Western Ground Parrot (*Pezoporus flaviventris*; WGP), Kyloriny – Disease Risk Assessment for Highly Pathogenic Avian Influenza (HPAI) H5N1 Clade 2.3.4.4b incursion in Western Australia

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Summary

The Western Ground Parrot (*Pezoporus flaviventris*; WGP), known as Kyloriny by the Noongar Aboriginal people, is a critically endangered medium-sized, cryptic and mostly green, parrot (DBCA 2025). The Western Ground Parrot is one of 22 bird species nationally which the Australian Government has prioritised for recovery. The WGP has been listed as Critically Endangered under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 since 2013. It has a low susceptibility index (0.19) to Highly Pathogenic Avian Influenza (HPAI) or H5 avian influenza (Ryding et al. 2024). The likelihood of WGPs becoming infected seems LOW given their cryptic and mostly solitary nature and given they are not in close proximity to poultry production facilities. Compared to other avian orders, the frequency of H5 avian influenza detection in psittacine birds globally is low and they are therefore not considered to have a major role in the ecology and epidemiology of AIVs (Alexander 2000a; Hawkins et al. 2006; DAWE 2020). However, despite this, H5 avian influenza has been detected in a range of psittacine species from several countries. WGPs are very unlikely to come in contact with migratory seabirds or shorebirds, so transmission via this route is highly unlikely. There is a very low likelihood that WGPs might come in contact with small numbers of freshwater aquatic birds following substantial rainfall events in WGP habitat, but the presence of such birds in WGP habitat only happens very rarely. Overall, there is a LOW likelihood of exposure, but if infection ensues the consequences may be HIGH for this critically endangered species owing to their small population size and their significant cultural and indigenous importance. With such a small population located in only a few locations, the impact of a catastrophic event, such as a disease outbreak, could lead to significant population decline and significant erosion of genetic variability. Management options to reduce disease risk are indicated.

1.Introduction

We provide a formal H5 avian influenza Disease Risk Analysis for the Western ground parrot in WA (Appendix 1) to help inform the Department of Biodiversity, Conservation and Attractions (DBCA) preparedness activities and mitigation responses (Appendix 1 and 2) for H5 avian influenza incursion.

2. Population and conservation status

2.1 Conservation status

The Western Ground Parrot (*Pezoporus flaviventris*; WGP), known as Kyloriny by the Noongar Aboriginal people, is a critically endangered medium-sized, cryptic and mostly green, parrot (DBCA 2025). The Western Ground Parrot is one of 22 bird species nationally which the Australian Government has prioritised for recovery. The WGP has been listed as Critically Endangered under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 since 2013. It is listed as Threatened Fauna under the WA Biodiversity Conservation Act 2016 and classified by the WA Threatened Species Scientific Committee as Critically Endangered. Given that its specific status is not currently recognised by the IUCN, it is not listed as threatened in the IUCN Red List but would fit the IUCN criteria for Critically Endangered given its small (<250 mature individuals), declining population with more than 90% of individuals in one population (Burbidge et al. 2016). (Note that current genomic analyses by L. Joseph et al. suggest that the WGP is indeed a separate species from its eastern Australian relatives; see also Smith et al. 2024).

2.2 WGP populations in WA

The species is restricted to one small population (estimate of approximately 150 animals) in Cape Arid National Park and the adjacent Nuytsland Nature Reserve in Western Australia (WA) (Burbidge et al. 2016; Berryman et al. 2021). A translocation has also commenced east of Albany and a small captive management group (n=6) also exists at Perth Zoo.

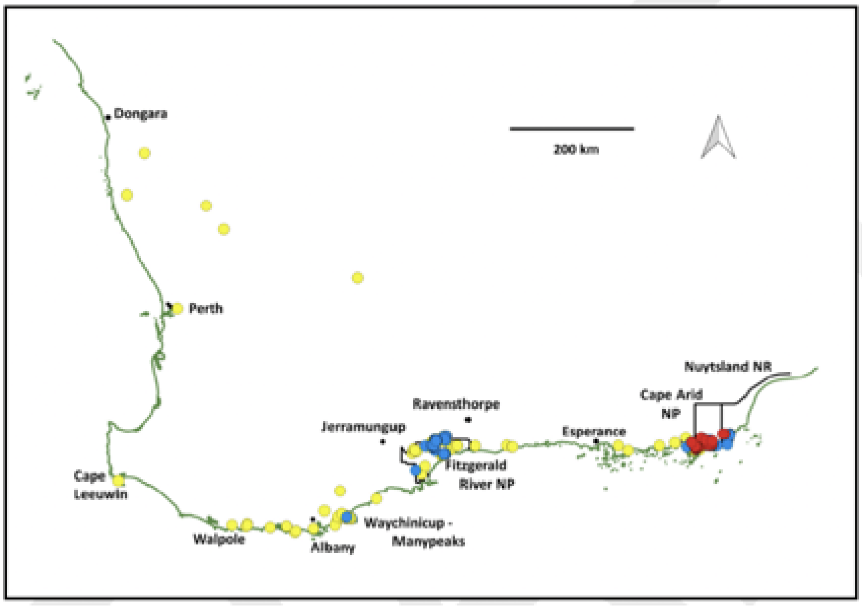

Figure 1: Known historical distribution of the WGP (from Burbidge et al. (2016) and S. Comer et al. unpubl.). Yellow symbols are historical records up to 2002, blue symbols are records from 2003 to 2012, and red symbols are records from 2013 to 2020. Of the records from Perth northwards, some have poor spatial or temporal resolution, and some are unconfirmed.

3 Population ecology and health

3.1 Habitat and diet

WGPs spend most of their time foraging on or near the ground but have good flight capabilities and will fly between foraging areas and roost sites. Juvenile birds can disperse up to tens of kilometres from breeding sites (A.H. Burbidge unpubl.). A radio-tracking study in 1988-89 in the Fitzgerald River National Park (FRNP) (Burbidge et al. 1989) and another in Cape Arid National Park in 2018 (A. Martin et al. unpubl.) showed that WGPs forage during the day in floristically diverse low heath (60-70+ vascular plant species per 100m^2) and have foraging ranges that show considerable overlap. Foraging and roosting areas are often separated by several hundred metres but in the absence of fire are structurally and floristically similar; however, roosting sites are usually relatively long unburnt (Berryman et al. 2021).

3.2 Population ecology

The WGP population is localised and there is minimal overlap with migratory shorebirds and other susceptible waterfowl, with the greatest potential for interaction along coastal regions. Figure 2 illustrates the nationally and internationally significant migratory shorebird areas and we note there is minimal overlap with the confirmed WGP populations at Cape Arid National Park and the adjacent Nuytsland Nature Reserve in Western Australia (WA) (Burbidge et al. 2016; Berryman et al. 2021). The translocated population being established east of Albany may be more susceptible but, owing to the cryptic and ground dwelling nature of WGP's, interactions with migratory shorebirds are likely to be minimal.

The small captive management group (n=6) at Perth Zoo will soon be roofed to minimise access to migratory birds as part of the Perth Zoo Biosecurity management plan to minimise access to wild birds.

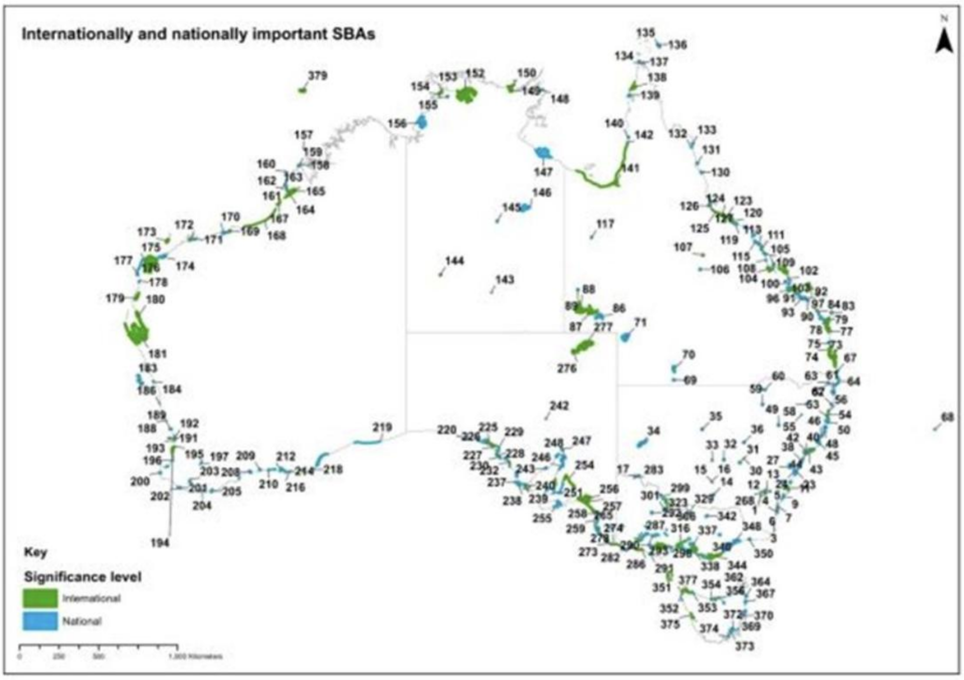

Figure 2. Nationally and internationally significant migratory shorebird areas within Australia (East Asian - Australasian Flyway Partnership (EAAFP), 2021).

3.3 Behaviours associated with spread and associated human activities

Although the knowledge of WGP social organisation is constrained by limited opportunities for observation, they do not appear to flock or have closely bonded social groups, with the possible exception of family groups during the breeding season (late winter/spring) and the pair bond (S. Comer et al. unpubl.).

Observations of a male WGP in Fitzgerald River National Park in Spring 2006 showed that the bird either walked on the ground or clambered on or through vegetation during the day. Flights were rare during the day, but often occurred at first and last light when the bird moved between its foraging and roosting areas, or when a male met up with his mate to feed her (B. Barrett unpubl.). The nest is a hollow in the ground, lined by dry grass or other vegetation (Burbidge et al. 2016). Their ground dwelling nature would limit their direct contact with other psittacine and avian species and therefore also lower the likelihood of disease transmission between psittacines and other avian and mammalian species.

Interestingly, paired captive WGPs do not associate closely with each other, apparently preferring to occupy their own space within the aviary, apart from when feeding and engaging in breeding behaviour (A. Berryman pers. comm.). Captive pairs have not been observed roosting together or engaging in allopreening (A. Ferguson pers. comm.).

Population monitoring of this species is typically undertaken through passive listening by human observers during the calling times which are within the hour before sunrise and the hour after sunset (Burbidge et al. 2007) or by autonomous recording units (ARUs) (e.g. Comer et al. 2017, 2020a).

In 2003, the Department of Parks and Wildlife established the Western Ground Parrot Recovery Project. Field monitoring of population trends, radio tracking and a captive management program have significantly improved the body of knowledge about this cryptic species. A recovery project and strategy led by the Western Australian Department of Biodiversity, Conservation and Attractions (DBCA) has been under way for over two decades. The strategy is implemented by the South Coast Threatened Birds Recovery Team led by DBCA (DPaW 2014). Recovery team membership includes on-ground managers, researchers, Perth Zoo staff including Senior Technical officers, Supervisors and the Veterinary Services Manager, the Friends of the Western Ground Parrot (FWGP), BirdLife Australia, Traditional Owners, and other partners/stakeholders (Burbidge et al. 2018).

The Recovery strategy was informed and further developed following an expert workshop held in 2016 and identified the following priority goals:

• Recover and protect wild populations of WGP

• Establish additional populations of WGP

• Secure awareness, support and long term resourcing for conservation efforts of WGP and species that share their habitat

• Optimize the value of the captive programme to WGP recovery and conservation.

A three-year trial translocation was initiated in 2021, with a small number of birds being moved from Cape Arid National Park to a conservation area east of Albany. This trial's goal was to begin establishment of an insurance population.

Short and medium term objectives of this trial have been met, with long term criteria still to be assessed. A disease risk analysis was undertaken prior to the planned translocation which summarised previously reported disease and reviewed the disease risks of translocation (Vaughan-Higgins and Wallace 2021).

• The WGP DRA process identified 52 hazards of concern (both infectious and non-infectious) and ranked each hazard in importance.

• Two hazards (predation, and wildfire) were identified as high risk; seven hazards (Aspergillosis, environmental stressors including climate change, low genetic diversity and population size, trauma, Psittacine Beak and Feather Disease, Avian chlamydiosis, and Avian gastric yeast) were identified as medium risk and forty-three hazards were identified as low risk.

• The cryptic nature of the WGP and its ecological niche lower the likelihood of transmission of infectious disease (including H5 avian influenza) to other WGP, and psittacine species at translocation release sites. WGP are unlikely to be in close contact, as WGPs don’t flock, are ground dwelling and don't appear to have closely bonded social groups, other than the pair bond and the family group of parents and dependent offspring. WGPs are also unlikely to be utilising the same habitat and food sources as other psittacine species.

• A detailed risk assessment was undertaken on all high and medium priority hazards (if risks were not already managed through other processes); detailed risk assessment was undertaken on four infectious hazards: Aspergillosis, Avian chlamydiosis, Avian gastric yeast and Psittacine Beak and Feather Disease.

• It was determined that preventative measures should be employed to reduce risks in all four infectious hazards that underwent assessment and long-term monitoring of translocated populations was indicated.

Because ground parrots are highly cryptic and very difficult to observe directly, there are currently no practical alternatives to gather data on animal movements, home range size, other than externally applied transmitters.

Radio-tracking was undertaken post translocation to allow monitoring of the survival and movement of released individuals in the months following release. The preferred attachment method is with a rubber band harness, fitted over the wings as a backpack. Transmitters included a GPS data logger as well as VHF, and the VHF signal should last approximately four months. Rubber band harnesses degrade over time and eventually detach, removing the need to recapture the bird to retrieve the transmitter.

For longer term monitoring, ARUs are deployed, using standard monitoring techniques (Tiller et al. 2017). Listening surveys may also be conducted, as this allows the direction and distance of calls to be determined, which can be used to gain a rough estimate of how many WGPs may be calling (Berryman, Burbidge and Comer 2021). Monitoring of introduced predators has continued after release, to ensure that predator control measures are effective.

A further planning Structured Decision Making workshop to inform the future direction of WGP recovery was held in June 2024 and January 2025. This reaffirmed and extended the goals and recommendations of the 2016 Recovery workshop (S. Comer et al. in prep.) with actions pending.

3.4 Threats

The main documented threats to the species include loss of habitat through bushfire and predation by introduced predators such as the feral cat and fox. Small population effects, genetic factors, and climate change have also been implicated in the declining population size. Fire management and introduced predator control, in particular for feral cats and foxes, has continued as a key focus (DPaW 2014; Comer et al. 2019, 2020a, 2020b).

The health and disease status of the WGP, like the majority of Australian psittacines (other than the Orange-bellied Parrot, *Neophema chrysogaster*) has not been extensively studied. To date there has been limited health screening of wild populations of WGPs, with most being carried out on wild caught captive WGPs from the captive management colony from the south coast and at Perth Zoo. Disease screening and microchipping was also conducted at the captive management colony in 2012 by a Perth Zoo veterinary team. These data were used to inform a simplified tabulated disease risk assessment for the WGP in 2014 (Vitali 2014).

Review of captive management records and deaths in the captive management colony from November 2009 to July 2014 reported a total of eight deaths (five of which were chicks). Bronchopneumonia was definitively diagnosed in 2/8 (25%), aspergillosis and head trauma 1/8 (12.5%), hot weather leading to hyperthermia in chicks 3/8 (37.5%), trauma necessitating euthanasia 1/8 (12.5%), and unknown (remains of a young chick discovered three months later) 1/8 (12.5%). Of particular note was a wild individual entering the captive management colony in 2009 (230-06710 band number) who sustained trauma and then developed a fulminant bacterial (*Avibacterium paragallinarum*) pneumonia (DPIRD AA-09-0778). Infectious coryza (IC), caused by *A. paragallinarum* is a widely occurring respiratory disease of chickens that results in acute inflammation in the upper respiratory tract, nasal discharge, facial oedema, and conjunctivitis. Transmission occurs via direct contact, aerosols or contaminated drinking water. Chronically ill and clinically normal carrier birds may also act as reservoirs of infection (Quinn et al. 2011). This clinical case warrants attention as WGPs seem particularly susceptible to significant trauma and secondary disease. For example, from 1988 to April 2021 capture-related deaths of WGP were thought to be as high as 8.5% (Berryman et al. 2021). Trauma leading to breaks in the mucosal barriers may then allow fastidious organisms such as *Avibacterium paragallinarum* to cause disease.

Capture, and entry into the aviaries carries an inherent risk of injury to the birds because they may panic and collide with hard surfaces within the aviary as demonstrated by the multiple trauma related incidents of variable severity sustained over the 2009-2011 period (Berryman 2015). The initial trauma event may also predispose a bird to the development of secondary disease (Quinn et al. 2011). Multiple methods to minimise trauma in the aviaries and during capture have subsequently been recommended, including the addition of soft linings within aviaries, minimising capture time, and having protocols and procedures in place to minimise the time required for handling.

In 2009, eight birds were captured, four of which were taken into captivity (one died shortly after capture – see above record (230-06710 band number), and four were released. Three individuals were tested for BFDV on capture via PCR, HA and HI conducted at the Veterinary Diagnostic Laboratory at Charles Sturt University, Qld. One of these individuals returned a weak positive PCR result. This was thought to be a probable false positive, as when retested two months later the individual was PCR, HA and HI negative. Five individuals were also screened for avian chlamydia on capture via immunofluorescence through Vetpath veterinary diagnostic laboratory (Ascot WA), and all were negative.

In 2010, nine birds were captured (six taken into captivity, and three were released). The five taken into captivity were tested for BFDV (three months post-capture) and all were negative. Three were tested for avian chlamydia on capture (all taken into captivity) with two positive results, but no signs of clinical disease. All birds were treated with in-water doxycycline, and subsequent tests were all negative, and continued to be negative when re-tested three months later.

In 2015, two birds were captured (taken into captivity) and no health samples were taken on capture to minimise stress and handling. However, these birds were transported to Perth Zoo to become part of the captive programme and screened for BFDV and Chlamydia spp. and results were negative.

In 2018, 11 birds were captured (five were taken into captivity, five released, and one died post coracoid trauma). Nine birds were tested and returned negative results for BFDV and Chlamydia spp. The five released birds were tested for chlamydia and all were negative.

Review of captive breeding records and deaths at Perth Zoo from July 2014 to April 2021 reports a total of seven deaths. Aspergillosis was definitively diagnosed in 4/7 (57%), trauma 1/7 (14%), egg binding 1/7 (14%) and egg laying associated with bacterial salpingitis and a corresponding finding of a *Mycobacterium avium* granuloma in the lung, with a previous history of osteomyelitis 1/7 (14%). Faecal mycobacterial screening (including Zn staining for acid fast bacteria, PCR and culture) had been undertaken twice in the colony and no evidence of mycobacterial shedding found. Lice had been identified in two individuals associated with skin irritation and successfully treated with Ivermectin (Avimec Vetafarm, Wagga Wagga, Australia). Preliminary identification suggests this is likely a species-specific louse from the genus *Forficuloecus*.

A spirochaete-like bacterium was isolated from five individuals on choanal swab, in 2015. However, no pathogenic species have been subsequently identified from whole genome sequencing. For this reason, a decision to monitor choanal swabs opportunistically for the presence of spirochaetes was decided to be a reasonable management plan. *Staphylococcus sciuri* was isolated from five individuals from a choanal swab sample. This is usually a commensal infection but there are reports of it causing disease, mainly in mixed infections and in humans when there is underlying disease such as diabetes. Therefore 400g/L of in-water doxycycline was prescribed for two months, and this seemed to reduce the bacterial load as birds were no longer culturing *Staphylococcus*. Five individuals were screened for Psittacine Beak and Feather Disease Virus (BFDV) in 2018, and all were negative. Faecal screening was also undertaken for psittacine adenovirus-2 in May 2020. All individuals were negative; however, faecal screening is not the most sensitive method for detection.

Trauma remains a significant concern. There have been two deaths following the capture of wild individuals (November 2018 and January 2019). In both cases the cause of death was a coracoid injury that appears to have been sustained when the bird flew into the mist net (Berryman et al. 2021). These, and other adverse events, are being summarised and analysed by Burbidge et al. (in prep.).

A discussion of disease would not be complete without examining the genetics of the population. Hawes (2020) examined phylogeography and genetic relatedness in the WGP and reported that over the past 200 years the WGP mitochondrial genetic diversity has been low, probably related to a small population size. Although the findings in the Hawes (2020) study were limited by a small sample size, the nuclear DNA analysis demonstrated an excess of homozygosity within the population. This infers a genetic state that is not favourable for captive breeding programs and is especially detrimental to management of rare species with such a small founding population. These findings highlight concerns about the genetic similarity of individuals in the remaining population and the potential impact of a catastrophic event, such as wildfire or a disease outbreak, which could lead to significant population decline and significant further erosion of genetic variability. Recent complete genome sequencing (Pandey et al. 2023) has paved the way for more detailed analysis of genetic variability in the species, currently underway.

4.Current management of population including human interactions

A captive management programme commenced in a facility on the southern coast of WA near Albany in 2009 as a step towards determining whether a captive breeding for release programme was feasible for this species. Four WGPs were initially captured, and a further six birds were added to the captive population in November 2010. Breeding attempts in 2011 and 2012 resulted in five chicks being produced, but none survived to fledging (three from one clutch were believed to have succumbed to heat stress, one died from aspiration pneumonia and one from unknown causes). This initial phase of the programme allowed the establishment of capture, transport and husbandry protocols but given breeding and rearing protocols still needed to be further refined, the remaining seven birds were transferred to Perth Zoo in July 2014 with ongoing attempts to achieve captive breeding. The aim of the captive programme was to learn how to breed WGPs, with a longer-term view to produce birds suitable for later release to the wild once threats had been mitigated. This would enable the restocking of depleted populations or reintroduction into areas where prior records exist. Wild-to-captive translocations of a small number of birds were also carried out in 2015 (two birds) and 2018 (five birds) as part of the trial captive breeding programme at Perth Zoo. There are currently six birds in the captive colony (March 2025). However, successful breeding and raising is yet to be achieved.

Management of the wild WGP population (DPaW 2014) is focussed on fire management and control of introduced predators, with translocation and captive breeding also being important actions. The recovery strategy is aimed at maintaining or improving population size, and hence resilience to any further threats or disturbances. These actions should also assist in increasing demographic resistance to HPAI and thereby reducing the possible impacts of this or other serious diseases.

WGPs are very unlikely to come in contact with members of the general public in the field, due to the nature of their habitat (low heath) and remote location. DBCA staff involved in research or management are made aware of what to look out for in relation to wildlife health, and appropriate protocols in relation to recording and reporting of any suspected incidences of disease, following guidelines such as outlined by WHA (20243c, and relevant updates). When field teams are involved in capture of birds, at least one appropriately qualified person with veterinary training is embedded in the team.

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Appendix 1. Disease risk assessment for H5 avian influenza incursion for wild WGPs

Justification of hazard -
Disease due to avian flu (AIV) is a result of infection with influenza A viruses. Influenza A viruses are members of the Orthomyxoviridae family. Variances in influenza A viruses are delineated based on their hemagglutinin (HA) protein, and nucleoprotein (NP) structures (Webster et al. 1992) and these are further defined as either low pathogenic avian influenza viruses (LPAIV), or highly pathogenic avian influenza viruses (HPAIV) (Abad et al. 2013). High pathogenicity avian influenza (HPAI) strains including the HPAI H5 virus strains, cause severe illness and high mortality in poultry (Alexander 2000, Kim et al. 2015) but have variable effects in other avian species, from no clinical signs, to high mortality rates (Olsen et al. 2006). HPAIV strains are thought to emerge from LPAIV precursors once introduced into poultry (Capua and Alexander 2006). HPAIVs have not been detected in Australian wild birds YET (WHA 2023a) and are notifiable. 1072 migratory birds of the orders *Charadriiformes* and *Procellariiformes* were sampled in October–December 2023 and no evidence of HPAI H5N1 2.3.4.4b was found in Australia for the second year in a row (Wille et al. 2024). A formal risk assessment undertaken by Wildlife Health Australia in partnership with Deakin University and the University of Melbourne in 2023 concluded that the overall risk associated with HPAI in wild birds in Australia has increased and is considered high, with moderate uncertainty. The global avian influenza situation is dynamic and the risk of HPAI virus incursions into Australia via wild birds is moderate to high. The return of migratory birds via the Australasian East Asian flyaway from late August represents a time of increased likelihood of introduction of HPAI viruses into Australia (WHA 2023a). Faecal-oral transmission is thought to be the predominant means of AIV spread in wild bird populations. Airborne transmission may be important in some species, when in close contact (CIDRP 2013). Thirteen outbreaks of HPAI that occurred in Australia between 1976 and 2024 were most likely due to LPAIV infection being passed from wild water fowl (ducks) to commercial poultry, followed by mutation to HPAIV (Agriculture Victoria 2024). HPAI viruses caused clinical disease in commercial poultry in Victoria in 1976 (H7N7), 1985 (H7N7), 1992 (H7N3), 2020 (H7N7) 2024 (H7N3), 2024 (H7N9); 2025 (H7N8); in Queensland in 1994 (H7N3); New South Wales in 1997 (H7N4), 2012 (H7N7), 2013 (H7N2), 2024 (H7N8) and Australian Capital Territory: 2024 (H7N8) (DAFF 2024, Westbury 1997, Agriculture Victoria 2025). Each time, there was severe disease in affected chicken flocks. A National Avian Influenza Wild Bird Surveillance Program commenced in Australia in 2006 and is ongoing (WHA 2023a). Since 2021, the frequency and geographic range of outbreaks overseas has increased, and outbreaks have been recorded for the first time in wild birds and poultry in North and South America. In late 2022, HPAI reached Central and South America, spreading through nine countries within four months (WOAH 2023a). HPAI has been detected in the brown skua population in South Georgia, the first known cases in the Antarctic region Antarctica (Oct 23 2023, WOAH 2023b). The closest incursion to Australia was in Kalimantan, Indonesia in 2022. Clade 2.3.4.4b H5 viruses have become a conservation threat, killing thousands of wild birds on nearly all continents other than Australia. Anseriformes (waterfowl: ducks, swans, geese) and Charadriiformes (gulls, terns and shorebirds) are the natural reservoir for all avian influenza A viruses (Olsen et al. 2006). However, birds from a diverse array of other avian orders have been affected by HPAI: Accipitriformes, Caprimulgiformes, Casuariiformes, Columbiformes, Cathartiformes,

Ciconiiformes, Falconiformes, Galliformes, Gaviiformes, Gruiformes, Passeriformes, Pelecaniformes, Piciformes, Podicipediformes, Procellariiformes, Psittaciformes, Rheiformes, Sphenisciformes, Strigiformes, Struthioniformes, Suliformes, and Trogoniformes.

While WGPs have not been reported to be infected to date, infection and disease in similar species such as Amazon parrots (*Amazona farinosa),* Budgerigar (*Melopsittacus undulatus*), and Solomons Corella *(Cacatua ducorpsii*) in collections would likely imply a similar disease susceptibility. See https://www.fao.org/animal-health/situation-updates/global-aiv-with-zoonotic-potential/bird-species-affected-by-h5nx-hpai/en (last updated April 2025). Compared to most other avian orders, the frequency of AIV detection in psittacine birds globally is low and they are therefore not considered to have a major role in the ecology and epidemiology of AIVs (Alexander 2000a; Hawkins et al. 2006, DAWE 2020). However, AIVs have been detected in a range of psittacine species from several countries most commonly in Budgerigars with the remaining made in various other parrot species including Blossom-headed Parakeets, Cockatiels, and Rose-ringed Parakeets (DAWE 2020). International trade in psittacine birds is common, and a large proportion of AIV detections in psittacine birds have been made through the routine testing that occurs when birds are held in quarantine after importation (Pasick et al. 2003). Parrots with AIV infection display a range of clinical presentations, from subclinical infection to peracute disease (Hawkins et al. 2006). The Deakin University model (2025) for susceptibility index based on phylogeny estimated the Western ground parrot to have a susceptibility index of 0.19 (based on a scale of 0-1) (Ryding et al. 2024). This would equate to a low susceptibility rating.

HPAI H5 virus strains (including H5N1) have caused mortality events in a variety of wild bird species overseas (e.g. swans, migratory geese, wood ducks, African penguins) (Molini et al. 2019, WHA 2023a). In some wild bird species, HPAI can result in sudden death. Experimentally infected wild bird species have shown watery diarrhoea, depression, inappetence, neurological and respiratory signs and death (Stallknecht et al. 2007), similar to the signs seen in infected poultry. Influenza A viruses have been recovered from psittacines with subclinical infections as well as from birds dying peracutely or after an acute onset of depression, neurologic disease, or clinical signs associated with the respiratory tract. Haemorrhagic enteritis was identified as a postmortem finding in psittacine birds (Hawkins et al. 2006). Certain subtypes have been associated with disease in humans, ranging from mild illness to severe respiratory disease, and death due to HPAI H5N1 (WHO 2016).

Concerns remain about the potential for any avian influenza viruses providing the precursor for a human pandemic strain of influenza and the potentially extreme social and economic consequences of the virus. Between 2003 and July 2023, a total of 868 cases of HPAI H5N1 infection in humans were documented across over 20 countries, resulting in 457 fatalities. The majority of these cases occurred prior to 2016. Between 2022 and July 2023, a total of 14 cases of HPAI H5N1 were confirmed in accordance with the WHO report, resulting in two fatalities only (Charostad et al. 2023). HPAI H5N1 clade 2.3.4.4b has only been associated with 1 mortality to date in January 2025 relating to exposure to backyard chickens. Human transmission of HPAI H5N1 infection primarily occurs through direct contact with infected birds. The movement of infectious HPAI H5N1 within airborne particles encompasses distances of less than 10 m. However, within macroscopic particles containing viral RNA, the potential for travel extends remarkably to

approximately 80 m (Charostad et al. 2023). The likelihood of inter-premises airborne transmission of clade 2.3.4.4b H5N1 is assessed as being minimal. Other variables, such as the indirect interaction with wild avian species and the effectiveness of biosecurity measures, are pivotal in influencing disease introduction. The incubation period of H5 avian influenza infection is typically short, lasting for approximately 7 days or less, with an average duration of 2–5 days (Imperia et al. 2023). In addition to respiratory signs, humans infected with HPAI H5N1 may experience accompanying symptoms such as headache, muscle pain, sore throat, runny nose, and less commonly, conjunctivitis or bleeding gums. HPAI H5N1 has the potential to affect various organs in humans, including the lung, central nervous system (CNS), and digestive system. Wildlife Health Australia (2023a, b, c, d) provides advice and a toolbox to assist in managing HPAI in the field.

Risk assessment		
Release assessment	Exposure assessment	Consequence assessment
Known to infect multiple species of birds and mammals including psittacines however H5 avian influenza is not currently present in Australia so exposure highly unlikely at present. The risk of introduction of HPAI virus to Australia was previously assessed as low (Wille et al 2019, WHA 2023a), but recent assessment indicates that with the emergence of the new strain of H5 avian influenza virus, the likelihood of introduction to Australia via migratory birds has increased. WGPs will likely be exposed through interactions with wild birds or via fomites from humans involved in parrot population management. However, the cryptic nature of the WGP and its limited social interactions lower the likelihood of transmission of disease to other WGPs. WGPs are unlikely to be in close contact, as they don't flock, are ground dwelling and don't appear to have closely bonded social groups, other than the pair bond and the family group of parents	WGPs may be exposed through direct contact with infected wild birds (e.g. faecal matter or close contact) although this is unlikely owing to their cryptic and solitary nature. AI viruses are most commonly transmitted between birds or to other animals via direct contact with respiratory aerosols / secretions and faecal material, as well as indirect exposure to contaminated environments, water, or objects (e.g. clothing, boots, equipment). In the case of mammals (both terrestrial and marine), infection is also thought to occur via ingestion of infected birds through predation or scavenging behaviours. If WGPs are infected they could excrete HPAI through inhalation, ingestion, direct inoculation into the eye and nares and vertical transmission. The likelihood of exposure to other avian species, and possibly mammals, is probably low owing to the cryptic nature of the WGP and its somewhat solitary behaviour, lowering the likelihood of transmission of disease to other WGP, and other psittacine species in their wild ranges. WGPs are also unlikely to be utilising the same habitat and food sources as other psittacine species. However, if exposed it is likely that the individual will disseminate H5 avian influenza	The consequences based on overseas experience, could be HIGH to poultry, certain mammals and WGPs if infected, however the likelihood of WGPs becoming infected seems LOW given their cryptic and mostly solitary nature and given they are not in close proximity to poultry production facilities. Compared to other avian orders, the frequency of AIV detection in psittacine birds globally is low and they are therefore not considered to have a major role in the ecology and epidemiology of AIVs (Alexander 2000; Hawkins et al. 2006; DAWE 2020). **Their susceptibility index (Deakin University 2025) was also estimated as LOW (0.19).** However, AIVs have been detected in a range of psittacine species from several countries. WGPs are of EXTREMELY HIGH conservation value to the state and country given their critically endangered status. They are also internationally recognised and hold significant cultural and indigenous importance. Currently negligible likelihood of exposure exists from contact between WGPs and infected migratory seabirds and shorebirds or fomites as no current evidence of infection in Australia. However. heightened surveillance has been initiated to ensure early

and dependent offspring. WGPs are also unlikely to be utilising the same habitat and food sources as other psittacine species. Similarly, they are not in close proximity to poultry production facilities. Overall, there is a negligible likelihood of HPAI being present in current populations as there has been no evidence on necropsy exam of prior records, or reports of disease through a national surveillance programme commencing in 2006 and more recent targeted surveillance (Wille et al. 2023). WGPs are very unlikely to come in contact with migratory seabirds or shorebirds, so transmission via this route is highly unlikely. There is a very low likelihood that WGPs might come in contact with small numbers of freshwater aquatic birds following substantial rainfall events in WGP habitat, but the presence of such birds in WGP habitat only happens very rarely. If infection ensues there is a medium likelihood of developing disease which is highly pathogenic to multiple avian and mammalian species including humans.	through faecal-oral transmission or aerosols via inhalation, ingestion, direct inoculation into the eye and nares. Given the wide host range, all avian species may be susceptible, and likewise some mammals which occur in close proximity may also become infected. This could lead to higher consequences and opportunity for further dissemination, especially via scavengers such as foxes and feral cats, and potentially native bush rats (*Rattus fuscipes*). Humans handling unwell or dead birds may also be infected if not wearing appropriate PPE.	detection. Medium likelihood of carriage and transmission given species susceptibility and not in close proximity to poultry production facilities. H5 avian influenza not present in Australia therefore very low disease risk for humans contracting the zoonotic disease from WGPs. The disease causes heavy losses for small scale poultry keepers as well as the poultry industry. Disease control operations in poultry involve slaughter and eradication of susceptible birds as well as infected individuals. The disease has great impacts on local and national economies both in terms of costs of disease control operations but also lost revenue from trade restrictions. If an outbreak occurred, it is likely there would be a reduction in availability of poultry products but this is not likely to impact the WGP population. Most illness and deaths associated with AIV infection in humans occurred after close contact with infected poultry or with objects contaminated by their faeces (WHA 2024) which will not occur if strict biosecurity is undertaken, and access of domestic fowl and pet birds to DBCA employees is minimised should disease incursion with H5 avian influenza occur in WA. There is a low likelihood of exposure through access to wild birds given their cryptic and mostly solitary nature other than the pair bond. If exposed, infection could result in mild to severe respiratory disease including death. **Stressors and co-infections may also play a role in promoting overt disease.**
Risk evaluation		
Preventative measures should be employed to reduce the disease risks.		
Risk management options		

Management of HPAI outbreaks in poultry is subject to international and national government regulations and includes quarantining of infected farms, culling of poultry, and vaccination in some countries (Roberts et al. 2023a). In parts of Asia, vaccination of birds against HPAI is routine, with countries such as Hong Kong requiring all poultry farmers to vaccinate their birds (Mills 2023). Options available to manage the disease are limited. Historically, vaccination of poultry against HPAI has been restricted to a few countries and vaccination of wild species, including *Spheniscus* spp., has been performed only in zoos, with one trial reported in captive African penguins (Roberts et al. 2023a). Roberts et al. (2023b) provides an excellent review of the descriptive epidemiology of and response to the HPAI (H5N8) epidemic in South African coastal seabirds, in 2018. In this case actions were limited to removing carcasses and sick birds as sources of the virus, where possible, and limiting the additional mechanical spread of the virus and disturbance caused by human activities (for example by banning all hands-on research activities and restricting monitoring activities to remote methods). The public was requested via media releases to avoid handling dead bird carcasses, especially if they had contact with domestic birds. At the seabird colonies, conservation authorities distributed information on the disease to staff, with instructions for biosecurity and managing sick birds and carcasses and for record-keeping. Protective clothing, including gloves as a minimum, rubber boots, disposable aprons, and face masks for added protection, was to be worn in the colonies, especially when handing sick birds and carcasses. Disinfectant was distributed for application to equipment, clothing, footwear, and vehicles. At the two mainland penguin colonies, additional measures were required to manage visitors, including footbaths and restricting access to the raised boardwalks. Notices were also displayed to inform guests of the situation and potential risk to domestic birds. Over the peak outbreak period, the release of African penguins and other seabirds from rehabilitation centres was discontinued at the Simon's Town African penguin colony.

In Australia, management of this notifiable disease is tightly controlled owing to the potential economic, political, animal welfare, and zoonotic impact. It is strongly recommended that Wildlife Health Australia's Risk mitigation Toolbox for wildlife managers is closely referred to when planning appropriate responses https://wildlifehealthaustralia.com.au/Portals/0/Incidents/WHA_HPAI_Risk_mitigation_toolbox.pdf (WHA 2023d). This document has been informed by the National Wildlife Biosecurity guidelines (WHA 2018).

Diagnosis

If a high index of clinical suspicion, contact the Emergency Animal Disease Hotline on 1800 675 888 and await further instruction from government authorities in regards to sampling (WHA 2023b, 2023c).

Note information such as the date/time/location, HPAI signs detected, approximate number and species of birds affected, and photographs and videos as possible.

Do not handle dead or sick birds unless you are specifically permitted to do so.

If approval given to handle suspect bird (dead or alive), appropriate PPE consisting of disposable gloves, overalls, goggles and an N95 facemask should be worn.
All boots, exterior clothing, and equipment should be decontaminated with a broad-spectrum disinfectant such as 70% ethanol, Virkon S, F10, soap + 10% bleach solution, or 0.1% iodine solution.

HPAI should be considered as a differential diagnosis in the following scenarios for wild birds:

• Small groups or clusters (5 or more) of sick or dead wild birds of any species.

• Sick or dead wild birds: (5 or more) seabirds, waterbirds, shorebirds or birds of prey or any other bird species with signs of avian influenza infection as outlined below.

Infected live birds may show a wide range of clinical signs, including:
• Neurological signs (ataxia, paralysis, seizures, tremors, abnormal posture)
• Respiratory signs (conjunctivitis, increased nasal secretions, oedema of the head, dyspnoea)
• Gastrointestinal signs (diarrhoea)
• Sudden death
Some species may be asymptomatic or show only very mild clinical signs. In some cases, birds may die suddenly without displaying any clinical signs (WHA 2023c)

A primary diagnosis of avian influenza is usually via qPCR testing of oropharyngeal and cloacal swabs. Plain sterile swabs are used to collect samples individually from the cloaca and oropharynx and are then placed in tubes containing viral transport media. In carcasses a post-mortem examination should only be considered if using requisite PPE, alternatively submit the whole carcass to the laboratory. All samples and carcasses must be stored at 4°C prior to submission (WHA 2023c). Enzyme-linked immunosorbent assays (ELISA) or haemagglutination inhibition (HI) and neuraminidase inhibition (NI) assays (Abad et al. 2013) may also be undertaken for evidence of antibodies and exposure.

Potentially H5 avian influenza positive sample (including cloacal and pharyngeal swabs) tubes should be individually labelled. The outside of the sample container should be disinfected, clearly marked as samples for H5 avian influenza analysis, and stored separately from other samples. Samples should never be stored in areas containing food.

Ensure proper labelling in adherence to the testing laboratory requirements and/or federal regulation, if shipping. Labelling should identify sample contents, date collected, and responsible contact person.

PPE and other material used in the collection of samples should be combined in a sealable bag and disposed of in sanitary waste. Any PPE used in the collection of presumed H5 avian influenza-positive samples should be combined in a sealable bag before disposal. Hands should be washed with soap or sanitized with alcohol-based hand sanitizer after any bird-handling.

Strict biosecurity protocols are required when undertaking post-mortem examination and sampling to minimise disease transmission. Cleaning and disinfection, including personal hygiene, (e.g., hand washing, cleansing/ disinfection of footwear) are also important in preventing transmission on fomites.

<u>Site closures</u>
It is important that people do not act as mechanical vectors of H5 avian influenza for example through contaminated footwear, clothing, equipment and vehicles and likewise that staff minimise the risk of human exposure to pathogens. Of key concern is the potential for visitors to WGP habitat, including staff, to unintentionally spread the virus between individuals. Therefore, during a disease outbreak or mass mortality event, it is important to limit the number of people moving into and walking around areas where affected birds are feeding, resting or breeding.
Personnel should not enter sites where H5 avian influenza is known to be present or likely to be present or there is an outbreak within 10 km (based on the

surveillance zone limit for poultry). Appropriate biosecurity and hygiene precautions should be adopted when carrying out any activities within or near any WGP habitat. Conservation activities, research programs and maintenance projects in suspect areas should be temporarily halted to reduce and prevent possible fomite spread of the virus. Only essential activities that directly relate to disease mitigation measures or monitoring should continue. Research activities in particular pose a higher risk for disease transmission due to the close contact personnel have with the birds. However the use of ARU's does limit the need for hands on population estimates in WGP's. It is acknowledged this will have an impact on long term monitoring and research projects.

Treatment

Clinically diseased birds pose a risk to other wildlife, livestock and humans in regards to disease transmission and therefore must be managed with strict biosecurity and isolation practices at all times. Treatment was attempted in an endangered African penguin with mild neurological signs with supportive therapy and antivirals comprising 35 mg oseltamivir twice a day, in isolation, for 3 weeks. A PCR test after two weeks of treatment indicated that virus shedding may have ceased, however the bird was euthanased due to a deteriorating neurological state (Roberts et al. 2023b). In the same 2018 event affecting African penguins, the mortality rate of symptomatic birds was high (no birds with neurological disease survived) and the few that survived all had permanent neurological deficits, limiting release (Roberts et al. 2023b). Euthanasia was advised for Swift (Greater Crested) Terns with suspicious clinical signs, given that treatment had already proven unsuccessful. Private veterinarians, without frequent bird patients, assisted with this. Penguins with mild or moderate signs were accepted for assessment at the rehabilitation centres, given their endangered status.

Birds undergoing treatment or awaiting the results of disease testing should be placed in an isolation facility until completion of treatment and follow up testing indicates they are no longer shedding. The incubation period of H5 avian influenza is typically 2-8 days, but it can be up to 14 days. Therefore, while awaiting results, all birds should enter a strict 14 day quarantine period. Euthanasia of sick wild birds may take place based on considerations of individual animal welfare, consistent with the relevant animal welfare legislation (WHA 2023d). However, Australia's policy as per the AUSVETPLAN Disease Strategy for Avian Influenza is that no destruction or culling of healthy wild birds will occur because it is not practical or environmentally sound and may be counterproductive in stopping spread of the disease (WHA 2023d). The isolation facility should have strict biosecurity protocols to limit disease transmission and ideally have separate staff, which do not have backyard birds or chickens.

Management of carcasses in an outbreak

In the 2018 HPAI event in African penguins minimising colony disturbance was prioritised, so although carcass removal was perceived as ideal, it was ultimately not considered essential (Roberts et al. 2023b). People managing and handling sick individuals and dead carcasses must adhere to strict biosecurity recommendations to limit further transmission of infection. Indirect effects of people trampling over beaches and through habitat and burrows and potential disease transmission must be counter balanced with removal of carcasses to minimise scavenging and secondary infection. Removal should be assessed on a site-by-site basis taking into account accessibility, and ability to collect and dispose of carcasses in line with the Australian Environmental Protection Authority guidelines. For WGP it is unlikely carcasses would be found and they would likely be readily predated, limiting the usefulness of this mitigation measure for a species with a low population size and low population density.

While the above actions entail best practice disease risk management, what is also needed is consideration of preventative health and control strategies to promote health and longevity in regards to anthropogenic hazard mitigation. Vaccination should also be floated as realistically one of the few ways to minimise the consequences of exposure to infection and subsequent development of disease with a high likelihood of associated morbidity and mortality. However, for WGP the logistics and feasibility of a large scale catch up for initial vaccination and individual identification, ideally subsequent catch ups to monitor antibody responses through blood collection and the associated stress to the colony, compared to no intervention is HIGHLY UNLIKELY to be feasible or justifiable given the cryptic and stressy nature of this free-living species.

A captive trial could be considered for the Perth Zoo captive management group but vaccination would probably be best trialled in a more robust species initially. The WOAH (2023c) 'Considerations for emergency vaccination of wild birds against high pathogenicity avian influenza in specific situations' is an excellent discussion paper providing guidance on considerations for emergency vaccination of wild birds against HPAI in immediate response to an outbreak or increased risk of introduction of HPAI. This recent paper provides high level international guidance, but still requires national interpretation within governmental jurisdictions.

<u>Preventative management and vaccination</u>
Vaccination against H5N1, or any strain of AI, comes with challenges, including the logistics of giving a vaccine to a large group of birds and difficulties in differentiating between infected and vaccinated birds, meaning there may be trade implications (Mills 2023). Vaccination, as a method of preventing infection, virus shedding and (or) disease, was stated as impractical for wild populations by Roberts et al. (2023b) in the 2018 HPAI disease event. However, available vaccines and vaccine technology should be explored to assess possible situations where vaccination may become feasible.

Following an outbreak of H5 avian influenza, Australia's preferred policy is to control the disease without the use of vaccination. The use of vaccination in wild birds is not considered to be feasible. In addition, environmental modification, environmental disinfection, wildlife dispersal or wildlife containment are not considered effective or appropriate for HPAI control, irrespective of the species.

Consider instead:
Staff awareness and training
Documenting this policy as part of the site H5 avian influenza risk mitigation plan.
Document features of the site and wild animal populations that may be useful when making decisions around removal of infected carcasses.
Could people and vehicles easily access sites if carcasses were to be removed?
What scavengers are present in the area that are likely to scavenge on carcasses?
Do members of the public have access to the site? If so, can their access be restricted?
What would the risk to the population be of significant disturbance of the site, such as accessing the site with people, vehicles and interacting closely with the population and habitats to remove carcasses?

<u>Other recommended biosecurity practices</u>

Information about avian influenza in humans should be distributed to conservation authorities, with instructions to visit the nearest health clinic if flu-like symptoms are experienced post working with birds.

Critical control points	Mitigation Options	Effectiveness	Feasibility	Explanation (include any relevant sources of information)	Recommendation (Y/N)
1	Passive surveillance	High	High	Passive surveillance of wild populations can lead to preventative actions such as removing affected carcasses to minimise access to predators.	Logistically challenging and not practical
2	Communication with public	High	High	Educating and warning public of disease risks and importance of exclusion and direct contact with wild WGPs in outbreak scenario, for example closure of national parks, signage	Y
3	Active surveillance of live birds	Low	Low	Disease can be transmitted through direct contact between conspecifics. Therefore, early detection in live birds could be used as an early warning system. However, this is likely to be not cost effective, with surveyed birds negative currently, and with WGPs being very difficult to detect in the wild. Passive surveillance of dead indicator birds, seabirds and shorebirds is a far more effective strategy.	N for WGP Y for indicator species
4	Passive surveillance and removal of any dead carcasses	High	High	It is important to catch outbreaks early, because dead birds create an infection source for the rest of the population. Dead birds can be removed to reduce outbreak severity.	Logistically challenging and not practical

				However, this is unlikely to be feasible owing to the cryptic nature of the WGP	
5	Avian Biosecurity	High	High	In case of an outbreak, H5 avian influenza can be carried on fomites (cages, car tyres, clothing etc); high biosecurity and appropriate decontamination is therefore essential. Researchers and DBCA staff with chickens at home must shower before work and wear clean clothing not used to service backyard chickens or fowl.	Y
6	Insurance populations	High	Moderate	Consideration of boosting the Perth Zoo captive management population as an insurance population for future breeding attempts through bringing birds into captivity	For discussion
7	Human biosecurity	High	High	High standards of personal hygiene should be used when dealing with poultry or handling wild birds including hand washing and taking care to avoid rubbing eyes and touching the mouth, eating, drinking or smoking until hands are clean. Appropriate personal protective clothing, gloves, facial and ocular protection should be worn.	Y
8	Treatment	Moderate	Low	Theoretically, supportive care only, but many birds die peracutely, and treatment of large numbers of affected birds would be difficult.	Consider for zoo housed captive population only

				They would need to be housed in strict isolation during treatment and with use of PPE.	
9	Routine monitoring should cease at times of high risk of infection			At times of higher risk, e.g. when infection has been found within region, and/or during long periods of extreme weather conditions, stressors to wild bird populations (e.g. routine monitoring) should be minimised.	Y
10	Site closure: If disease has been confirmed in a region or in close proximity			Extra care should be taken regarding potential for introducing infection on fomites such as footwear or vehicle tyres, using disinfection procedures, as appropriate. **Site access to national parks where WGPS inhabit should be restricted** during these times. Disturbing activities should be suspended. Public education to raise awareness of H5 avian influenza the risks it poses, and some simple precautions and response actions, should be given, including prohibition of feeding of wild birds.	Y
11	Vaccination	High	Moderate	To reduce associated morbidity and mortality associated with disease and control outbreak scenario. Emergency vaccination of wildlife now being considered by WOAH (2023c).	Consider in captive population only

Appendix 2. Suggested Triggers and actions for H5 avian influenza management for wild WGPs at Cape Arid National Park and the adjacent Nuytsland Nature Reserve as well as the translocated population east of Albany

	TRIGGER(S)	ACTIONS
STAGE 1 LOW ALERT	No signs of unusual or mass mortality of wildlife. AND No wildlife displaying behavioural signs consistent with H5 avian influenza	<u>Staff/volunteer/visitor measures</u> -Routine / maintenance biosecurity measures (dedicated work boots not worn around poultry, or pet birds) -Staff / volunteer education and awareness program: aware of clinical signs and how to report, https://www.wa.gov.au/organisation/department-of-primary-industries-and-regional-development/avian-influenza https://www.dbca.wa.gov.au/management/threat-management/h5-avian-influenza-bird-flu DBCA factsheet to be circulated -Seasonal flu vaccination recommended for those handling birds and mammals, PPE (gloves, N95/P2 masks, coveralls, facial protection supplied in a grab box to Albany office with video instructions, & written instructions in event of incursion. -Identify staff with poultry, pet birds at home who may need extra uniform provisions to enable staff to wear clean clothes daily to minimise fomite transmission if/when disease present in WA <u>Animal measures</u> -Risk assessment completed for highly susceptible and threatened species and sites and discuss potential mitigation actions with site managers and traditional owners (this document) -No restrictions on project/infrastructure work or recreational activities • Wildlife interactions for approved scientific purposes continue as approved • If a suspected case is sent for exclusion testing it must be reported to the Regional Manager and a full investigation process is carried out to ensure that best available advice and information is provided to the Wildlife Response Co-ordinator and DBCA Co-ordination group to confirm the likely presence of H5 avian influenza before escalation <u>Other measures</u> -Ensure other stakeholders are educated and aware of risk, brief contractors, and industry of disease implications including need for potential quarantine and site closures and advise recreational and commercial tourism industry networks. -Stakeholders to be identified by regional managers and further communications to be led by Regional Manager and Wildlife Response Co-ordinator in consultation with DBCA H5 Avian Influenza Co-Ordination Group.
STAGE 2 MODERATE ALERT	HPAI H5N1 clade 2.3.4.4b confirmed in Australia *May escalate quickly to Stage 4	Stage 1 measures plus <u>Staff/volunteer/visitor measures</u> -Notice of enhanced biosecurity measures (moderate alert) given presence in Australia to DBCA staff, volunteers and stakeholders - Staff / volunteer education program (above websites regularly updated) consider face fit & respiratory protection for fauna teams as determined by H5 avian influenza co-ordination group, extra clean clothing provisions for those keeping birds at home) -Continue monitoring and reporting based on observations (bird deaths, same species - greater than 5 together) – all staff -Continue active review of external reports of H5 avian influenza cases on adjacent migratory paths and wildlife breeding locations undertaken by Wildlife Response Co-ordinator -Development of appropriate signage to educate and inform public why some areas may be off limits in future developed by H5 avian influenza co-ordination group – Regional Manager . <u>Animal measures</u> - Wildlife interactions for approved scientific purposes can continue as per approved arrangements

		-Any personnel conducting animal related activities must follow hygiene/PPE protocols to levels prescribed and include processes for donning and doffing PPE to reduce possibility of transmission (e.g. wear appropriate PPE) -Wildlife professionals should avoid contact with domestic birds, especially poultry, for 48 hours prior to and after handling wild birds or mammals.
STAGE 3 HIGH ALERT	HPAI H5N1 clade 2.3.4.4b confirmed in Western Australia *May escalate quickly to Stage 4	Stage 1 & 2 measures plus Staff/volunteers/visitor measures - Notice of enhanced biosecurity measures (High alert) given confirmed presence in WA to DBCA staff and stakeholders -If staff/volunteers unwell with respiratory signs, advised to stay home Animal measures -Follow DPIRD updates and update DBCA Co-ordination group with species specific status updates -Limit non-essential staff in WGP habitat -Consider cessation of field work and population monitoring limited to acoustic/camera monitoring only -Consider harvesting insurance population from the wild to boost captive breeding attempts at Perth Zoo captive management facility to also act as an insurance population. -Record all cases of bird mortality in surrounds, investigate and report any unusual mortality events (a the Wildlife Response Co-ordinator should be contacted to help with the investigation of any unusual mortality events). -Restrict access to suspect and susceptible populations and areas (staff and visitors). -Restrict visitor access to sites/areas where birds congregate (boardwalk access only). -Even where no signs of infection, it is not safe to assume that the virus is not circulating, and appropriate biosecurity and hygiene precautions should be adopted when carrying out any activities within or near any WGP habitat, including strict biosecurity for all clothing, footwear, vehicles, tools and equipment.
STAGE 4 EMERGENCY ANIMAL DISEASE RESPONSE	HPAI H5N1 clade 2.3.4.4b confirmed at wild sites	Stage 1, 2 & 3 measures plus If suspected or confirmed cases Notice of enhanced biosecurity measures (EAD response) given presence at site to DBCA staff, volunteers and stakeholders -Provide advice to Incident Controller / Head of Division. -Follow DPIRD & WA health updates inform DBCA Co-ordination group with species specific status updates -Increase biosecurity and quarantine in infected areas with no public access, erect signage -Testing of suspected birds and mammals as indicated-by DPIRD -Monitor only if will directly contribute to understanding the impacts of the outbreak; all other activities suspended (research, maintenance, conservation programs). -All activities which require handling of wildlife should cease unless they directly relate to mitigation measures or disease outbreak monitoring. -Full PPE in WGP habitat to include N95 facemask, safety glasses disposable coveralls and dedicated boots. --Under no circumstances should anyone who owns or works with domestic poultry come into contact with any bird suspected of carrying avian influenza; no person who has worked with a suspected bird should visit any areas where domestic poultry are kept for at least two weeks. -Removal of carcasses and sick birds unlikely given cryptic nature of species..

		-Daily counts of mortality and routine testing of suspicious cases would be difficult owing to cryptic nature of species.

NB. Perth Zoo captive management group will be managed under the Perth Zoo site based risk assessment

Appendix 3. Budget submission for captive management ZAA grant at Perth Zoo

WGP Aviary 1 (next to Numbats)

- Install a solid polycarbonate roof system over current aviary - $60k
- Fencing and gates - $20k
- New changing rooms male and female - $50k

- New aviaries to (double the size of current) – $140k
- Site works - $20k
- Internal netting, CCTV and substrate - $40k
- Fencing and gates around new site -$20k
- Removal of trees -$15k
- Total - $365K

WGP Aviary 2

- Install a solid polycarbonate roof system over current aviary - $40k
- Fencing and gates - $20k
- New changing rooms male and female - $50k

- New aviaries to (double the size of current for insurance population) – $120k
- Site works - $20k
- Internal netting, CCTV and substrate - $40k
- Fencing and gates around new site -$20k
- Total $330K