

Psittacid herpesviruses in birds in Australia

Fact sheet

February 2023

Key points

- Psittacid herpesvirus-1 (PsHV-1) is the cause of Pacheco's disease, a rapidly fatal disease of parrots and may also cause mucosal papillomas and associated neoplasia.
- PsHV-1 was reported for the first time in a recent study of wild Australian birds, in psittacine (parrot) and non-psittacine species.
- PsHV-1 (and associated mucosal disease) was previously identified in Australia only in a small number of imported green-winged macaws.
- Psittacines are the natural host for PsHV-1 and are most susceptible to disease following infection.
- Many Australian parrot species are considered susceptible to PsHV-1 infection and disease.
- Other novel herpesviruses have been described in wild and captive psittacines in Australia, sometimes associated with disease.

Introductory statement

Psittacid herpesvirus-1 (PsHV-1) (sometimes abbreviated PsAHV-1) causes both Pacheco's disease and mucosal papilloma disease in parrots. Pacheco's disease is an acute, rapidly fatal disease of parrots that has caused significant mortality events in captive parrot collections overseas. Many species of Australian parrot are considered or known to be susceptible to PsHV-1 infection and disease [1]. Subclinical infections result in carrier birds that remain infected for life. These birds are then sources for future outbreaks [2]. The confirmed presence of PsHV-1 in Australian wild birds poses a potential risk to both captive and wild parrots, including those that are already threatened.

PsHV-1 and associated disease occurs widely overseas. PsHV-1 was reported for the first time in wild Australian birds in a recent study (2019-2021, Qld) in psittacine (parrot) and non-psittacine species [3]. PsHV-1 was previously identified in Australia only in a small number of captive, imported green-winged macaws (*Ara chloroptera*).

Aetiology

Family (Herpesviridae), subfamily (*Alphaherpesvirinae*), genus *Iltovirus*. There are four genotypes [4].

One Health implications

Wildlife and the environment: PsHV-1 has the potential to cause significant disease in Australian parrot species, including those that are already threatened. The draft report of Australia's Biosecurity Import Risk Review for Psittacine Birds (<https://www.agriculture.gov.au/biosecurity-trade/policy/risk-analysis/animal/psittacine-birds>) predicted high mortalities in the event of a Pacheco's disease outbreak in the wild, with impact on local biodiversity and likely significant impacts on endangered species. Although not a notifiable disease, PsHV-1 is one of the "higher risk" native animal diseases on the National Priority List of Exotic Environmental Pests, Weeds and Diseases (www.agriculture.gov.au/biosecurity-trade/policy/environmental/priority-list).

Domestic animals: PsHV-1 is not known to cause disease in non-psittacine birds (although infections can occur), or in other animal species.

Humans: there are no human health implications.

Natural hosts

Psittacines are the natural host of PsHV-1. The potential range of carrier species of PsHV-1 is not known. The majority of birds shown to be subclinically infected are neotropical parrots, but subclinical infections have also been documented in African and captive Australian parrots overseas [2].

Pacheco's disease has been reported in Australian bird species held overseas, including: sulphur-crested cockatoo (*Cacatua galerita*); gang-gang cockatoo (*Callocephalon fimbriatum*); galah (*C. roseicapilla*); green rosella (*Platycercus caledonicus*), Eastern rosella (*P. eximius*), pale-headed rosella (*C. adscitus*), crimson rosella (*P. elegans*); Port Lincoln parrot (*Barnardius zonarius*); regent parrot (*Polytelis anthopeplus*); princess parrot (*P. alexandrae*); fig parrot (*Cyclopsitta* sp.); eclectus parrot (*Eclectus roratus*); cockatiel (*Nymphicus hollandicus*); and red-rumped parakeet (*Psephotus haematonotus*) [4-8].

PsHV-1 has also been suspected as the cause of disease in a zebra finch (*Taeniopygia guttata*) (D. Phalen pers. comm. 2005).

These viruses have also been isolated from a number of passerine species [3, 9].

World distribution

It is highly likely that this virus has co-evolved with neotropical (South American) parrots [4]. Infected birds have been documented in North America, Europe, the Middle East, Japan, New Zealand (in quarantined birds), and Australia [1, 3, 10].

Occurrences in Australia

Psittacid herpesvirus-1 (PsHV-1) has been reported, from one study, in a number of wild Australian bird species, with samples collected from 2019-2021 in southeast Qld (Table 1). There were no signs of disease directly associated with PsHV-1 infection in these birds [3].

Table 1: Australian wild birds found to be positive on PCR for PsHV-1 [3]

Common name	Scientific name	Numbers positive/sampled
Psittacine species		
Little corella	<i>Cacatua sanguinea</i>	3/17
Long-billed corella	<i>C. tenuirostris</i>	1/2
Sulphur-crested cockatoo	<i>C. galerita</i>	2/24
Australian king parrot	<i>Alisterus scapularis</i>	1/10
Rainbow lorikeet	<i>Trichoglossus moluccanus</i>	13/131
Non-psittacine species		
Forest kingfisher	<i>Todiramphus macleayii</i>	1/2
Sacred kingfisher	<i>T. sanctus</i>	5/14
Crested pigeon	<i>Ocyphaps lophotes</i>	10/40
Nankeen kestrel	<i>Falco cenchroides</i>	1/2

Internal papilloma disease was first reported in Australia (southern Qld) in 1997 in two captive green-winged macaws (*Ara chloroptera*) imported from the United Kingdom [11]. The presence of PsHV-1 was first confirmed in Australia (Sydney, NSW) in 2004, also in two captive imported green-winged macaws. Both birds were part of the original consignment that had been imported from the UK in 1993. An offspring of this pair was also positive and the papilloma contained PsHV-1 genotypes 2 and 3, the same genotypes identified in the parents [10].

Negative data

Previous published studies in Australian birds found no evidence of PsHV-1 infection. A study of 409 wild and captive native birds presented to Healesville Sanctuary, Vic, from December 2014 to December 2015 found no evidence of PsHV-1 infection on PCR examination of choanal and cloacal swabs and post-mortem tissues [12]. A study of 55 wild psittacines in Vic, between November 2015 and June 2016, also found no evidence of PsHV-1 infection on PCR examination of choanal and cloacal swabs [13]. An earlier study examined sera from 411 wild and captive psittacines from NSW, Vic, Tas and WA, between 1992 and 1994. All birds were seronegative to PsHV-1, but it is likely only one serotype was examined (see Diagnosis) [14].

Reports in eWHIS of disease events where PsHV-1 was excluded include a pied oystercatcher (*Haematopus longirostris*) from WA in 2022, a glossy black cockatoo (*Calyptorhynchus lathami*) from NSW in 2021, a yellow-tailed black cockatoo (*C. funereus*) from Tas in 2021, a swift parrot (*Lathamus discolor*) from NSW in 2020, and a white-bellied sea eagle (*Haliaeetus leucogaster*) from NSW in 2016. All tested negative by PsHV-1 qPCR or, in one case, pan-herpesvirus nested PCR. Samples tested included liver, blood and combined oral/cloacal swabs.

Other Psittacid herpesviruses in Australia

Other alphaherpesviruses have been isolated from psittacines in Australia. Novel **cacatuid alphaherpesvirus-1** (CaHV-1) was found in a diseased wild sulphur-crested cockatoo in Vic. The bird had concurrent beak and feather disease and disease appears to have been related to that infection. No inclusion bodies, inflammation in the lungs nor any other sign of herpesvirus infection were seen in any of the tissues of this bird examined histologically [12].

Novel **cacatuid alphaherpesvirus-2** (CaHV-2) was isolated from a wild little corella with non-specific signs of illness [13].

Psittacid alphaherpesvirus-3 (PsHV-3) was isolated from two captive eclectus parrots in Australia with respiratory and gastrointestinal disease [15]. **Psittacid alphaherpesvirus-5** (PsAHV-5) caused a significant disease outbreak with sudden death and respiratory signs in captive ringneck parrots (*Psittacula krameri*) in Australia [16].

PsHV-3 was also implicated as the cause of a severe respiratory disease in Bourke's parrots (*Neopsephotus bourkii*) in the United States [17].

Epidemiology

Parrots are the natural host and the taxon most susceptible to disease as a result of infection with PsHV-1. Parrots subclinically infected with PsHV-1 genotypes 1, 2 and 3 may develop mucosal papillomas [18, 19].

Whether infection proceeds to a **carrier** state, the development of **mucosal papillomas**, or **Pacheco's disease** depends on the genotype of the virus and the species of parrot infected [1, 19].

Many other factors will determine the impact of the introduction of PsHV-1 to a collection of parrots, including the level of immunity already in the collection, the housing density and if birds are housed indoors or outdoors. For example, Amazon parrots (*Amazona* spp.) are highly susceptible to all 4 genotypes of PsHV-1 and densely-housed collections and indoor collections are more prone to outbreaks of Pacheco's disease [1, 4].

There is no known age or sex predilection.

Experimental infections have shown the incubation period to range from 5 to 10 days. Without treatment, birds that develop **Pacheco's disease** die. All treated birds and all subclinically infected birds become carriers [20].

Mucosal papillomas develop in some species of subclinically infected parrots (particularly in macaws, Amazon parrots and, less frequently, conures), in the months following infection with PsHV-1 genotypes 1,2 or 3.

Recently infected birds shed virus in oral secretions and droppings. High concentrations of virus can be found in the blood and all tissues. Most infections occur when contaminated material is ingested. [20]. Subclinically-infected birds are at high risk for developing mucosal papillomas if infected with genotype 3, and have a lower risk if infected with genotypes 1 and 2 [19].

Clinical signs

Pacheco's disease has few clinical signs. Most birds are found dead. When signs occur, birds stop eating and are less active. Yellow or green stained urates reflect the severe liver damage that these birds are experiencing.

Mucosal papillomas can occur in the cloaca, oral cavity, and less frequently in the crop, oesophagus, proventriculus and ventriculus. Signs include straining to defecate, frank blood in the droppings and prolapse of papillomatous lesions from the cloaca. Oral papillomas rarely cause signs. When disseminated papillomas are present in the oesophagus, crop or proventriculus, birds may experience a chronic wasting disease with or without regurgitation. Mucosal papillomas are typically raised, pink and have a cauliflower-like surface. They can be

found locally or diffusely in the cloaca and may ulcerate and bleed. Lesions in the mouth are most commonly found along the margins of the choanae and at the base of the tongue. Lesions can wax and wane, disappear completely or become progressive [1, 19].

Bile duct and pancreatic duct carcinomas containing PsHV-1 DNA are fairly common occurrences in parrots that have mucosal papillomas containing PsHV-1 genotype 3. Birds with bile duct carcinomas will often exhibit signs of chronic liver disease such as weight loss, an overgrown beak, and poor feather quality. When they finally go into liver failure, signs are generally not specific. Pancreatic duct carcinomas are much less common and clinical signs are vague and non-specific. Bile duct carcinomas develop in the months and years following the onset of mucosal papillomas [18].

In the study by Kasimov et al. 2023 [3], Australian wild birds did not demonstrate any signs of disease directly associated with PsHV-1. A number of birds were co-infected with PsAHV-1 and other viruses; some of these showed signs of disease, but none of these signs were consistent with Pacheco's disease or mucosal papillomatosis. The birds infected only with PsAHV-1 did not show signs of disease.

Diagnosis

Pacheco's disease is readily confirmed by histopathology of the appropriate tissues. PsHV-1 genotypes 1, 3 and 4 can be cultured from spleen or liver. PsHV-1 genotype 2 is less likely to be isolated from these tissues [4].

Subclinically-infected birds can be detected with PCR of oral or cloacal swabs [2].

Serology may detect subclinically infected birds, but should include testing against all known (at least 3) serotypes [2].

Gross observation of the papillomatous lesions is sufficient for diagnosis of mucosal papillomatosis. These lesions will also be positive for PsHV-1 DNA. Biopsies will reveal the characteristic papillary changes to the mucosa.

Diagnosis of bile duct carcinomas in a live bird can only be made with a liver biopsy.

In Australian wild birds, PsHV-1 was more than four times more likely to be detected in the liver than from eye/ choana/ cloacal samples [3].

Laboratory diagnostic specimens and procedures

From birds with Pacheco's disease:

- Formalin-fixed tissues (liver, spleen, pancreas, intestine, crop) for histopathology
- Blood (0.1 ml), liver, spleen (submit frozen), swabs of liver or spleen (chilled) for PCR.
- Liver or spleen (frozen) for culture.

Subclinically infected birds:

- Swabs of the oral cavity and cloaca
- PsHV-1 DNA can be found in blood in some birds; however, oral and cloacal swabs are better sources of PsHV-1 DNA.

PCR testing for PsHV-1 is provided by request at the University of Sydney see www.sydney.edu.au/content/dam/corporate/documents/faculty-of-science/schools/vetscience/real-time-pcr-panel-%E2%80%93-avian-pathogens-brochure.pdf.

Clinical pathology

It is rare that a bird with Pacheco's disease survives long enough to have blood collected. Experimentally-infected birds develop leukopenia and marked elevations in serum AST [21]. Birds with bile duct carcinomas may have marked elevations in serum GGT [1].

Pathology

Pacheco's disease

Gross lesions may or may not be present. When present, there is usually enlargement of the spleen and liver. The liver be diffusely pale yellow and appear as though there is a diffuse lipidosis. Because most birds die suddenly, they are typically in good body condition.

Moderate to marked hepatic necrosis is found in nearly all birds with Pacheco's disease. Often the only hepatocytes that are spared are the ones surrounding the portal tracts. Intranuclear eosinophilic inclusion bodies may be common or rare. Splenic necrosis is also common and inclusion bodies are regularly found in splenocytes. Pancreatic necrosis and necrosis of the intestinal and crop mucosa occurs less frequently. Inclusion bodies are commonly seen in these lesions [22].

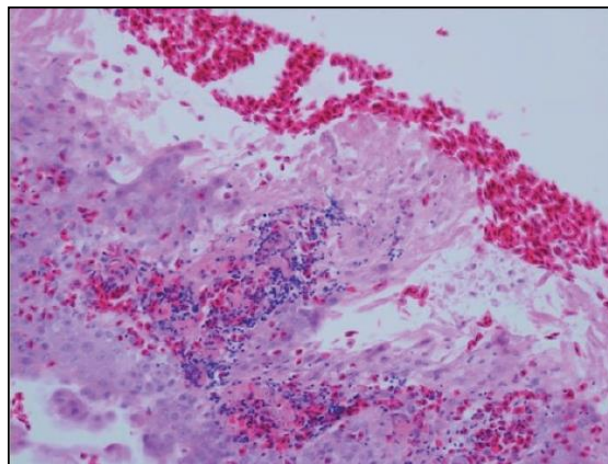


Figure 1: Histopathology of cloacal papilloma: green-wing macaw (Photo: Australian Registry of Wildlife Health)

Mucosal papillomas

- See *Clinical signs* for gross lesions.
- Bile duct carcinomas are multifocal and coalescing. They will often replace much of the liver before birds die. They do not metastasize. Pancreatic duct carcinomas are grey, nodular and coalescing. There may be atrophy of the associated exocrine pancreas.
- Microscopically mucosal papillomas are made up of multiple fimbriae with a variably wide to narrow base. Each fimbria is composed of a fibrovascular core surrounded by a

pseudostratified or stratified cuboidal to columnar epithelium. The lesions may be ulcerated. Lymphoplasmacytic infiltrations of the fibrovascular cores occur intermittently [1, 22].

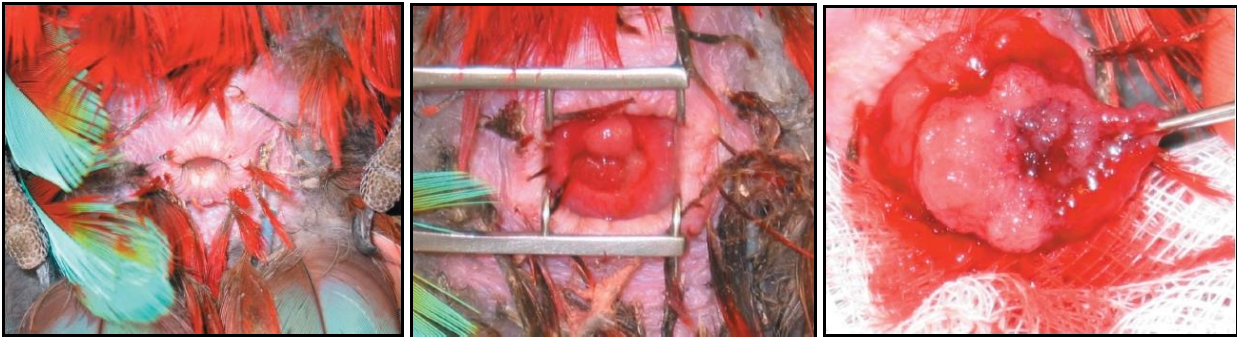


Figure 2: Green-wing macaw showing cloacal granuloma due to PSHV-1 (Photo Larry Vogelnest)

Differential diagnoses

Pacheco's disease:

- Acute systemic bacterial infections (e.g. pasteurellosis from a cat bite)
- Other acute viral infections (e.g. avian polyomavirus in nestling birds)
- Hepatic lipidosis.

Mucosal papillomas:

- Other neoplasia of the cloaca and oral cavity
- Bacterial cloacitis.

Bile duct carcinomas:

- Other liver tumours
- Cirrhosis.

Treatment

Virus replication is rapidly inhibited by acyclovir and birds in the early stage of Pacheco's disease can be saved with treatment. These birds will not be cured of infection and will become lifetime carriers of the virus. Treatment with acyclovir is not successful in carriers or birds with overt mucosal papillomas. Surgical resection of papillomas is a palliative treatment [1].

Prevention and control

Subclinically-infected captive birds (tested by PCR) can be held in isolation. There is strong evidence of parent-to-offspring transmission after hatch, but no evidence of vertical transmission through the egg. Therefore, positive birds should not be allowed to raise their own chicks. There are three principal serotypes of the virus and infection with one serotype does not protect against infection with another. A polyvalent vaccine would be necessary to prevent infection with all serotypes and a vaccine for this virus is not available in Australia [2].

PsHV-1, as an enveloped virus, is readily inactivated by commonly used disinfectants. A similar virus, the infectious laryngotracheitis virus is inactivated by temperatures of 58°C for one hour, but may persist for many days in biological tissues [23].

Research

Further research is recommended to better understand the presence, host range and prevalence of PsHV-1 in wild birds and Australia, and whether there is any evidence of associated disease.

Surveys of high-risk species in avicultural collections e.g. macaws, Amazon parrots and conures, would add to the understanding of this virus in Australia.

The University of Sydney Veterinary Pathology Department may be interested in frozen samples and swabs from birds with mucosal papillomas, as well as frozen tissues from birds with suspected herpesvirus infections. See www.sydney.edu.au/science/schools/sydney-school-of-veterinary-science/veterinary-science-services.html.

Surveillance and management

Wildlife disease surveillance in Australia is coordinated by Wildlife Health Australia. The National Wildlife Health Information System (eWHIS) captures information from a variety of sources including Australian government agencies, zoo and wildlife parks, wildlife carers, universities and members of the public. Coordinators in each of Australia's States and Territories report monthly on significant wildlife cases identified in their jurisdictions. NOTE: access to information contained within the National Wildlife Health Information System dataset is by application. See the WHA website for more information:

<https://wildlifehealthaustralia.com.au/ProgramsProjects/eWHIS-WildlifeHealthInformationSystem.aspx>.

There is no formal surveillance program for PsHV-1 in Australia. PsHV-1 is one of the “higher risk” native animal diseases on the National Priority List of Exotic Environmental Pests, Weeds and Diseases. It is not a nationally notifiable animal disease and is not a WOA listed disease.

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To provide feedback on this fact sheet

We are interested in hearing from anyone with information on this condition in Australia, including laboratory reports, historical datasets or survey results that could be added to the National Wildlife Health Information System. Negative data are also valuable. Please contact us.

We would be grateful for any feedback on this fact sheet. Please provide detailed comments or suggestions to admin@wildlifehealthaustralia.com.au. We would also like to hear from you if you have a particular area of expertise and would like to produce a fact sheet (or sheets) for WHA (or update current sheets).

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