High pathogenicity avian influenza in wildlife: Is Australia prepared?

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Summary

Over the past 20 years, high pathogenicity avian influenza viruses have been spreading around the world, killing millions of wild birds, as well as poultry, and thousands of wild mammals. With the continued evolution and spread of new variants, the risks of the disease arriving in Australia and causing mass mortality of native birds and mammals are likely to have increased.

Australia has a national response plan focused primarily on the risks to the poultry industry. We urge Australia's governments to establish a national taskforce to prepare and oversee the implementation of a national response plan for wildlife.

Recommendations

Risk assessments

1. The Australian Government commission an expert assessment of the risks of high pathogenicity avian influenza for Australian wild birds and mammals, including threatened species.
2. As part of the risk assessment for wildlife, review the potential benefits and risks for wild birds of the vaccination of poultry against avian influenza. Do not permit vaccination if it will increase the disease risks for wildlife.

National wildlife taskforce

3. To coordinate a national response to the risks of high pathogenicity avian influenza for wildlife, the Australian Government establish a national taskforce, with membership including environmental and biosecurity agencies from all governments, Wildlife Health Australia, other wildlife and disease experts (including veterinarians), zoo organisations involved in captive breeding and environmental NGOs.

National wildlife response plan

4. The national wildlife taskforce prepare and oversee the implementation of a national wildlife response plan for avian influenza.
5. The national taskforce review measures applied in and experiences with avian influenza outbreaks in overseas bird colonies to learn what was effective, what to avoid and how to optimise recovery afterwards.
6. In developing a national response plan for wildlife, the national taskforce consider measures of the following types:

   (a) monitoring, reporting and research

   (b) regulating human access and activities

   (c) removing and disposing of dead birds

   (d) rescuing and euthanasing wildlife

   (e) response planning for local colonies

(f) keeping humans safe and building public awareness

(g) vaccinating captive-bred colonies of threatened species.

Local response plans

7. Australian governments encourage and provide resources for managers of sites with high concentrations of shorebirds, waterbirds or seabirds to prepare local response plans for avian influenza outbreaks in wild birds, guided by advice from the national wildlife taskforce.

Surveillance

8. The national wildlife taskforce review the 2023 avian influenza surveillance program and provide advice about supplementary surveillance priorities for wild bird populations, including seabirds. This could be supplemented by surveillance, in cooperation with international partners, along inward migration pathways and in the Southern Ocean.
9. The national wildlife taskforce develop a program to encourage surveillance by indigenous rangers, birdwatchers, land managers and researchers, particularly in remote locations.

1. Introduction

While COVID has been spreading around the world, killing at least 7 million humans, another deadly virus has also been spreading, killing millions of birds. High pathogenicity avian influenza (HPAI) viruses of subtype H5 have been circulating since 1996 in poultry and since 2002 in wild birds, infecting more than 300 wild bird species and poultry in Europe, Africa, Asia and America. They have also infected thousands of mammals, including a few hundred humans.

Through COVID-19, people have come to understand viruses as relentless innovators and adapters. The emergence of HPAI H5 has many overlaps with that of COVID – spillover from wild animals, rapid spread into new domains, prolific mutations and genetic shuffling, leading to multiple waves of infection. Like coronaviruses, avian influenza viruses are beneficiaries of globalisation. The transformation of local infections into a global panzootic has been driven by a booming poultry industry, with poultry now making up an estimated three-quarters of the world's bird biomass [1].

The only continents apparently free of HPAI H5 are Australia and Antarctica. New Zealand has also not been affected. The consequences if it does arrive in Australia are hard to predict but, based on overseas experience, could be devastating for wild birds, as well as poultry, and potentially also for some mammals.

How well prepared is Australia for its potential arrival and mass infection and mortality of wild birds and mammals? Here, we review the global origins, spread and impacts of HPAI H5. We then consider Australia's state of preparedness and recommend measures for boosting Australia's capacity to respond to the growing risks to wildlife populations.

Box 1. How avian influenza viruses are classified

All avian influenza viruses are classified as influenza A. Of the 4 types of influenza viruses – known as A, B, C and D – only influenza A is known to have caused pandemics (in humans) and panzootics (in animals) [2].

Influenza A viruses (species *Alphanifluenzavirus influenzae*, family Orthomyxoviridae) are RNA viruses and classified into subtypes based on 2 types of protein on the virus surface and further classified according to whether they cause severe or mild disease in chickens [2].

The outer surface of influenza A viruses is a lipid envelope derived from the membrane of the host's respiratory cell from which the virus budded. This envelope is studded with the proteins haemagglutinin (H) and neuraminidase (N) [2] (Figure 1). Haemagglutinin is essential for the virus to attach to the surface of the host's respiratory cells while neuraminidase is essential for the release of the virus from those cells and also facilitates its penetration of mucus [2].

Wild birds, particularly ducks, geese, swans, shorebirds and gulls, are reservoirs for 16 of the 18 known H subtypes and 9 of the 11 known N subtypes [1]. More than 130 subtype combinations have been identified in nature so far, mainly in wild birds [2].

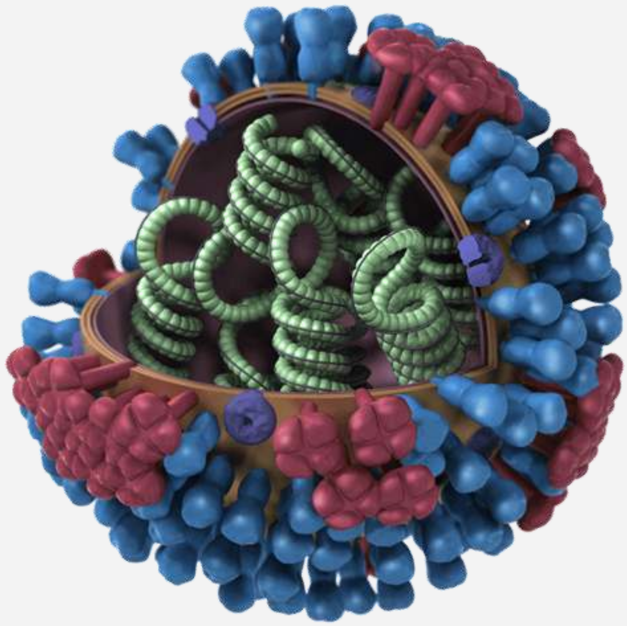

Figure 1. A representation of an influenza virus, showing the surface proteins haemagglutinin (red) and neuraminidase (red) and RNA (green).

Source: US Centers for Disease Control and Prevention [3]

Avian influenza viruses are further classified as high or low pathogenicity based on their ability to cause disease in poultry. Subtypes H5 and H7 are the only ones with the capacity to mutate from low to high pathogenicity forms when introduced into poultry [4]. The current panzootic was initiated by a virus classified as H5N1, which emerged as a highly pathogenic form after infecting domestic geese [5] (section 2).

Influenza A viruses are highly adept at modifying their H and N proteins – by (a) mutation and (b) genetic reassortment – which helps them avoid immune detection by hosts [6]. They have a high rate of mutations because the influenza A enzyme that copies RNA for virus replication is prone to errors [2]. Natural selection for and accumulation of these mutations causes gradual changes in the H and N proteins. An influenza A virus can also modify its H and N proteins by swapping genetic material with other influenza A viruses. This is facilitated by the segmentation of the genetic material into 8 separate bits, each coding for 1–3 proteins. Viruses that infect the same cell at the same time can easily swap segments.

2. The origins and spread of HPAI H5

A diverse group of influenza A viruses naturally infect wild aquatic birds all over the world – mainly ducks, geese, swans, shorebirds, terns and gulls – and cause only mild symptoms or none at all [4,7]. Sometimes, these viruses spill over to domestic poultry, where they typically also cause mild or no disease. But, occasionally, the viruses of subtypes H5 and H7 mutate in poultry into deadly strains, killing up to 100% of infected birds.

Until recently, high pathogenicity strains of H5 and H7 were thought to be a risk only for poultry. Of 42 conversions of low pathogenicity to high pathogenicity strains from 1955 to 2019, 40 were recorded only in poultry, which meant that outbreaks could be controlled by culling or vaccinating poultry flocks [8]. The 2 exceptions were a 1961 event in South Africa that spilled over into terns and the current panzootic, each involving the H5N1 subtype [5].

In 1996 a high pathogenicity strain of H5N1 emerged in domestic geese in Guandong, China, killing more than 40% of infected birds [5]. The following year it infected domestic chickens in Hong Kong, and also people working with chickens, resulting in 6 human deaths.

Five years later, H5N1 killed waterbirds in the Hong Kong parklands – overturning presumptions that it was not a risk for wild birds. By early 2004 it had spread to 8 other Asian countries [5]. From May to July 2005 it killed more than 6,000 wild migratory birds at Qinghai Lake in north-west China [9]. By 2009 it had been reported from 38 countries in Africa, Asia, Europe and the Middle East [5].

In the 2010s the threat escalated with the emergence of a new lineage (2.3.4.4) that gave rise to several new N subtypes (H5N2, H5N6, H5N8) and became better adapted to waterbirds and more capable of infecting mammals [7]. In late 2014 H5N1 arrived in Canada and the United States probably via migratory waterbirds. As it spread, new variants emerged as genes were exchanged with existing influenza strains in wild birds. In mid-2015 a large outbreak killed an unknown number of wild birds and more than 50 million poultry birds (which died from disease or were culled) [7].

Outbreaks continued in Asia and Europe, and sporadically in Africa, sometimes killing more than 10,000 birds at a time [5]. From 2016 to 2017, more than 100 mass mortality events in wild birds were reported across Europe [4], and from 2016 to 2018, mass mortality, particularly of seabirds (terns and penguins), was reported in Africa [10].

Since October 2021 the situation has dramatically worsened. The World Organization for Animal Health reported an 'unprecedented number of outbreaks' with 'an alarming rate of wild bird die-offs' and infections of sea and land mammals [11]. Some 400,000 wild birds were reported to have died in the 8 months from October 2021 to June 2022 in 2,600 outbreaks, although the true toll is likely to have been much higher – 'only a fraction of cases in wild birds are diagnosed and reported' [12,13].

In late 2022, HPAI reached Central and South America, spreading through 9 countries within 4 months [14]. In Peru, more than 60,000 seabirds and some 3,500 sea lions have died [15,16]. The sea lions may have been infected due to close contact with infected birds, but transmission between sea lions has not been ruled out [15].

Figure 2. A dead South American sea lion in Peru during an outbreak of avian influenza in late 2022
Source: Peruvian National Forest and Wildlife Service [17]

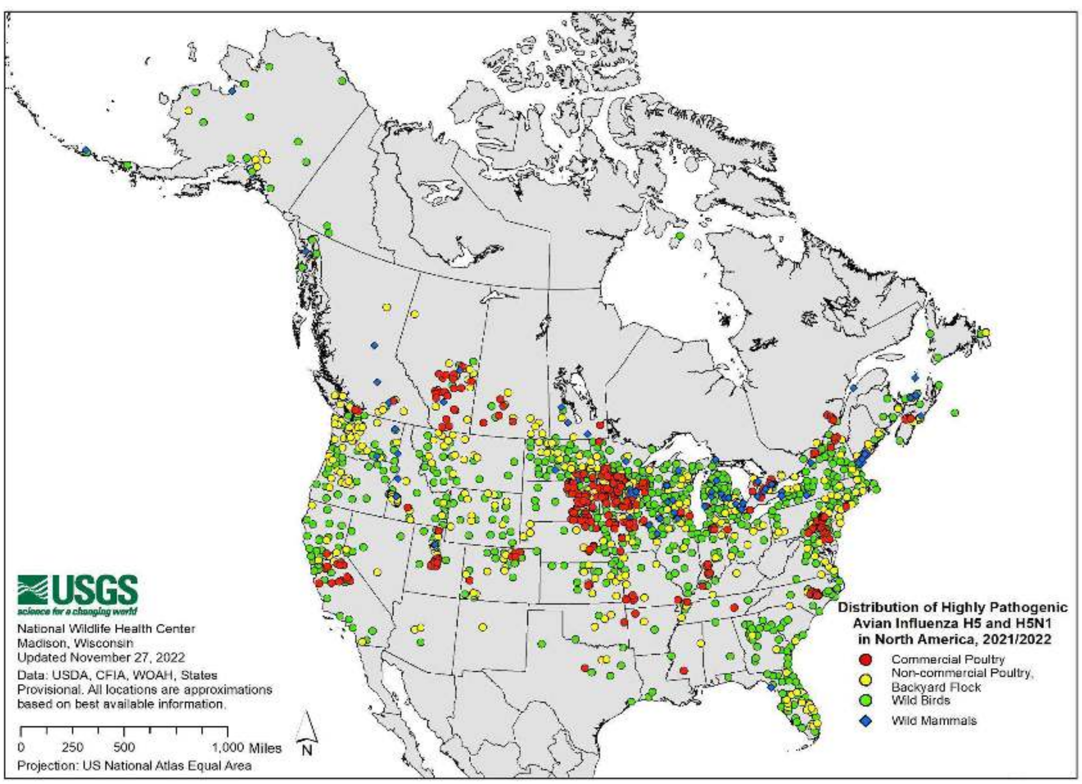

Figure 3 The distribution of HPAI H5 in the United States in 2021–2022

Source: National Wildlife Health Center [18]

The bird species so far infected are highly diverse – waterbirds such as geese, ducks, herons, cranes and swans; seabirds such as terns, pelicans, gulls and skuas; raptors such as eagles, vultures and owls; shorebirds such as knots and stints; and passerines such as crows [19–22]. HPAI H5 has also infected numerous mammals likely to have fed on infected birds, including badgers, foxes, bears, wild cats, pigs, dolphins, seals and sea lions [12,23,24]. In October 2022, the virus proved apparently capable of spreading between mammals when it infected a large (50,000) mink farm in Spain [25]. So far, only about 900 humans have been reported infected, about half of whom died [23].

There are now many genetically distinct HPAI H5 virus clades in circulation, displaying varying degrees of virulence and host range specificity. Wild birds 'are in a transient state towards becoming a reservoir' [26]. The trajectory of HPAI is unpredictable. Numerous low- and high-pathogenicity H5 strains are co-circulating and available for reassortment with each other. At any time, strains 'may arise with enhanced ability to transmit to and among mammals' [26].

Table 1. The spread and impacts of HPAI H5 around the world

1996–2004	**Initial outbreaks**
1996	Outbreak in domestic geese, Guangdong, China
1997	Outbreaks in domestic chickens, Hong Kong. Also infects humans.
2002	Outbreak in wild and captive waterbirds, Hong Kong parklands
2005–10	**Wave 1**
Spread	38 countries in Asia, Europe, Africa, Middle East. Mainly affected Asia.
Variants	H5N1, clade 2.2
Wild birds	China (2005): >6,000 birds at Qinghai Lake died, particularly geese, gulls and cormorants
Poultry	>55 million birds died/culled
2011–19	**Wave 2**
Spread	Asia, Europe, Africa, North America (2014).
Variants	Emergence of clade 2.3.4.4, with multiple H5 subtypes
Wild birds	North America (2015): Large outbreak, unknown numbers Europe (2016–17): 112 mass mortality events reported, including 13,600 of 71 species in the Netherlands South Africa: (2017–18): >7,500 of 20 seabird species, mainly terns, gannets and penguins.
Poultry	140 million birds died/culled
2020–ongoing	**Wave 3**

Spread	Asia, Europe, Africa, North America (2021), South America (2022)
Variants	Emergence of clade 2.3.4.4b. Mainly H5N1, H5N8 subtypes.
Wild birds	Europe (2021–22): 3,500 detections, 37 countries, 63 species. UK (2021–22): >300 outbreaks in seabird colonies, 30,000–50,000 died on Farne Islands, 13,000 barnacle geese died on Solway Firth. Netherlands (2022): Of 18,000 breeding pairs, 8,000 adult sandwich terns died and very few chicks fledged France (2022): 10% of the breeding population of sandwich terns died in 1 week Israel (Dec 2021–Jan 2022): 8,000 Eurasian cranes died South Africa (2022): 24,000 Cape cormorants, >200 African penguins died Peru (2022): 60,000 seabirds died
Poultry	194 million birds died/culled (to November 2022)
Wild mammals	US (2021): bears, seals, raccoons died Peru (2022): 3,500 sea lions died
Farmed mammals	Spain (2022): >50,000 mink died/culled (probable animal-to-animal transmission)

Sources: [4,5,9,10,27–33]. **Note**: The division into 3 ‘waves’ is based on [27].

3. The risks of HPAI H5 to Australian wildlife

3.1 Risks of entry to Australia

The main means of spread of avian influenza virus is through ‘the movement of live birds, bird products (such as eggs), fomites [contaminated objects], people and equipment’ [19]. The main pathways for the spread of HPAI around the world have been the migration of aquatic birds that are reservoirs for avian influenza, as well as the poultry trade [34,35].

The risk for Australia along both these pathways has long been considered ‘low’ [4] – the only poultry meat permitted for importation is ready-to-eat cooked chicken meat from New Zealand [36] and waterbirds (ducks, geese and swans) do not migrate to Australia [37]. The most likely pathway for introduction is shorebirds and seabirds migrating from Asia and North America [1,37].

Every spring (from August to November), some 8 million shorebirds of some 50 species fly to Australia along the East Asia/Australasia Flyway, which encompasses 37 countries from Arctic Russia and North America through large parts of East Asia and all of Southeast Asia [38,39]. Normally, the risk of avian influenza entering Australia via shorebirds is considered low [4]. And thus far there is no evidence that HPAI H5 viruses have entered Australia [37,38]. But with the increased frequency and range of overseas outbreaks, wildlife health experts warn that the risks of entry to Australia have increased [4,38].

The understanding of HPAI H5 infection in shorebirds is ‘extremely limited’, but there is evidence they ‘could be exposed, survive infection, and potentially disperse’ the virus over long distances during migration [38]. Researchers have shown that red-necked stints in Australia have previously been exposed to HPAI H5 viruses – 1.5% of samples collected between 2011 and 2018 had HPAI H5 antibodies [38]. They recommend that the potential for migratory shorebirds to introduce HPAI H5 viruses ‘inform future avian influenza surveillance’.

There is also a risk of migratory seabirds introducing avian influenza to Australia’s Antarctic and sub-Antarctic territories [40]. No HPAI outbreaks have been recorded in the Southern Ocean, but several species impacted in the northern hemisphere, such as skuas and terns, migrate to Antarctica. The arrival of migratory seabirds, mostly between September and November, coincides with the arrival of penguins and other seabirds for breeding [40].

Box 2. Outbreaks of high pathogenicity avian influenza in Australian poultry

Australia has recorded 8 HPAI outbreaks in poultry, all H7 subtypes – in 1976, 1985, 1992, 1994, 1997, 2012, 2013 and 2020 [4]. They are all thought to have resulted from the mutation of low pathogenicity virus introduced by direct or indirect contact with wild birds [41].

Modelling of Australia’s outbreak history indicates there are probably regular incursions of avian influenza into poultry flocks, but that spread between birds and mutation to the high pathogenicity form occurs only rarely. This is probably because the industry is dominated by meat production – Australia’s estimated 2,000 poultry farms hold close to 200 million meat chickens at any time compared with 20 million layer chickens [42,43] – and the production cycle in meat enterprises is short (about 7 weeks), limiting the potential for virus spread and mutation [41].

While low pathogenicity H7 circulates naturally in Australian wild birds, the only detection of a high pathogenicity H7 strain has been in a Eurasian starling trapped inside a poultry shed during the 1985 outbreak [4].

For exotic avian influenza viruses introduced to Australia with migratory shorebirds, the likely pathway to poultry is via waterbirds infected while mixing with shorebirds in shoreline or wetland habitats. Migratory shorebirds mostly do not come into contact with poultry farms [41].

3.2 Risks of HPAI H5 infecting Australian wildlife

Because HPAI has previously been regarded as a disease risk only for poultry, there has been limited focus on the risks of the current panzootic for Australia's wild birds and mammals. No formal risk assessment for wildlife has been conducted (as far as we know).

The 8 outbreaks of HPAI in Australian poultry, all involving H7 subtypes, did not result in infection of wild birds except for a single Eurasian starling (Box 2) [4]. Low pathogenicity avian influenza viruses, including the H5 subtype, have been detected in wild birds in Australia, but not HPAI viruses [19]. However, the risks of spread from poultry to wild birds (and vice versa) have increased as the Australian poultry industry has expanded, particularly free-range production [42].

Wildlife Health Australia advises that all Australian bird species should be assumed to be susceptible to infection by HPAI H5 [44]. Species infected elsewhere have included those native or endemic to Australia (e.g. black swans, peregrine falcons and red knots). Thousands of red knots (listed as endangered in Australia) have died – in 2021 more than 3,000 in an outbreak in Germany [45] and several hundred washed ashore in the Netherlands [46]. But the patterns of disease in Australia could be different from elsewhere due to Australia's distinctive ecology and phylogenetic differences [4]. Species' differences are exemplified by black swans, which are considered to be 'at significant peril' due to genetically coded differences in their immune response to viruses [47] (Box 3).

Since 2022, there has been a major increase in outbreaks of HPAI in seabirds and sea mammals [40]. Colonial nesting seabirds may be at high risk of disease spread because of their proximity to each other over extended periods. Antibodies against avian influenza viruses have been detected in birds in Antarctica and on sub-Antarctic islands, but their pathogenicity was not assessed [48].

Given the likely high susceptibility of Australian wild birds and mammals to HPAI infection if H5 strains arrive in Australia, we recommend the Australian Government commission an expert assessment of the risks to Australian wildlife, including identifying species at potential high risk. The United Nations Environment Program recommends that all countries undertake transparent, structured, and science-based risk assessments, making use of all available knowledge [49].

Recommendation

- ❖ The Australian Government commission an expert assessment of the risks of HPAI for Australian wild birds and mammals, including threatened or highly susceptible species.

Box 3. The risks of HPAI for black swans

Black swans are likely to be at significant 'peril' from HPAI [47]. Infected black swans in captivity overseas have died [50] and those infected experimentally with HPAI all died within 2–3 days after becoming infected [51].

Genetic research has revealed they lack immune genes that help swan species from the northern hemisphere and other waterbirds combat certain viral infections [47]. It appears that black swans have lost some genes with immune functions from the ancestor they shared in common with other swan species – presumably due to 'limited pathogen challenge' in Australia. The researchers predict that 'should HPAI become more prevalent in the Oceania region, the ongoing survival of the black swan would be at significant risk' [47].

4. Australia’s preparedness for avian influenza

Australia has a national plan for avian influenza focused primarily on poultry, aviary and zoo birds [19]. There are also guidelines for a public health response to avian influenza infections in humans [52]. But there is no national response plan for HPAI infections in wild birds or mammals.

4.1 National strategy for avian influenza

Australia’s 2022 *Response strategy: Avian influenza* – an Australian Veterinary Emergency Plan, known as an AUSVETPLAN – sets out the ‘nationally agreed approach’ for responding to avian influenza in poultry, or cage (aviary) or zoo birds so as ‘to ensure that a fast, efficient and effective response can be implemented consistently across Australia with minimal delay’ [19]. ‘Poultry’ means chickens, turkeys, guineafowl, ducks, geese, quail, pigeons, pheasants, partridges, emus and ostriches reared or kept in captivity, including commercial and backyard.

Strategies for poultry

For poultry, the AUSVETPLAN specifies a policy to [19]:

> *use stamping out to control spread of HPAI (any subtype) and LPAI (H5/H7), and to reduce the potential for mutation of LPAI (H5/H7) virus to HPAI virus.*

Strategies that may be used to achieve this include:

- destruction, disposal and decontamination of infected birds and contaminated products
- biosecurity controls (e.g. quarantine, declared areas, movement controls)
- declaration of restricted and control areas, with restrictions on movements of birds, avian products and associated items
- flock or area depopulation by pre-emptive slaughter
- increased biosecurity at poultry establishments (such as mandatory housing of free-range poultry) and premises holding cage or zoo birds.

The response plan says that vaccination of poultry may be considered if an H5 or H7 outbreak is likely to spread or has become widespread. While vaccination will reduce spread, there is concern by some experts that it could increase the risks for wild birds by facilitating the emergence of new variants (Box 4). Risks recognised in the response plan are that vaccination ‘may favour the emergence of more virulent variants through indirect selection of viruses’ and ‘could possibly mask low levels of circulating field virus by not fully preventing virus excretion and by masking clinical signs in susceptible animals’. We recommend that the potential risks for wildlife of poultry vaccination be the focus of an expert review and that vaccination of poultry be ruled out if there is an increased risk for wildlife.

Strategies for cage and zoo birds

The policy for high pathogenicity infections is similar to that for poultry – ‘stamping out’. For low pathogenicity H5/H7 infections, the plan specifies ‘modified stamping out’ (not implemented in full), based on a risk assessment. The plan says that vaccination may be considered for certain captive birds at risk of infection, such as ‘captive endangered species’.

Although it’s not clear in the AUSVETPLAN, we assume the strategy of ‘pre-emptive slaughter’ would not apply to aviary or zoo birds. The Scientific Task Force on Avian Influenza and Wild Birds (convened by two United Nations bodies, the Convention on the Conservation of Migratory Species of Wild Animals and the Food and Agriculture Organisation) says, ‘There is no justification for any pre-emptive culling of zoological collections’ and ‘only when necessary, limited culling of affected birds’ may be warranted [53].

Strategies for wild birds

Effective biosecurity by the poultry industry – including to prevent interactions between poultry and wild birds and respond effectively to outbreaks – is essential for protecting both wild birds and poultry from HPAI. Apart from that, there is little focus in the AUSVETPLAN on managing the risks and impacts for wild birds.

If HPAI infection is detected in wild birds, the Consultative Committee on Emergency Animal Diseases will convene and commission an epidemiological risk assessment. No action will be required unless the risk assessment indicates an ‘unacceptable threat’ to poultry or public health. HPAI infections in wild birds ‘are not considered to pose an immediate threat to Australia’s domestic or zoo birds, or to public health’, so will not be treated as an ‘emergency animal disease’ (for the purposes of the AUSVETPLAN). If a response is considered necessary to protect poultry or human health, it may include:

- declaration of restricted areas
- surveillance to determine the extent of infection
- enhanced biosecurity
- a public awareness campaign to communicate risk and promote cooperation from industry, zoos, cagebird owners and the community
- protection of public health in consultation with human health authorities.

The plan rules out destruction of wild birds as being ‘neither practical nor environmentally sound’, other than for reasons of animal welfare. An appendix in the AUSVETPLAN lists actions to consider in response to HPAI in wild birds (see section 4.2).

Recommendation

- ❖ As part of the recommended risk assessment for wildlife, review the potential benefits and risks for wild birds of the vaccination of poultry against avian influenza. Do not permit vaccination of poultry if it will increase the risks for wild birds.

Box 4. Would vaccination of poultry increase the risk for wild birds?

There is considerable global debate about whether the vaccination of poultry against avian influenza could increase the risks for wild birds [54,55]. Poultry vaccines typically reduce disease symptoms in chickens but do not wholly prevent virus infection and transmission [56]. While they would reduce spillover from poultry into wild birds and humans [57], if viruses continue to circulate undetected in asymptomatic vaccinated poultry, it could spur the emergence of new more-virulent strains that evade wild bird immune defences:

> *A key concern is the role of poultry vaccination in driving endemicity and the evolution of antigenically diverse HPAI H5 lineages [57].*
>
> *Poultry vaccines may have an impact on wild bird viruses through … the transmission of virulent viruses that have evolved in response to the use of poultry vaccines [56].*
>
> *Vaccines that keep hosts alive but still allow transmission could thus allow very virulent strains to circulate in a population [58].*
>
> *[The] use of leaky vaccines can facilitate the evolution of pathogen strains that put unvaccinated hosts at greater risk of severe disease [58].*

These phenomena have probably contributed to epizootics. The origins of current HPAI H5N8 epizootics have been traced to mutations of a 2.3.4.4b lineage in poultry in Egypt, where vaccination is used [57]. In China, the widespread use of H9N2 vaccines in chickens 'exerted continuous mutation pressure', which resulted in increased virus infectivity and led to widespread outbreaks in chickens in 2010–13 [59].

4.2 Planning for HPAI infections of wildlife

There is no national HPAI strategy specific for responding to infections in wild birds and mammals. The AUSVETPLAN contains an appendix with actions to consider, including the following for widespread infection:

- identify and proclaim restricted areas (for exceptional circumstances)
- apply appropriate surveillance and biosecurity measures; apply enhanced biosecurity and control measures at local poultry holdings
- implement enhanced communications strategy
- consider use of vaccination in domestic poultry and for captive birds
- consult with health officials and environmental officials.

This very limited approach provides little impetus or guidance for wildlife managers to prepare for HPAI infections in wildlife and respond to conservation emergencies.

Wildlife Health Australia has prepared *Guidelines for Management of an Emergency Wildlife Disease Response*, which provides only general (although useful) guidance on processes and is still in draft form from 2018 [60]. The guidelines say that the management of a response to a particular emergency wildlife disease needs 'a similar basis' as a disease in production animals (i.e. a plan similar to an AUSVETPLAN). Likewise, a Ramsar handbook on avian influenza advises governments to undertake risk assessments and contingency planning, advised by an expert ornithological panel, prior to incursions of avian influenza [49].

Because it would not be feasible to eradicate avian influenza from infected wild bird populations, an outbreak would not trigger a response under the National Environmental Biosecurity Response Agreement. Unless infection in wildlife is considered a risk to poultry or people and therefore triggers some response under the Emergency Animal Disease Response Agreement, any response would normally be the responsibility of each state and territory government.

The lack of national arrangements for responding to wildlife diseases that cannot be eradicated is a major gap in biosecurity. Environment groups have proposed a category of ‘emerging key threatening processes’ under the Environment Protection and Biodiversity Conservation (EPBC) Act 1999 that could precipitate national planning. There needs to be an agreed process to ensure the collaboration of environmental and biosecurity agencies to prepare for and respond to emerging wildlife disease threats, whether or not they can be eradicated from wildlife.

The potentially imminent serious risks of avian influenza warrant a national wildlife plan prepared and overseen by a national wildlife taskforce. We discuss potential measures for the proposed plan in section 4.4.

Recommendations

- The Australian Government establish a national wildlife taskforce, with membership including environmental and biosecurity agencies from all governments, Wildlife Health Australia, other wildlife and disease experts (including veterinarians), zoo organisations and environmental NGOs.
- The national wildlife taskforce prepare and oversee the implementation of a national wildlife response plan for avian influenza.

4.3 Avian influenza surveillance

Australia’s National Avian Influenza Wild Bird Surveillance Program, managed by Wildlife Health Australia, has been running for 18 years. It includes targeted surveillance (sampling of waterbirds where they mix with shorebirds and where they are in close proximity to poultry and humans) and general surveillance (investigation of mass mortality and morbidity events in wild birds in Australia and the Australian Antarctic Territory) [61].

The AUSVETPLAN says, ‘Surveillance of wild bird populations will be commensurate with the level of assessed risk posed to domestic bird populations’, which implies that surveillance is not necessarily focused on the priority risks for wild bird populations.

In light of the escalating incursion risks, researchers have called for enhanced surveillance of wild birds in the second half of 2023 [37]. We recommend the surveillance program be reviewed by the proposed national wildlife taskforce to ensure that it includes surveillance priorities for tracking risks to wild birds, including seabirds.

Because Australia is so vast, and many shorebird, waterbird and seabird populations inhabit remote areas, the best chances of detecting early signs of avian influenza may come from observations by Indigenous rangers, birdwatchers, land managers or researchers. Training should be provided to ensure safety protocols are followed by those participating in surveillance.

Recommendations

- ❖ The national wildlife taskforce review the 2023 avian influenza surveillance program and provide advice about supplementary surveillance priorities for wild bird populations, including seabirds. This could be supplemented by surveillance, in cooperation with international partners, along inward migration pathways and in the Southern Ocean.
- ❖ The wildlife taskforce develop a program to encourage surveillance by indigenous rangers, birdwatchers, land managers and researchers, particularly in remote locations.

4.4 Potential measures for preventing and responding to infections in wild birds

The current policy under the AUSVETPLAN is to stamp out HPAI in poultry and other captive birds by culling. This is not regarded as effective or feasible for wild bird populations. There is no effective treatment for avian influenza in wild birds (or poultry) [4]. It is also not feasible to vaccinate wild birds, although there is apparently potential for a future vaccine to be delivered by bait [55].

The main potential strategies available for wild bird populations are to limit the risk of virus spread by human activities (e.g. restricting access to sites and interactions with birds), remove carcases (to prevent scavenging by susceptible species), monitor impacts (to inform understanding of the disease and recovery priorities) and conduct research (to better inform risk mitigation). It is also important to keep humans safe by avoiding interactions with sick animals.

Measures applied overseas and experiences with outbreaks should be reviewed to learn what was effective and what should be avoided. Only a few countries or organisations have published wild bird response plans or guidance. The most detailed are advice by a UN Scientific Task Force on Avian Influenza and Wild Birds [53], a 2010 Ramsar handbook [49], a 2022 United Kingdom plan [62], a report on a 2022 British workshop planning future responses [63], and a paper describing the response in South Africa [29]. In Australia, the managers of one important bird site, the Phillip Island Nature Parks, have taken the initiative to develop a local response plan (see Box 5) [64]. Apart from that, there is no public evidence in Australia of any site-based or jurisdictional planning focused on avian influenza in wildlife.

Several groups and researchers overseas have noted a lack of preparedness for mass outbreaks in wild birds. The UK Royal Society for the Protection of Birds, which manages 222 nature reserves, said guidance from the government during outbreaks had 'been slow in coming, and often contradictory and confusing' [31]. Granted consent by one agency to bury dead terns, the organisation was investigated by another agency for unlawful disposal. South African researchers reported on opportunities lost due to a lack of preparation for outbreaks in coastal birds [29]. Although there were broad guidelines for disease response, they had not been implemented at colonies, which 'resulted in a high level of uncertainty and lack of confidence' when making decisions. The lack of a pre-prepared monitoring plan meant opportunities were lost to gather information about the disease source, transmission, morbidity and mortality [29]. An analysis of HPAI in America noted a lack of national mortality data for Canada, Central America and South America, and the 'need for effective decision framing to prioritize management needs and scientific inquiry' [65].

We do not recommend specific measures for Australia (because that is not our expertise). But based on other plans and guidance, we recommend that national response planning consider the following types of measures.

Monitoring, reporting and research

In addition to the national surveillance program, monitoring of local sites is important for early detection of avian influenza and the collection of data on impacts should avian influenza be detected. Documenting real-time progress of the disease can inform ongoing risk management, increase understanding of disease epidemiology and shape recovery priorities. It may also be useful to collect baseline information for some populations. One recommendation from Britain is to collect baseline information on raptors because they are highly susceptible but tend to be found singly, which makes it difficult to determine population-level impacts [63].

A national system with protocols for documenting and reporting avian influenza infection and mortality in wild bird populations should be established and promoted to enable standardised data collection. Australia already has an emergency animal disease hotline.

A national response plan could specify standardised methods for monitoring and data collection and protocols for testing for avian influenza in infected populations. Monitoring methods could include environmental DNA techniques (for virus detection) and drone monitoring of affected colonies to avoid human entry (this was done in Peru [15]).

'Management-driven scientific inquiry' is urgently needed to develop disease response protocols for avian influenza (and other wildlife diseases) [65]. It will be important to learn as much as possible from disease events to apply to future risk mitigation efforts and recovery efforts. Governments should collaborate with researchers to identify priority research questions and facilitate the implementation of pre-prepared research projects should HPAI H5 reach Australia.

Regulating human access and activities, biosecurity measures

Restricting human access to bird colonies can help to reduce the risks of virus introduction and spread and minimise impacts on bird welfare. The Scientific Task Force on Avian Influenza and Wild Birds advises consideration of restrictions such as suspending recreational activities in affected sites, with pre-determined processes and structures [53].

The AUSVETPLAN notes the potential to declare a restricted area, but says declared areas is not a strategy for wild bird outbreaks. Whatever the mechanism of restricting access, decisions would have to be made about who should be permitted access (e.g. researchers and veterinarians) and under what circumstances. It would be particularly important to limit access by people who come into contact with poultry. Where access is permitted, there should be protocols to reduce the risk of virus spread such as disinfection of clothing, footwear, equipment and vehicles at key access points.

The Scientific Task Force on Avian Influenza and Wild Birds recommends reducing forms of disturbance that may encourage birds to fly to other areas [53]. Risk assessments of activities such as duck hunting, boating and bird feeding would help inform restrictions [31,66].

Removing and disposing of dead birds

The bodies of birds killed by avian influenza represent a potential source of infection for many days or weeks after death. Viral infectivity can persist in feathers for 15–30 days at 20°C [67,68]. There is emerging evidence from European seabird colonies that carcass removal may reduce the incidence of avian influenza in some species – by reducing scavenging and interactions with bodies [32]. In the Netherlands and Belgium, the regular (every 2 days) removal of dead sandwich terns when case numbers were low was estimated to reduce mortality by 80% [69].

Research and case-by-case assessment would be needed to weigh up whether the potential benefits of removing a source of infection exceed the risks of spreading infection by carcass collectors and bird disturbance [32]. Protocols for body collection and disposal would need to be specified. Under the UK plan, body collection is permitted in residential areas and where carcasses may be scavenged by susceptible species [62]. It is a strategy specified in the Phillip Island Nature Parks plan [64].

Rescuing and euthanasing wildlife

Consideration should be given to whether euthanasia of infected wild birds by suitably qualified veterinary practitioners on welfare grounds would be permitted and under what circumstances. In South Africa swift terns with clinical signs of avian influenza were euthanased while endangered penguins with mild or moderate signs were assessed at a wildlife rehabilitation centre [29]. The UK plan allows for euthanasia [62].

There also need to be plans and protocols in place for wildlife rescue groups and wildlife hospitals – to limit the risks for infection of rescuers and other wildlife in care and collect data – including through education, risk assessments, quarantine, disinfection and potentially vaccination. This is not covered in the AUSVETPLAN. In the Netherlands, a large bird rescue centre suffered an outbreak after an HPAI-infected goose was admitted, which resulted in the infection of more than a third of the birds in care [70].

Response planning for local colonies

Phillip Island Nature Parks, which has important seabird populations and overlaps a Rasmar wetland, has developed a local response plan specifying their intended precautions and actions for different levels of risk (Box 5) [64]. Planning and preparation is warranted for other important bird sites across Australia. Communications with and between site managers and other stakeholders will be important to support preparation for, responses to and recovery from outbreaks, and to exchange ideas and information [63].

Keeping humans safe and building public awareness

There should be a strong focus on how to limit the risks of humans being infected by interactions with wild birds and vice versa. People need to know to not touch sick or dead birds and to control pets when around wild birds. They should know what signs in wild birds could signify infection. Wildlife Health Australia advises the following could indicate infection [44]:

- small groups or clusters (>3) of dead or sick wild birds.
- individual sick or dead wild birds, including for example birds of prey (eagles, hawks, etc.).
- clinical signs that include incoordination, inability to stand or fly, diarrhoea, difficulty breathing, increased nasal secretions, cloudiness of the eyes.

Vaccinating captive-bred colonies of threatened species

Although the AUSVETPLAN notes the potential for this to occur, there is no guidance about the species for which it should be considered, the circumstances under which it should occur and whether there are arrangements in place to progress this.

Protecting bird habitats

Although not a short-term strategy, one important measure is to strengthen protection for wetland habitats. A study in China found that the risk of HPAI outbreaks for wild birds was lower in proximity to highly protected habitats than in proximity to unprotected habitats [71]. The protective effect was likely due both to the separation of wild bird populations from poultry and their diversion from human-dominated landscapes toward protected areas. Risks may also be reduced by not permitting the establishment of new poultry businesses near important wild bird habitats.

Recommendations

- ❖ The national taskforce review measures applied in and experiences with avian influenza outbreaks in overseas bird colonies to learn what was effective, what to avoid and how to optimise recovery afterwards.
- ❖ In developing a national response plan for wildlife, the national taskforce consider measures of the following types:

    (a) monitoring, reporting and research

    (b) regulating human access and activities

    (c) removing and disposing of dead birds

    (d) rescuing and euthanasing wildlife,

    (e) response planning for local colonies

    (f) keeping humans safe and building public awareness

    (g) vaccinating captive-bred colonies of threatened species.

- ❖ Australian governments encourage and provided resources for managers of sites with high concentrations of shorebirds, waterbirds or seabirds to prepare a local response plan for avian influenza outbreaks in wild birds.

Box 5. Phillip Island Nature Parks draft response plan

This is the only Australian response plan for HPAI in wild birds that we are aware of, prepared for Phillip Island Nature Parks in 2022 [64]. In collaboration with researchers, park managers have also been undertaking surveillance. They have specified measures based on degrees of risk.

Low risk: (no detection of HPAI in Australia) - actions from late September to April
- Monitor field sites for sickness or deaths of wildlife prior to undertaking handling.
- Wear appropriate PPE when handling wildlife, wear clean/disinfected footwear and clothing when entering a colony and use clean equipment, wash hands before and after.
- Do not approach colonies if a disease outbreak is suspected (follow specified protocols)
- Undertake staff training on signs of disease and response measures

Medium risk: (detection of HPAI in Australia)
- Minimise movements between colonies/areas within a single day
- Wear clean clothing that has been washed with warm water and soap and disinfect footwear every day and between colonies
- Consider avian influenza when examining any live birds in the rehabilitation centre; quarantine any bird showing symptoms of HPAI
- Keep a log of visits to field sites
- People not to touch sick or dead wildlife
- Wildlife professionals should avoid contact with domestic birds, especially poultry, for 48 hours prior to and after handling wild birds or mammals

High risk: (detection of HPAI in Victoria and/or northern Tasmania)
- Increase frequency of monitoring for unusual bird mortality
- Record all cases of bird mortality, investigate and report any unusual mortality events (with the assistance of a veterinarian)
- 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 colonies are not showing signs of infection, do not assume that the virus is not circulating. Adopt appropriate biosecurity and hygiene precautions when carrying out any activities within or near any bird colony.
- Establish a satellite rehabilitation facility for screening suspect cases.

Immediate risk: (spreading detection and mortalities in Victoria)
- Undertake only essential activities in seabird and seal colonies e.g. monitoring that will directly contribute to understanding the impacts of the outbreak; all other activities suspended (research, maintenance, conservation programs, etc)
- Cease all activities which require handling of wildlife unless they directly relate to mitigation measures or disease outbreak monitoring
- Increase PPE to include N95 facemask, safety glasses and disposable overalls
- Consider closure of areas (including penguin colonies) with high scale mortalities
- 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.
- Undertake daily monitoring for unusual bird mortality at key locations.

- Remove carcasses and sick birds as deemed appropriate
- Conduct daily counts of mortality and routine testing of suspicious cases.

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