current known populations are in SW and Qld. Large, single fire events removing long unburnt Triodia, feral cats and potentially foxes, illegal collecting (eggs, nestlings and adults) as well as overgrazing in critical habitats.	Unknown
9. Norfolk Island green parrot	Predation by rats and cats, competition from Crimson Rosellas, there is demographic stochasticity and a small gene pool.	Potential significant threat as there is decreased immunity owing to BFDV infection, leading to higher mortality rates and reduced recruitment in a recovering population.

10. Orange-bellied parrot	Degradation and loss of habitat (in particular, loss and fragmentation of its non-breeding salt marsh habitat), competitors and predators, disease, limited genetic diversity, stochastic environmental events (which affect the small, vulnerable wild population). In addition to listed threats from the recovery plan, the species is known to be prey for sugar gliders (which have been recorded as killing and eating adult females and their eggs at nest boxes in Tas). This is listed in the new recovery plan (draft). Wildfire, disease outbreak and other stochastic events pose major risks to the extant population at Melaleuca because there are no insurance populations elsewhere.	The virus causing PBFD is present in both wild and captive populations of this species. There is potential for transmission from other parrot species (not confirmed by DPIPWE testing) e.g. Green rosellas, Sulphur-crested cockatoos, Crimson rosellas (Peters et al. 2014, Eastwood et al. 2015). PBFD was a significant cause of death among captive Orange-bellied Parrots during the breeding program in 1986–1991 (Brown 1988). The species is very vulnerable to PBFD because it occurs in a single population, and there is no evidence that current approaches to handling wild birds are adequate to prevent PBFD transmission by management activities.
11. Princess parrot	Remoteness hinders accurate knowledge.	Unknown
12. Red-tailed black cockatoo	Declining hollow availability and habitat quality. Also questions around taxonomy, is it one species or a composite of several currently unrecognized species?	It is unknown at this stage of the presence and extent of the disease in the South-eastern Red-tailed Black-Cockatoo.
13. Regent parrot	Key threatening processes remain uncertain. Postulated threatening processes include clearing and fragmentation of native nesting and feeding habitat; changes in water flow along the river system; persecution as a perceived agricultural pest; nutritional imbalances or exposure to toxins from feeding in and around crops and orchards; and disease.	At this stage there is a limited ability to provide answers on the relative threat of PBFD (and other diseases) against other potential factors.
14. Superb parrot	Debate seems to continue on true status of species and whether high numbers seen around centres like Canberra are a true indication of status.	Unknown
15. Swift parrot	Predation by introduced sugar gliders was recently discovered for this species and represents the principal cause of mortality and nesting failure.	Believed to be one confirmed case of PBFD for the species after testing hundreds of birds. If the species experiences greater stresses such as due to habitat loss and predation then their susceptibility to disease problems may increase.
16. Western ground parrot	Small population size.	Insufficient data.

Parrot and BFD publications

Table 13: Resources from experts

Author	Yr	Title	Published
Abi Smith	2013	Green Parrot Action Plan	
Andrew Peters, et al	2014	Evidence of psittacine beak and feather disease virus spillover into wild critically endangered orange bellied Parrots (Neophema chrysogaster)	Journal of Wildlife Diseases, 50(2), 2014, pp. 288–296
Subir Sarker, et al	2014	Mutability Dynamics of an Emergent Single Stranded DNA Virus in a Naıve Host	PLOS ONE, 2014, Volume 9 Issue 1
Justin R. Eastwood, et al	2015	Prevalence of beak and feather disease virus in wild *Platycercuselegans: comparison of three tissue types usinga probe-based real-time qPCR test*	Australian Journal of Zoology, 2015, 63, 1–8
OBPRT	2014	National Recovery Plan for the Orange-bellied Parrot, *Neophema chrysogaster*.	http://www.environment.gov.au/resource/draft-national-recovery-plan-orange-bellied-parrot-neophema-chrysogaster
DPIPWE	2015	DPIPWE Biosecurity and Disease Management Protocols for Captive and Wild Orange-bellied Parrots in Tasmania	http://dpipwe.tas.gov.au/Documents/DPIPWE%20Biosecurity%20and%20Disease%20Management%20Protocols%20for%20Captive%20and%20Wild%20Orange-bellied%20Parrots%20in%20Tasmania.pdf
Ireland McLelland and Ryan Colton	2013	Smokers' Health – the effort to understand regent parrot declines in South Australia	Proceedings of the Wildlife Disease Association Australasia Conference.
Sarker S, et al	2014	Whole-genome sequence characterization of a beak and feather disease virus in a wild regent parrot (*Polytelis anthopeplus monarchoides*).	Genome Announc 30:2(1).
Garnett, et al	1999	The Breeding Biology of the Glossy Black-Cockatoo on Kangaroo Island SA	Emu, vol. 99, pp 262-279
J. R. Eastwood, et al	2015	Comparison of sample types for avian virus surveillance using a novel probe-based quantitative real-time PCR test for beak and feather disease virus	Australian Journal of Zoology 63, 1-8.
J. R. Eastwood, et al	2014	Phylogenetic analysis of beak and feather disease virus across a hybridising host species complex	Proceedings of the National Academy of Sciences USA 39, 14153-14158.
M. Massaro, et al.	2012	Molecular characterisation of Beak and feather disease virus (BFDV) in New Zealand and its implications for managing an infectious disease.	Archives of Virology 157: 1651-1663.
L. Ortiz-Catedral, et al.	2011	Avian malaria in a remnant population of red- fronted parakeets on Little Barrier Island, New Zealand.	New Zealand Journal of Zoology 38: 261-268.

L. Ortiz-Catedral	2010	No T-cell-mediated immune response detected in a red-fronted parakeet (Cyanoramphus novaezelandiae) infected with the Beak and Feather Disease Virus (BFDV).	Notornis 57: 48-49.
L. Ortiz-Catedral, et al.	2010	A new isolate of beak and feather disease virus from endemic red-fronted parakeets (Cyanoramphus novaezelandiae) in New Zealand.	Archives of Virology 155: 613-620.
L. Ortiz-Catedral, et al.	2009	First report of beak and feather disease virus (BFDV) in wild Red-fronted parakeets (Cyanoramphus novaezelandiae) in New Zealand	Emu 109: 244-247.
K. Rose	2005	Common Diseases of Urban Wildlife: BIRDS	Australian Registry of Wildlife Health
Australian Wildlife Health Network	2009	Psittacine Circovirus Disease (PCD, PBFD) FACT SHEET	Australian Wildlife Health Network
The University of Melbourne	2014	Wildlife Health Surveillance Victoria	Faculty of Veterinary Science
Renate Velzeboer	2013	Information sheet on PBFD	http://www.environment.sa.gov.au/managing-natural-resources/plants-and-animals/Living_with_wildlife
Andrew Peters, et al.	2014	Evidence Of Psittacine Beak And Feather Disease Virus Spill over Into Wild Critically Endangered Orange bellied Parrots (*Neophema Chrysogaster*)	Journal of Wildlife Diseases, 50(2), 2014
S. Sarker , et al.	2014	Mutability Dynamics of an Emergent Single Stranded DNA Virus in a Naı¨ve Host.	PLoS ONE 9(1): e85370. doi:10.1371/journal.pone.0085370
B. Jackson, et al.	2014	Preliminary surveillance for beak and feather disease virus in wild parrots of New Caledonia: implications of a reservoir species for Ouvea Parakeets	Emu 114, 283.
Fortescue Metals Group	2014	Night Parrot (Pezoporus occidentalis) Research Plan	http://www.environment.gov.au/epbc/notices/assessments/2010/5696/2010-5696-approved-management-plan.pdf
Department of Sustainability and Environment	1993	Flora and Fauna Guarantee Action Statement Orange-bellied Parrot Neophema chrysogaster	http://www.depi.vic.gov.au/__data/assets/pdf_file/0018/251217/Orange-bellied_Parrot_Neophema_chrysogaster.pdf
Department of Sustainability and Environment	2006	Flora and Fauna Guarantee Action Statement South-eastern Red-tailed Black-Cockatoo Calyptorhynchus banksii graptogyne	http://www.depi.vic.gov.au/__data/assets/pdf_file/0017/251225/Red-tailed_Black-Cockatoo_Calyptorhynchus_banksii-graptogyne.pdf
Department of Sustainability and Environment	1992	Flora and Fauna Guarantee Action Statement Superb Parrot Polytelis swainsonii	http://www.depi.vic.gov.au/__data/assets/pdf_file/0016/251242/Superb_Parrot_Polytelis_swainsonii.pdf
Department of Sustainability and Environment	2002	Flora and Fauna Guarantee Action Statement Swift Parrot Lathamus discolor	http://www.depi.vic.gov.au/__data/assets/pdf_file/0017/251252/Swift_Parrot_Lathamus_discolor.pdf
Dr Bethany Jackson BVSc MVS (Con Med)	2014	Health and disease in Red-crowned Parakeets (Cyanoramphus novaezelandiae) on Tiritiri Matangi Island; causes of feather loss and implications for conservation managers	http://researchrepository.murdoch.edu.au/26687/1/whole.pdf
Dr Bethany Jackson BVSc	Peer	Clinical Beak and feather disease virus (BFDV) infection in	New Zealand Veterinary Journal

MVS (Con Med)	Review	wild juvenile eastern rosellas of New Zealand; biosecurity implications for wildlife care facilities	
Bethany Jackson, et al.	2012	Pilot survey of New Caledonian parrots for Beak and feather disease virus (BFDV)	Conservation Fund Auckland Zoo
S. Kundu, et al	2012	Tracking viral evolution during a disease outbreak: the rapid and complete selective sweep of a circovirus in the endangered Echo parakeet	Journal of Virology86 (9): 5221-9
Heather Richards	2010	The 500 Mark: A Landmark Season	PsittaScene22(3): 6-10 http://issuu.com/worldparrottrust/docs/ps_22_3_aug_10-500-mark-echo?e=2859271/4179655
Robert Heinsohn, et al.	2015	A severe predator-induced population decline predicted for endangered, migratory swift parrots (*Lathamus discolor*)	Biological Conservation 186 (2015) 75–82
Dejan Stojanovic, et al.	2014	Discovery of a novel predator reveals extreme but highly variable mortality for an endangered migratory bird	Diversity and Distributions, (Diversity Distrib.) (2014) 20, 1200–1207
R.E. Johnstone and J.C. Darnell	2015	Checklist of the Birds of Western Australia	Western Australian Museum, Perth, Western Australia 6000
By R.E. Johnstone and T. Kirkby	2015	Contact Calls Of Baudin's Cockatoo *Calyptorhynchus Baudinii*	The Western Australian Naturalist 30(1): 48–52 (2015).
R.E. Johnstone1 and T. Kirkby	2008	Distribution, status, social organisation, movements and conservation of Baudin.s Cockatoo (*Calyptorhynchus baudinii*) in South-west Western Australia	Records of the Western Australian Museum 25: 107.118 (2008).
Ronald E. Johnstone, Clemency Fisher & Denis A. Saunders	2014	*Calyptorhynchus baudinii* Lear, 1832 (Aves, CACATUIDA): proposed conservation of usage by designation of a neotype	Bulletin of Zoological Nomenclature 71(3) September 2014
R. E. Johnstone, T. Kirkby and K. Sarti	2013	The breeding biology of the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* Gould in south-western Australia. II. Breeding behaviour and diet	Pacific Conservation Biology Vol. 19: 143–155. Surrey Beatty & Sons, Sydney. 2013.
R. E. Johnstone, T. Kirkby and K. Sarti	2013	The breeding biology of the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* Gould in south-western Australia. I. Characteristics of nest trees and nest hollows	Pacific Conservation Biology Vol. 19: 121–142. Surrey Beatty & Sons, Sydney. 2013.
Johnstone 1, T. Kirkby 1 and M. Mannion 2	2015	Trials On The Use And Effectiveness Of Artificial Nest Hollows For Carnaby's Cockatoo At Cataby, Western Australia	The Western Australian Naturalist 29(4): 250–262 (2015).
Ron Johnstone	2010	Information Sheet Baudin's Cockatoo *Calyptorhynchus baudinii*	Department of Terrestrial Vertebrates Western Australian Museum
R.E. & C. Johnstone and T. Kirkby	2010	Black Cockatoos on the Swan Coastal Plain	Department of Planning, Western Australia
Ron Johnstone	2010	Information Sheet Carnaby's Cockatoo *Calyptorhynchus latirostris*	Department of Terrestrial Vertebrates Western Australian Museum

Ron Johnstone	2010	Information Sheet Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*	Department of Terrestrial Vertebrates Western Australian Museum
Ron Johnstone	2012	Information Sheet Western Long-billed Corella Muir's Corella *Cacatua pastinator pastinator* Butler's Corella *Cacatua pastinator butleri*	Department of Terrestrial Vertebrates Western Australian Museum
A. D. Manning, P. Gibbons, J. Fischer, D. L. Oliver & D. B. Lindenmayer	2012	Hollow futures? Tree decline, lag effects and hollow-dependent species	Animal Conservation. Print ISSN 1367-9430
Adrian D. Manning, David B. Lindenmayer, Simon C. Barry	2004	The conservation implications of bird reproduction in the agricultural ''matrix'': a case study of the vulnerable superb parrot of south-eastern Australia	Biological Conservation 120 (2004) 363–374
Raidal S. R, Sarker, S., Peters, A.	CONFIDENTIAL DRAFT	A review of Psittacine Beak and Feather Disease and its impact on Australian endangered species	School of Animal and Veterinary Sciences, Graham, Centre for Agricultural Innovation
Adrian D. Manning, Laura Rayner, Tingbao Xu, and Michael F. Hutchinson	CONFIDENTIAL DRAFT	Modelling of the projected bioclimatic domain of the Superb Parrot under Past, Present and Future scenarios	The Fenner School of Environment and Society, The Australian National University, Canberra, ACT.

Part F – Conclusions

Conclusions from the previous review

The following section draws information from the 2012 *Review of the Threat Abatement Plan for Psittacine Beak and Feather Disease Affecting Endangered Psittacine Species* (2005). It will revisit section 6.2: TAP action contribution to goals and objectives, and section 6.4: outstanding issues. The 2012 review of the TAP showed the implementation of actions occurred across all of the 5 objectives. It also highlighted some issues which are outstanding. Objectives which are still relevant in 2015 include:

1. The coordination of a national approach: an establishment of groups to advise on action required under the TAP has occurred. However only an ad hoc reporting and contact network is available through the Australian Wildlife Health Network.
2. Research furthering our knowledge of PBFD: understanding more about the disease, but further work as well as key research into a vaccine is still needed.
3. Surveillance of wild populations to better inform management strategies: resources to support working groups are required as there has been limited contribution to the change of threat through monitoring of the disease.
4. Identifying and implementing management actions and strategies to reduce the impacts of PBFD: there is concern around the effectiveness of threat abatement identifying PBFD in recovery plans, and the appropriate management techniques for species in conjunction with other recovery actions.
5. Sharing information between all parties interested in PBFD: it will be important in the future to ensure that disseminated material is up to date and relevant.

Many actions are still required under these objectives as they have only been partially met.

1. The key outstanding action required under the TAP is the development of a vaccine that can be used in captive populations of threatened psittacine species, with the long-term view of release of these birds into wild populations or, ultimately, to be able to administer the vaccine in a field situation.
2. Research is still required as there are still significant gaps in our knowledge about the virus characteristics, apparent immunity by some birds, and transmission factors including host factors, environment factors, population dynamics and other species as reservoirs of the virus.
3. A lack of funding is severely limiting the implementation of many threat abatement actions required under the TAP.
4. There are still gaps in recovery planning. Our knowledge is still limited in knowing if PBFD is a significant threat to certain species and, for other species, what the impact is on a population level relative to other threats. Even for those species where PBFD has been identified as a threat, there is little on-ground action to counter the threat.
5. Communication and information exchange could be better coordinated nationally and needs to be considered in the future management of PBFD. There will be an ongoing challenge to ensure good communication continues with many other issues demanding the time of those people interested in abating the threat of PBFD.

Conclusion

This paper provides an analysis of the degree of threat from Psittacine Beak and Feather Disease relative to other threats impacting the 16 identified threatened psittacine species. It also offers future options for threat abatement.

The analysis of recovery plans for threatened parrot species showed that PBFD is only addressed in four of the thirteen recovery plans as a problem and/or a future risk. Only Carnaby's cockatoo, Norfolk Island green parrot, orange bellied parrot and the swift parrot recovery plan mention PBFD in one form or another. This shows that PBFD is not considered a threat for most species, or it is not considered as important as other, more immediate, threats. The recovery plan summary indicates that there is limited knowledge and information surrounding PBFD. This is a cause for concern as PBFD has the future potential to impact upon all species and identifying and implementing management strategies to combat PBFD is essential to species survival.

There is no need for separate recovery plans for Baudin's cockatoo and the forest red-tailed black cockatoo as they occur in single populations, with the entire populations affected by the same threats. In order to address the limited knowledge and information surrounding the night parrot, the production of a recovery plan is currently underway. A princess parrot recovery plan would also be greatly beneficial to the species. However many obstacles complicate the viability for the production of a recovery plan, including the low densities and highly dispersive distribution of the species over various states and territories.

Information provided by parrot/disease experts indicates that there are differing levels of concern surrounding PBFD. There are diverse management and research approaches being implemented throughout Australia. PBFD has the potential to become a serious, significant threat to threatened parrot species given its ability to travel in common species to most niches in Australia. Unfortunately there seems to be a major gap in our knowledge on PBFD and more research will be needed to draw conclusive observations. In particular, there was a lack of information from experts regarding the Golden shouldered parrot, Princess Parrot and Western ground parrot. Experts in the field feel that more needs to be done to gain an understanding of PBFD as a threatening process to parrot species as there are several gaps in our knowledge on PBFD for Baudin's cockatoo, Golden shouldered parrot, Princess parrot, Red-tailed black cockatoo and the Superb parrot.

In light of the analysis of threats from Recovery Plans and the advice provided by experts, research on the potential threat of PBFD at a species level is required as well as a focus on actions across all of the species, particularly ones that require research or national materials to be developed (i.e. vaccine). By addressing PBFD at a species level and having an overarching way of connecting all actions to individual species the most impact can be made to combat PBFD.

References

Australian Government, 2007, Australian Threatened Species South-eastern red-tailed black-cockatoo - Calyptorhynchus banksii graptogyne

Australian Wildlife Health Network, 2009, Psittacine Circovirus Disease (PCD, PBFD) FACT SHEET, [online] Available at: https://www.wildlifehealthaustralia.com.au/Portals/0/Documents/FactSheets/Psittacine%20Circovirus%20Disease%20(PCD%20-%20PBFD)%2026%20Mar%202009%20(1.0).pdf

Bahman Khalesi, Nicolai Bonne, Meredith Stewart, Margaret Sharp and Shane Raidal, 2005, A comparison of haemagglutination, haemagglutination inhibition and PCR for the detection of psittacine beak and feather disease virus infection and a comparison of isolates obtained from loriids

Baker-Gabb, D and Hurley, V.G, 2011, National Recovery Plan for the Regent Parrot (eastern subspecies) Polytelis anthopeplus monarchoides, Department of Sustainability and Environment, Melbourne

Baker-Gabb, D, 2011, National Recovery Plan for the Superb Parrot Polytelis swainsonii, Department of Sustainability and Environment, Melbourne

Birdlife Australia, 2013, Parrots in Peril, [online] Available at: http://birdlife.org.au/australian-birdlife/detail/parrots-in-peril

Brown, P. 1988, A captive breeding program for Orange-bellied Parrots, Australian Aviculture, 42:165-75

Chapman T, Blyth J, Mawson P and Atkins K, 2008, Forest Black Cockatoo (Baudin's Cockatoo Calyptorhynchus baudinii and Forest Redtailed Black Cockatoo Calyptorhynchus banksii naso) Recovery Plan, [online] Available at: http://www.environment.gov.au/system/files/resources/48e4fc8c-9cb7-4c85-bc9f-6b847cf4c017/files/wa-forest-black-cockatoos-recovery-plan.pdf

Commonwealth of Australia, 2007, National Recovery Plan for the South-eastern Red-tailed Black-Cockatoo Calyptorhynchus banksii graptogyne, Department of the Environment and Water Resources, Canberra

Department of Conservation, 2004, Psittacine beak and feather disease (or psittacine circovirus, PCV), [online] Available at: http://www.doc.govt.nz/documents/science-and-technical/pcv.pdf

Department of Environment and Conservation, 2008, Muir's Corella (Cacatua pastinator pastinator) Recovery Plan, [online] Available at: http://www.environment.gov.au/system/files/resources/9170039a-db76-4835-b541-5c08bb4a9775/files/cyclopsitta-diophthalma-coxeni.pdf

Department of Environment and Conservation, 2009, South Coast Threatened Birds Recovery Plan 2009-2018, [online] Available at: http://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/recovery_plans/southcoastbirds_recovery_plan_44.pdf

Department of Natural Resources, Environment and the Arts, 2006, Threatened Species of the Northern Territory Princess Parrot Polytelis alexandrae, [online] Available at: http://www.lrm.nt.gov.au/__data/assets/pdf_file/0020/10865/princess_parrot_vu.pdf

Department of Parks and Wildlife, 2013 Carnaby's cockatoo (Calyptorhynchus latirostris) Recovery Plan, Department of Parks and Wildlife, Perth, Western Australia

Department of Sustainability, Environment, Water, Population and Communities, 2012, Review of the Threat Abatement Plan for Psittacine Beak and Feather Disease Affecting Endangered Psittacine Species (2005), Commonwealth Government, Canberra

Department of the Environment and Heritage, 2006, Hygiene Protocols for the Prevention and Control of Diseases (Particularly Beak and Feather Disease) in Australian Birds, Commonwealth of Australia

Department of the Environment, 2005, Beak and Feather Disease Affecting Endangered Psittacine Species, [online] Available at: http://www.environment.gov.au/system/files/resources/5764cda0-5e94-48c7-8841-49b09ff7398c/files/beak-feather-tap.pdf

Department of the Environment, 2008a, Approved Conservation Advice for Pezoporus occidentalis (Night Parrot), [online] Available at: http://www.environment.gov.au/biodiversity/threatened/species/pubs/59350-conservation-advice.pdf

Department of the Environment, 2008b, Approved Conservation Advice for Polytelis alexandrae (Princess Parrot), [online] Available at: http://www.environment.gov.au/biodiversity/threatened/species/pubs/758-conservation-advice.pdf

Department of the Environment, 2014, Norfolk Island rodent control expansion to protect green parrots, Commonwealth of Australia

Department of the Environment, 2015a, Recovery plans, [online] Available at: http://www.environment.gov.au/biodiversity/threatened/recovery-plans

Department of the Environment, 2015b, Threat abatement plans, [online] Available at: http://www.environment.gov.au/biodiversity/threatened/threat-abatement-plans
Department of the Environment, 2015d, Conservation advices, [online] Available at: http://www.environment.gov.au/biodiversity/threatened/conservation-advices
Department of the Environment, 2015e, Western ground parrot—Understanding the habits of a rare and secretive bird (WA), Commonwealth of Australia
Department of Primary Industries, Parks, Water and Environment, 2015, DPIPWE Biosecurity and Disease Management Protocols for Captive and Wild Orange-bellied Parrots in Tasmania [online] Available at: http://dpipwe.tas.gov.au/Documents/DPIPWE%20Biosecurity%20and%20Disease%20Management%20Protocols%20for%20Captive%20and%20Wild%20Orange-bellied%20Parrots%20in%20Tasmania.pdf
Eastwood, J., M.L Berg, R.F.H. Ribot, S Raidal, K. L. Buchanan, K. Walder and A.T.D. Bennett, 2014, Phylogenetic analysis of beak and feather disease virus across a hybridising host species complex, Proceedings of the National Academy of Sciences USA 39, 14153-14158.
Eastwood, Justin R., Mathew L. Berg A, Briana Spolding, Katherine L. Buchanan, Andrew T. D. BennettA and Ken Walder, 2015, Prevalence of beak and feather disease virus in wild *Platycercus elegans*: comparison of three tissue types using a probe-based real-time qPCR test, Australian Journal of Zoology, 2015, 63, 1–8
Foster and Smith Inc, 2015, Characteristics of Parrots and Other Psittacine, [online] Available at: http://www.peteducation.com/article.cfm?c=15+1840&aid=2470
Garnett, S.T. and Crowley, G.M., 2002, Recovery Plan for the golden-shouldered parrot Psephotus chrysopterygius 2003-2007, Report to Environment Australia, Canberra, Queensland Parks and Wildlife Service, Brisbane
Garnett et al, 1999, The Breeding Biology of the Glossy Black-Cockatoo on Kangaroo Island SA, Emu, vol. 99, pp 262-279
Hill R, 2002, Recovery Plan for the Norfolk Island Green Parrot Cyanoramphus novaezelandiae cookie, [online] Available at: http://www.environment.gov.au/system/files/resources/0444528b-6a68-470e-b536-a6fe4453e28b/files/norfolk-green-parrot.pdf
Jackson et al, 2015. Emerging infectious disease or evidence of endemicity? A multi season study of Beak and feather disease virus in wild Red-crowned Parakeets (*Cyanoramphus novaezelandiae*), Archives of Virology (in press)
John Chambers, 2009, `Parrots' and `Cockatoos' Order Psittaciformes, [online] Available at: http://rainforest-australia.com/parrots_and_cockatoos.htm
Kundu, S. et al, 2012, Tracking viral evolution during a disease outbreak: the rapid and complete selective sweep of a circovirus in the endangered Echo parakeet, Journal of Virology 86 (9): 5221-9
Leo Joseph, Alicia Toon, Erin E. Schirtzinger, Timothy F. Wright & Richard Schodde, 2012, A revised nomenclature and classification for family-group taxa of parrots (Psittaciformes), [online] Available at: http://biology-web.nmsu.edu/~twright/publications/Josephetal2012Zootaxa.pdf
Mooney, P.A. and Pedler, L.P., 2005, Recovery Plan for the South Australian subspecies of the Glossy Black-Cockatoo (Calyptorhynchus lathami halmaturinus): 2005-2010, unpublished report to South Australian Department for Environment and Heritage, Adelaide
Nicolai Bonne, Patrick Shearer, Margaret Sharp, Phillip Clark and Shane Raidal, 2009, Assessment of recombinant beak and feather disease virus capsid protein as a vaccine for psittacine beak and feather disease [online] Available at: http://vir.sgmjournals.org/content/90/3/640.short
NSW National Parks and Wildlife Service (2002) Approved Recovery Plan for the Coxen's Fig-Parrot Cyclopsitta diophthalma coxeni (Gould), NSW National Parks & Wildlife Service, Hurstville
Orange-bellied Parrot Recovery Team, 2006, National Recovery Plan for the Orange Bellied Parrot , Department of Primary Industries and Water (DPIW), Hobart
Peachy, M, [no date]., Psittacine Beak and feather Viral Disease in Parrots in the ACT [online] Available at: http://www.awrc.org.au/uploads/5/8/6/6/5866843/peachey_pbfcv_2012.pdf
Peters Andrew, Patterson Edward, Baker Barry, Holdsworth Mark, Subir Sarker, Ghorashi Seyed, and Raidal Shane, 2014, Evidence of psittacine beak and feather disease virus spillover into wild critically endangered orange bellied Parrots (Neophema chrysogaster), Journal of Wildlife Diseases, 50(2), 2014, pp. 288–296
Raidal Shane, Bonne Nicolai and Stewart Meredith (2005) Development of Recombinant Proteins as a Candidate Vaccine for Psittacine Beak and Feather Disease [online] Available at: http://www.environment.gov.au/system/files/resources/1c3cb2d5-a226-4747-82cb-dc8f744283f3/files/p-c-disease-vaccine.pdf
Richards, Heather, 2010, The 500 Mark: A Landmark Season, PsittaScene 22(3): 6-10

Sarker, S, et al. 2014, Mutability Dynamics of an Emergent Single Stranded DNA Virus in a Naïve Host, Plos One e85370
Saunders, D.L. and Tzaros, C.L, 2011, National Recovery Plan for the Swift Parrot Lathamus discolor, Birds Australia, Melbourne

Appendices

APPENDIX A: Published Papers & Online Groups

Below in tables 1 and 2 are examples of published works available and Australian bird groups which hold relevant information for both parrots and PBFD (note that time constraints and logistical constraints meant this is not comprehensive). These resources have not been heavily used in the contents of this paper but do hold significant information in relation to psittacines and BFD.

Table 1: Snapshot of published works available

		Description	Location
Parrot	**Government publications**	Management guidelines for golden-shouldered parrot conservation	http://www.firescape.com.au/wp-content/uploads/2012/10/Management-Guidelines-GSP-Conservation.pdf
		2011 Great Cocky Count Population estimates and identification of roost sites for the Carnaby's Cockatoo	http://www.birdlife.org.au/documents/CBC-GCC_Report-full-2011.pdf
		Regional Recovery Plan for Threatened Species and Ecological Communities of Adelaide and the Mount Lofty Ranges, South Australia	http://www.environment.gov.au/system/files/resources/c14c8f70-bcec-4d0d-ad51-0769bfb1dfb5/files/adelaide-and-mount-lofty-ranges.pdf
		Conserving Carnaby's Black-Cockatoo Future Directions Proceedings from a conservation symposium	http://www.birdlife.org.au/documents/CBC-conssymposium2003.pdf
		Survey guidelines for Australia's threatened birds	http://www.environment.gov.au/system/files/resources/107052eb-2041-45b9-9296-b5f514493ae0/files/survey-guidelines-birds.pdf
		Australian Threatened Species South-eastern red-tailed black-cockatoo - *Calyptorhynchus banksii graptogyne*	http://www.environment.gov.au/system/files/resources/cd811dec-47e0-4d3e-8854-d1fa7f99f693/files/tsd07-r-tailed-b-cockatoo.pdf
		Norfolk Island rodent control expansion to protect green parrots	http://www.environment.gov.au/system/files/resources/11b928c0-69db-41c9-a74f-eb99b8509d06/files/green-parrot.pdf
		Western ground parrot—Understanding the habits of a rare and secretive bird (WA)	http://www.environment.gov.au/system/files/resources/fcf259d4-b9c8-4cd5-967b-a5fe1569e2c2/files/factsheet-ground-parrot.pdf
	Journal Articles	Australia's national environmental legislation and human/wildlife interactions	https://www.google.com.au/?gfe_rd=ctrl&ei=WW34UoSZDsyN8QeQ3IDAAw&gws_rd=cr#q=australia+national+environmental+legislation+and+human+wildlife+interactions+Journal+of+International+Wildlife+Law+%26+Policy
		Survival on the ark: life-history trends in captive parrots	http://onlinelibrary.wiley.com/doi/10.1111/j.1469-1795.2011.00477.x/pdf
		The breeding and foraging ecology and abundance of the Princess Parrot during a population irruption	http://www.publish.csiro.au/?act=view_file&file_id=MU13050.pdf
		Psittacine reintroductions: Common denominators of success	http://ac.els-cdn.com/S0006320712000572/1-s2.0-S0006320712000572-main.pdf?_tid=2f9e8a38-abf6-11e4-8daf-00000aab0f02&acdnat=1423003637_60f5b245c2cc4c9ac0de8adc4cda7404
		On Not Protecting the Parrot: Impact of Conservation and Planning Legislation on an Endangered Species in Tasmania	http://www.tandfonline.com/doi/pdf/10.1080/13880292.2013.764777
	University publications	Climate change adaptation strategies for Australian birds final report	http://apo.org.au/files/Resource/Garnett-Report-Climate-change-adaptation-Australian-birds.pdf
	Other	The State of Australia's Birds 2010 Islands and Birds	http://birdlife.org.au/documents/SOAB-2010.pdf
		Australia's Important bird areas: Key sites for bird conservation	http://birdlife.org.au/documents/OTHPUB-IBA-supp.pdf
		Status Survey and Conservation Action Plan 2000–2004 Parrots	https://portals.iucn.org/library/efiles/documents/2000-016.pdf
		Update on the Orange-bellied parrot Recovery Program 2013	http://www.birdlife.org.au/documents/OBP-TUC-Feb13.pdf
		Conserving Kyloring Saving the Western Ground Parrot from extinction	http://www.western-ground-parrot.org.au/docs/Articles/Ground%20Parrot%20(hi%20res).pdf

PBFD	**Government publications**	Psittacine beak and feather disease A threat to our native parrots	http://www.doc.govt.nz/pagefiles/62104/psittacine-beak-and-feather-disease.pdf
		Hygiene Protocols for the Prevention and Control of Diseases (Particularly Beak and Feather Disease) in Australian Birds	http://www.environment.gov.au/system/files/resources/9349e95b-85ec-4c40-a457-1a9fdcb76642/files/hygiene-protocols-all.pdf
		Psittacine beak and feather disease (or psittacine circovirus, PCV)	http://www.doc.govt.nz/documents/science-and-technical/pcv.pdf
	Journal Articles	Detection of beak and feather disease virus DNA in embryonated eggs of psittacine birds	http://www.agriculturejournals.cz/publicFiles/00583.pdf
		Ultra structural, protein composition, and antigenic comparison of psittacine beak and feather disease virus purified from four genera of psittacine birds	http://www.bioone.org/doi/full/10.7589/0090-3558-26.2.196
		Genetic Diversity of Beak and Feather Disease Virus Detected in Psittacine Species in Australia	http://ac.els-cdn.com/S004268220090847X/1-s2.0-S004268220090847X-main.pdf?_tid=ca604b40-abf3-11e4-b945-00000aab0f02&acdnat=1423002608_3ad7fa413d8f58e1d568a5b6a1d7105c
		Evidence for specificity of psittacine beak and feather disease viruses among avian hosts	http://ac.els-cdn.com/S004268220200048X/1-s2.0-S004268220200048X-main.pdf?_tid=1b4235d2-abf4-11e4-aa3e-00000aacb361&acdnat=1423002744_674180695568a052b15622a5a2f17df8
		The haemagglutination spectrum of psittacine beak and feather disease virus	http://www.tandfonline.com/doi/pdf/10.1080/03079459408419032
		A comparison of haemagglutination, haemagglutination inhibition and PCR for the detection of psittacine beak and feather disease virus infection and a comparison of isolates obtained from loriids	http://vir.sgmjournals.org/content/86/11/3039.full.pdf+html
		Assessment of recombinant beak and feather disease virus capsid protein as a vaccine for psittacine beak and feather disease	http://vir.sgmjournals.org/content/90/3/640.full.pdf+html
	University publications	Development of a DNA Vaccine for the Prevention of Psittacine Beak and Feather Disease	http://etd.uovs.ac.za/ETD-db/theses/available/etd-04082009-151418/unrestricted/KondiahK.pdf
		Development of Recombinant Proteins as a Candidate Vaccine for Psittacine Beak and Feather Disease	http://www.environment.gov.au/system/files/resources/1c3cb2d5-a226-4747-82cb-dc8f744283f3/files/p-c-disease-vaccine.pdf
		Standardised Diagnostic Tests for Beak and Feather Disease Virus	http://www.environment.gov.au/system/files/resources/d51f18c3-459e-4f9f-884a-5aa3642ece4d/files/49540.pdf
	Other	Psittacine Beak and Feather Viral Disease in Parrots in the ACT	http://www.awrc.org.au/uploads/5/8/6/6/5866843/peachey_pbfcv_2012.pdf

Table 2: Snapshot of online bird groups

Name	Location/based	Website
Parrot Society of Australia Inc.	Brisbane QLD	http://www.parrotsociety.org.au/
Bird Life Australia	Australian wide	http://birdlife.org.au/
Canberra Ornithologists Group	ACT	http://canberrabirds.org.au/
Bird watch Australia	NSW	http://www.birdwatch-australia.com.au/
Birding NSW	NSW	http://www.birdingnsw.org.au/
NSW Bird Atlassers (NSWBA)	NSW	http://www.nswbirdatlassers.com/
Cumberland Bird Observers' Club	Sydney	http://www.cboc.org.au/
Birds Queensland	QLD	http://birdsqueensland.org.au/
Birds SA	SA	http://www.birdssa.asn.au/
Australian Bird Image Database	Australian wide	http://www.aviceda.org/abid/newimages.php
World Parrot Trust	SA	http://www.parrots.org/
Birds in Backyards	Australian wide	http://www.birdsinbackyards.net/
Wild Watch Australia: Jonathon Munro	North Queensland	http://www.wildwatch.com.au/Home
Queensland Ornithological Society Inc.	QLD	http://www.birdsqueensland.org.au/
Birding in Western Australia	WA	http://members.iinet.net.au/~foconnor/
Australian Bird and Bat banding Scheme	ACT	http://www.environment.gov.au/science/bird-and-bat-banding
Earth foot Birding & Natural History	Darwin	http://www.earthfoot.org/places/au002.htm
John Young Birder	QLD	http://www.johnyoungwildlife.com/index.php?option=com_content&task=view&id=13&Itemid=26
South Australian Birding	SA	http://www.sabirding.com/
Wildlife Preservation Society of Queensland	QLD	http://www.wildlife.org.au/
Queensland's Naturalists Club	QLD	http://www.qnc.org.au/
Wildlife Health Australia	Sydney, NSW	https://www.wildlifehealthaustralia.com.au/Home.aspx

APPENDIX B: Wildlife Health Australia (WHA) Aggregated electronic Wildlife Health Information System (eWHIS) data for the 16 Threatened Parrot Species

WILDLIFE HEALTH AUSTRALIA

Reply to PBFD Questionnaire – Department of Environment

AGGREGATED EWHIS DATA – 16 THREATENED PARROT SPECIES*

Data Export Date: ***25.5.15***
Data Sent To: ***Rachel Carte (Department Of Environment)***
Approval Process: ***Wildlife Health Australia Coordinators and Zoo/Sentinel Clinic Coordinators***

Background

in response to the circulation of a questionnaire regarding the potential risks of psittacine beak and feather disease (PBFD) on sixteen threatened species of parrots, wildlife health Australia (WHA; see appendix for further information) presents data drawn from the national wildlife disease surveillance database (eWHIS). PBFD data currently reported into eWHIS are collected via a general surveillance program and relies on the detection, submission and investigation of sick/dead captive or free-living wildlife. Data are submitted from multiple sources into eWHIS, including from our network of state / territory WHA coordinators (appointed by their state / territory chief veterinary officers), veterinarians based at zoo-based wildlife rehabilitation clinics and large private wildlife clinics, *university researchers and WHA members. It should also be noted that although WHA encourages all data submitters to report on diseases listed as key threatening processes in Australia, there has been no formal request or funding support for the structured capture of this data. as a result data captured on PBFD in the national system, as administered by*

WHA, occurs largely on an ad hoc basis and does not provide a representative picture of the current situation in Australia regarding this disease. This prevents this data being used to make valid deductions regarding the specific threat of PBFD to threatened parrots or any other species.

**** electronic Wildlife Health Information System***

Data collected through Wildlife Health Australia

Specifically, analyses of two datasets are presented:

1. *All database records pertaining to the 16 identified threatened parrot species (n=81; see appendix - figures 1-3)*
2. *All database records pertaining to a diagnosis of PBFD in any psittacine species (n=880; see appendix – figure 4)*

Please note: data reported within this document will most likely overlap with data received via other mechanisms for this review.

1. *Records pertaining to the 16 identified threatened parrot species*

Of 81 eWHIS records for captive and wild threatened parrot species (figure 2), only six relate to PBFD status or testing (figure 3). Where birds of these species presented with suspect PBFD clinical signs, PBFD testing was always undertaken. The remaining eWHIS records detail a range of presentations and diagnoses, some relating to primary disease agents other than PBFD. Birds submitted for disease investigations present an opportunity to better describe the potential risk of PBFD in these species. If funding had been available, specific testing for PBFD could have been conducted in some of these events, contributing to a more informed understanding of the relationship between PBFD and other disease threats for these species.

2. *Records pertaining to a diagnosis of PBFD in any psittacine species*

Of 880 eWHIS records relating to PBFD (figure 4), the vast majority of diagnoses are based only on clinical signs. A very small portion of submitted PBFD cases actually involve definitive PBFD diagnostic testing. Although many of the reports include species well known to be affected by PBFD, data collected from these species could be better utilised to determine the spatial distribution of disease in non-threatened species and where these locations overlap with habitat ranges of threatened species of parrots. Alternatively reporting effort could concentrate on locations relating to the 16 threatened species ranges, which would align with previous discussions by the national working group[1] regarding the identification of PBFD hot spots.

[1] **In 2009 the working group identified that threatened species should be the priority and therefore because the disease is ubiquitous and long-standing, it is more fruitful to concentrate on presenting the impact on endangered species rather than the distribution of all potentially affected species.**

Conclusions

An improved funding structure for diagnostic testing could quickly improve the proportion of laboratory confirmations of PBFD, possibly across species in strategic habitats or in specific (threatened) species. There are only a limited number of laboratories in Australia who are equipped to undertake the necessary diagnostic testing; most of these labs are focused solely on the detection of antigen via polymerase chain reaction (PCR). Expansion of laboratory capabilities would facilitate antigen and antibody tests - PCR, Haemagglutination Assay (ha) and Haemagluttination Inhibition assay (hi). Such expansion would allow all three tests to be performed more readily and achieve a more thorough understanding of a birds PBFD status.

WHA is well equipped with a framework to collect PBFD data and information on other diseases affecting threatened species. The data and analyses presented in this document demonstrate that the framework is currently being utilised to collect opportunistic surveillance data on PBFD and other diseases affecting threatened species. With appropriate resourcing, the framework provided by WHA could be utilised to manage Australian PBFD data. However, prerequisites for any structured reporting include adequate resourcing, an agreement on the purpose for reporting, and a clear definition of the information required to achieve the purpose.

The existing framework is already equipped to manage data collected as part of pathogen-specific, active surveillance programs. The framework currently delivers management of the national surveillance program for the detection or exclusion of avian influenza in wild bird mortality events. This model could be adopted to better inform on the risks of PBFD to threatened species, thereby assisting and directing research, funding and resources.

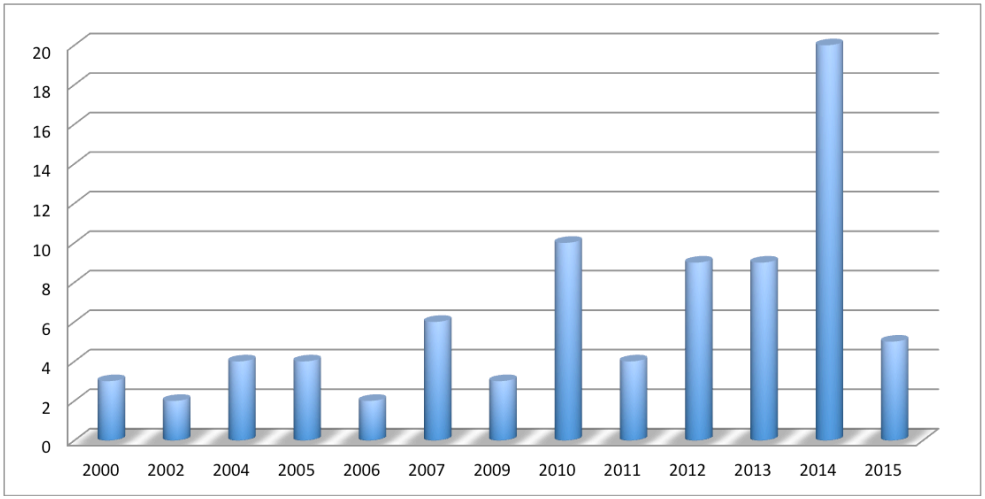
Appendix

1. ***Records pertaining to the 16 identified threatened parrot species***

There are a total of 81 database entries accounting for 11 of the 16 threatened parrot species listed.
There are no database entries for the following species:

- *Coxen's fig parrot (cyclopsitta diophthalma coxeni*)
- Muir's corella *(cacatua pastinator pastinator)*
- Night parrot *(pezoporus occidentalis)*
- Norfolk Island green parrot *(cyanoramphus novaezelandiae cookie)*
- Western ground parrot *(pezoporus wallicus flaviventris)*

FIGURE 1: Number of eWHIS records for threatened parrot spp. by year of submission*



**data for 2015 is still being collected*

FIGURE 2: Wild and captive breakdown of 81 eWHIS records for threatened parrot species (2000-2015)

	Captive	Wild	Wild and Captive*	Total
Calyptorhynchus banksii naso/Forest Red-tailed Black Cockatoo		6	2	8
Calyptorhynchus banksii/Red-tailed Black Cockatoo	1	3		4
Calyptorhynchus baudinii/Baudin's Black-Cockatoo		2		2
Calyptorhynchus lathami/Glossy Black Cockatoo		2		2
Calyptorhynchus latirostris/Carnaby's Black Cockatoo	1	21	4	26
Lathamus discolor/Swift Parrot		1		1
Neophema chrysogaster/Orange-bellied Parrot	23	2	1	26
Polytelis alexandrae/Princess Parrot	1			1
Polytelis anthropeplus/Regent Parrot	1	2		3
Polytelis swainsonii/Superb Parrot	7			7
Psephotus chrysopterygius/Golden-shouldered Parrot	1			1
Total	**35**	**39**	**7**	**81**

**Free-living, wild birds that were recruited into captivity for rehabilitation with the intention of restoring health and returning the bird to the wild.*

FIGURE 3: eWHIS data on Psittacine Beak and Feather Disease testing in threatened species of parrot (2000-2015)

	Total	State of Captivity	Testing information*
Calyptorhynchus banksii naso/Forest Red-tailed Black Cockatoo	4		
Beak and feather disease - Positive	2	Wild and Captive	Both birds PCR positive. Both low HI titres. Both high HA titres.
Beak and feather disease - Negative	2	Wild	PCR negative. Low HI and HA titres.
Calyptorhynchus lathami/Glossy Black Cockatoo	1		
Beak and feather disease - Negative	1	Wild	Nest material PCR negative.
Lathamus discolor/Swift Parrot	1		
Beak and feather disease - Positive	1	Wild	PCR positive. Low HI titre. High HA titre.
Total	**6**		

**for further information on diagnostic testing protocols, please see the WHA factsheet - psittacine circovirus disease on the WHA website.*

2. ***EWHIS RECORDS PERTAINING TO A DIAGNOSIS OF PBFD IN PSITTACINE SPECIES***

*FIGURE 4: Psittacine Beak and Feather Disease – all eWHIS cases (all database records for all psittacine species)^*

	Captive	Wild	Wild and Captive	Total
Alisterus scapularis/Australian King Parrot		17		17
Aprosmictus erythropterus/Red-winged Parrot		1		1
Cacatua galerita/Sulphur-crested Cockatoo		164		164
Cacatua sanguinea/Little Corella		40	1	41
Cacatua tenuirostris/Long-billed Corella		4		4
Callocephalon fimbriatum/Gang-gang Cockatoo		1	1	2
Calyptorhynchus banksii naso/Forest Red-tailed Black Cockatoo			2	2
Calyptorhynchus funereus/Yellow-tailed Black Cockatoo		1		1
Eolophus roseicapilla/Galah		18	1	19
Glossopsitta concinna/Musk Lorikeet		3		3
Lathamus discolor/Swift Parrot		1		1
Platycercus adscitus/Pale-headed Rosella		1		1
Platycercus elegans subadelaidae/Crimson Rosella, Adelaide Subspecies		1		1
Platycercus elegans/Crimson Rosella		7		7
Platycercus eximius/Eastern Rosella		7		7
Platycercus/Rosella		1		1
Psephotus haematonotus/Red-rumped Parrot	1			1
Trichoglossus chlorolepidotus/Scaly-breasted Lorikeet		101		101
Trichoglossus haematodus moluccanus/Rainbow Lorikeet (Eastern)	1	499	6	506
Total	**2**	**867**	**11**	**880**

^the vast majority of diagnoses are based only on clinical signs. See page 2 of this document for more information.

About Wildlife Health Australia

Wildlife Health Australia (WHA) is a not for profit, national organization and the peak body for wildlife health in Australia and operates nationally. The head office is located in Sydney, NSW.

WHA activities focus on the increasing risk of emergency and emerging diseases that can spill over from wild animals and impact on Australia's trade, human health, biodiversity and tourism. We provide a framework that allows Australia to better identify, assess, articulate and manage these risks. We provide the framework for Australia's general wildlife health surveillance system.

WHA's vision is "Healthy wildlife, healthy Australia". Our mission is to develop strong partnerships in order to better manage the adverse effects of wildlife diseases on Australia's animal health industries, human health, biodiversity, trade and tourism.

WHA administers Australia's general wildlife health surveillance system. Key elements of the system include a network of WHA coordinators (appointed by their Chief Veterinary Officers), zoo-based and sentinel clinic veterinarians, targeted projects and a number of focus/working groups.

WHA directly supports the Animal Health Committee (AHC), Animal Health Australia (AHA), the Animal Health Policy Branch and the Office of the Chief Veterinary Officer (OCVO) within the Australian Government Department of Agriculture (DoA) and Australian governments in their efforts to better prepare and protect Australia against the adverse effects of wildlife diseases. It provides priorities in wildlife disease work, administers Australia's general wildlife disease surveillance system as well as facilitating and coordinating targeted projects. Wildlife health intelligence collected through the National Wildlife Health Information System (eWHIS: www.wildlifehealthaustralia.com.au) administered by WHA is provided to members of AHC and the Australian Government DoA, and Departments of Health (DoH) and Environment (DoE), on issues of potential national interest, potential emerging issues and significant disease outbreaks in wildlife. The information is provided in line with the agreed policy for data security.

WHA is administered under corporate governance principles. A management group, chaired by an appointment from DoA provides strategic direction and advice to a small team, which oversees the running of WHA. It is important to note that WHA involves almost every agency or organisation (both government and NGO) that has a stake or interest in animal and wildlife health issues in Australia. In addition WHA also comprises more than 600 wildlife health professionals and others from around Australia and the rest of the world who have an interest in diseases with feral animals or wildlife as part of their ecology that may impact on Australia's trade, human health and biodiversity.

More information on WHA is available at: www.wildlifehealthaustralia.com.au and in Cox-Witton et al (2014). Emerging infectious diseases in free-ranging wildlife–Australian zoo based wildlife hospitals contribute to national surveillance. *PloS one*, *9*(5).