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Review

Avian influenza: A new threat to wild bird conservation?

Andreia Garcês[1,2,*], Isabel Pires[2]

[1] Wildlife Rehabilitation Center Teaching Veterinary Hospital of University of Trás-os-Montes and Alto Douro, Quinta dos Prados, 4500-801 Vila Real, Portugal
[2] CECAV, Centre for Animal Sciences and Veterinary Studies, Associate Laboratory for Animal and Veterinary Science—AL4AnimalS, University of Trás-os-Montes and Alto Douro, Quinta dos Prados, 4500-801 Vila Real, Portugal
*** Corresponding author:** Andreia Garcês, andreiamvg@gmail.com

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Abstract: Avian influenza, also known as bird flu, significantly threatens wild bird populations and global biodiversity. As wild birds are natural reservoirs for various strains of the influenza virus, they have a crucial role in the epidemiology of the disease, which has profound implications for both wildlife conservation and public health. The emergence and dispersion of highly pathogenic avian influenza strains, particularly H5N1, have resulted in large-scale mortality events in wild bird populations, disrupting ecosystems and threatening endangered species. The conservation of wild birds in the context of avian flu involves several critical actions, including surveillance, rapid response to outbreaks, habitat management, and minimizing human-wildlife interactions that facilitate virus transmission. Studying avian influenza's impact on wild bird populations is crucial due to its dual importance in wildlife conservation and public health. Wild birds, as natural reservoirs of the virus, play a central role in its spread, with highly pathogenic strains like H5N1 causing devastating mortality events that disrupt ecosystems and endanger species. Effective management, including monitoring, rapid outbreak response, and habitat protection, is essential to mitigate these effects. Collaboration among experts is vital to protect biodiversity, sustain ecological balance, and reduce risks to human health, ensuring the long-term survival of wild bird populations.

Keywords: birds; avian influenza; pathology; wildlife

1. Introduction

Avian influenza, or bird flu, is a viral infection that largely affects birds, though certain strains can also infect humans and other animals [1,2]. It is caused by the *Alphainfluenzavirus influenzae (*influenza A) virus, which circulates naturally among wild aquatic birds (e.g., ducks, geese, swans) [3]. While many avian influenza viruses cause slight or no symptoms in birds, certain strains can be highly pathogenic, leading to severe illness and death [1].

Various influenza viruses are maintained within wild bird populations, with over 1100 species from 15 orders identified as carriers [3]. The first isolation of avian influenza virus in wild birds occurred in 1961 from Common Terns (*Sterna hirundo*) in South Africa. Increased surveillance in the 1970s highlighted ducks and geese as key reservoirs, though the prevalence of the virus is strongly linked to the birds' association with fresh or marine water [4,5]. While passerine (dryland) birds can also carry influenza viruses, they are less commonly involved in outbreaks [2,4]. Seasonal patterns have been observed, with the highest virus prevalence in late autumn and winter. Younger birds, especially juvenile mallards, are more likely to be infected before migrating south for the winter. Waterfowl, through both direct and indirect contact, are often linked to avian influenza outbreaks in domestic birds. Water bodies

serve as a significant medium for virus transmission, as the virus can remain viable in freshwater for days or even months, especially in colder temperatures [4,6,7]. Research suggests an environmental role in the virus's persistence. Birds in the high Arctic shed the virus into cold water and frozen ground, where it survives through the winter. Migrating birds in spring may encounter the virus in thawing ponds or ice, leading to reinfection, thereby continuing the cycle of avian influenza transmission in wild bird populations [1,2,4].

This review aims to briefly review the influenza virus in wild birds and discuss its impact on wild bird populations.

2. Pathogeny and transmission

Influenza viruses are single-stranded RNA-enveloped viruses, pleiomorphic, with a size ranging from 80–120 nm of the family Orthomyxoviridae [1]. Three types (A, B, and C) are recognised [4], with only influenza A and B viruses occurring in highly pathogenic forms. The subtypes are based on two types of surface proteins: hemagglutinin ("H") and neuraminidase ("N") [6]. There are 16 types of H proteins (H1–H16) and 9 types of N proteins (N1–N9), and the various combinations of these proteins result in different subtypes of the virus. Each subtype can contain different strains, known as lineages. This means there are 144 possible combinations of H and N proteins (16H × 9N), each representing a different avian influenza subtype (**Figure 1**). However, not all of these combinations are common in birds [8]. Some subtypes such as H5, H7, and H9, have demonstrated the ability to overlap the species barrier and infect mammals, such as swine and humans [9].

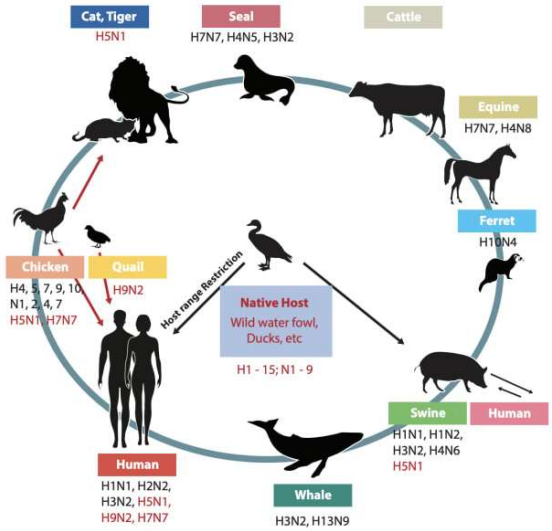

Figure 1. Subtypes of avian flu, Adapted from [10].

Aquatic birds, especially waterfowl, serve as natural reservoirs for all subtypes of avian influenza viruses [9]. These viruses multiply in the gastrointestinal tracts of birds, producing large amounts of viruses, typically without causing illness. In contrast, infections in poultry or non-natural hosts can range from minor to severe, depending on the virus [4].

They are classified as either low pathogenic (LPAI) or highly pathogenic (HPAI) based on their genetic nature and how severe the illness is [1,11]. Low-pathogenic avian influenza viruses usually cause little to no symptoms, though they may lead to mild respiratory or reproductive issues. They are commonly found in many wild bird species [4]. HPAI can cause severe illness, with mortality rates approaching 100% in affected poultry. Although wild birds are not primary carriers of HPAI, these viruses have occasionally been isolated from wild birds during domestic poultry outbreaks [4].

Transmission among wild birds occurs primarily through direct and indirect contact, especially in environments where birds congregate, such as wetlands, lakes, and coastal areas (**Figure 2**) [4,12]. The virus is commonly spread via contaminated water, as infected birds shed the virus in their faeces, saliva, and nasal secretions [3,13]. Waterfowl, shorebirds, and seabirds are particularly susceptible due to their close association with aquatic habitats, where the virus can stay viable for extended periods, especially in cold water or frozen conditions [8,14]. Migratory patterns also play an important role in the spread of avian influenza. Infected birds can carry the virus across vast distances during seasonal migrations, introducing the virus to new areas. Juvenile birds, which have weaker immune systems, are often more susceptible to infection before their winter migrations. The virus can persist in the environment, particularly in cold water and ice, allowing it to be reintroduced to bird populations when they return to breeding grounds in the spring (**Figure 2**) [3,6].

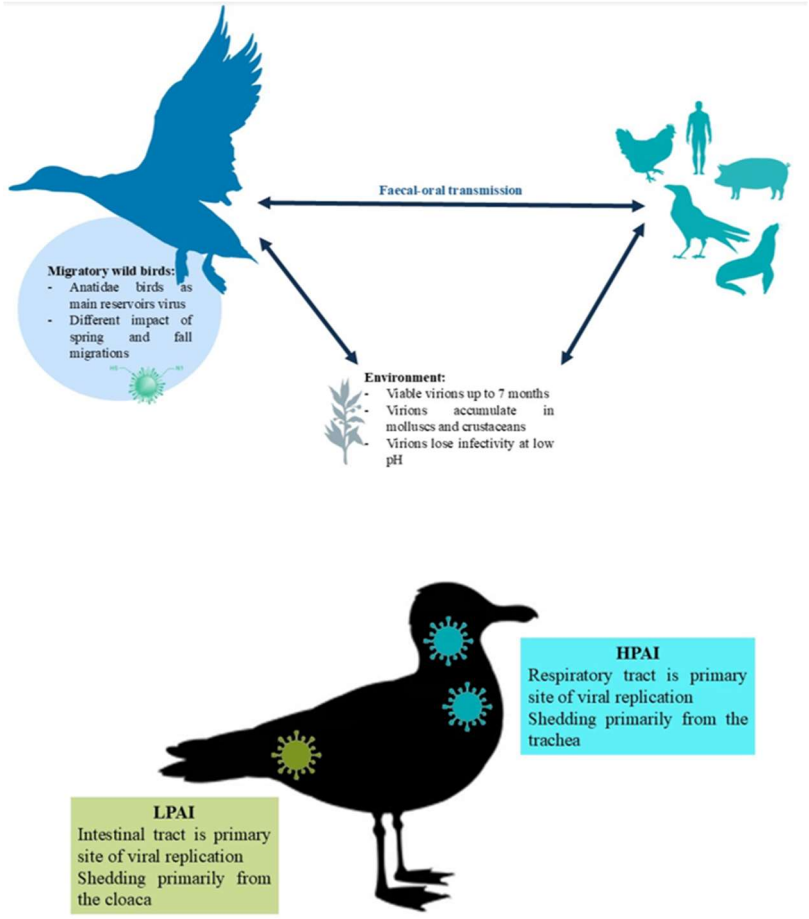

Figure 2. Avian influenza transmission in wild populations.

Anatomical location of highly pathogenic avian influenza (HPAI) infection versus low pathogenic avian influenza (LPAI) infection.

Avian influenza spreads rapidly among birds through inhalation or ingestion of viral particles from infected birds' nasal secretions, respiratory fluids, or faeces. In chickens, the incubation period is 1–7 days. HPAI causes systemic disease by spreading through the bloodstream and lymphatics, leading to damage in organs such as the heart, brain, and pancreas [8]. This damage, caused by a cytokine storm, can result in cardiopulmonary failure and multi-organ failure. The pathogenicity of this virus is determined by the sequence of basic amino acids at the cleavage site of the hemagglutinin (HA) protein [15]. Highly pathogenic strains like H5 and H7 contain pairs of basic amino acids that enable the virus to infect multiple organs, whereas low pathogenic strains only infect respiratory and digestive tissues due to fewer basic amino acids at the cleavage site. Influenza viruses are replicated in intestinal and respiratory tracts, but HPAI can also spread to blood vessels, causing necrosis in various organs. Infected birds produce neutralizing antibodies within 3–7 days, with levels peaking in the second week and persisting for up to 18 months [8]. Mortality is high with HPAI, while low pathogenic strains cause variable death rates depending on environmental factors and the presence of secondary pathogens. AI does not persist in individual birds but spreads slowly across a large population. Full eradication requires depopulation and thorough disinfection of infected facilities [8].

3. Hosts and distribution

It has a global distribution and can be found in many regions, with variations in the virus's spread depending on the strain (**Figure 3**).

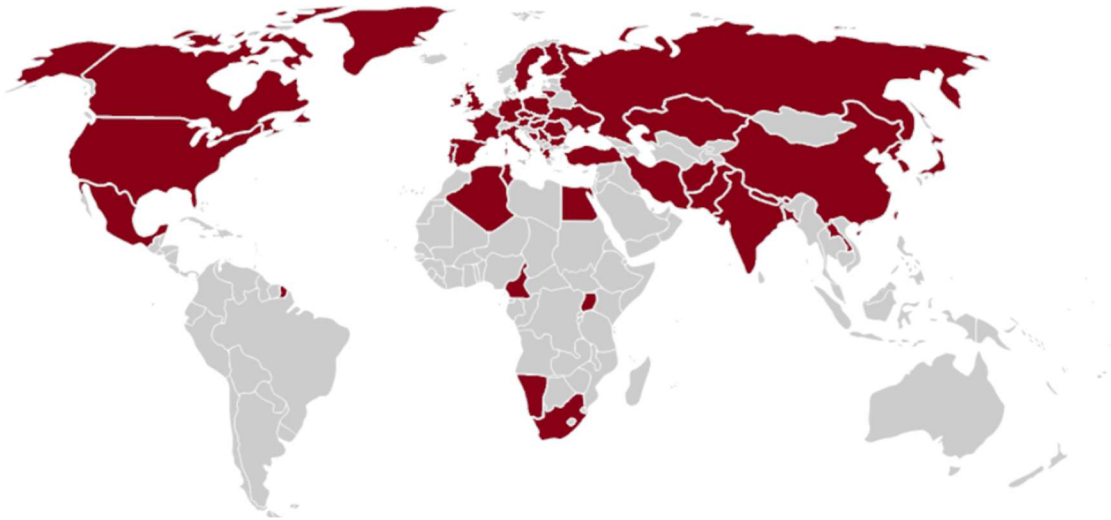

Figure 3. Map where outbreaks of avian influenza were reported in wild birds between 2015 and 2020 (data sources: ADNS and OIE).

Many bird species, such as waterfowl, shorebirds, songbirds, and raptors, undertake long-distance migrations between their breeding and non-breeding grounds [14]. These migrations allow birds to take advantage of seasonal food supplies in productive habitats during breeding seasons while escaping less hospitable areas during colder months. Migratory routes, known as "flyways," help guide conservation

efforts, as they include the full range of a species' movements, from breeding to non-breeding sites [1,13]. Some species such as waterfowl are natural hosts for avian influenza viruses, and their migrations can play a role in the spread of low pathogenic avian influenza viruses. *Anatidae* family, are the primary reservoir of all 16 hemagglutinin and 9 neuraminidase subtypes of avian influenza viruses [5,9].

However, their role in spreading the highly pathogenic H5N1 virus is less clear. Initially, the spread of H5N1 in Southeast Asia (2003–2004) was linked to poultry trade rather than wild birds. But by 2005–2006, outbreaks in wild birds across Europe suggested that migratory movements, possibly influenced by harsh weather [3], might have contributed to the virus' spread. [16].

According to the European Food Safety Authority (2022), Europe experienced its largest outbreak of highly pathogenic avian influenza (HPAI) during 2021–2022, impacting 46 million birds. Additionally, there were 2733 detections in wild birds across 36 European countries. Between 16 March and 10 June 2022, most wild bird cases were reported in Germany, the Netherlands, and the UK. The virus appears to be persisting in wild bird populations, suggesting it may now be endemic in Europe. The health risk to humans and wildlife remains constant throughout the year, peaking in autumn and winter [16].

Wild birds can contract both high and low pathogenic forms [17]. High pathogenic stirps like H5N1 have been most frequently detected in wetland birds (such as ducks, swans, gulls, and storks) [13]. In Appendix, presents a list of wild species where the virus has been detected. **Figure 4** is a graphic based on the information available in the Appendix, showing the number of species where was detected avian influenza for which order. It is possible to conclude that Charadriiformes (n = 113), Anseriformes (n = 93), Passeriformes (n = 54) and Accipitriformes (n = 52), were the orders more affected [16].

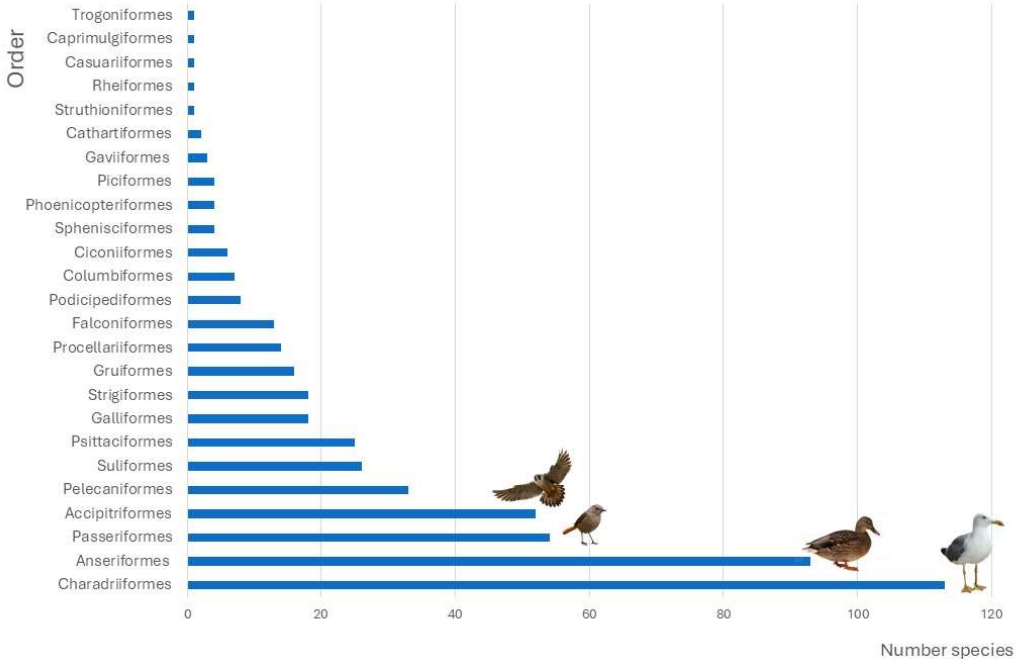

Figure 4. Graphic with the number of species by order affected by avian influenza according to FAO IN 2024 [16].

Order Anseriformes presents infection rates between 10 to 30% of LPAI in ducks during migration and wintering seasons. The mortality rates exceed 70% for some geese and swans. These species are often asymptomatic carriers of LPAI, allowing long-distance transmission [18]. The use of shared water bodies increases exposure to viral particles [19]. Some examples are the Mallards (*Anas platyrhynchos*) [20] with high LPAI prevalence (around 20%) and Mute swans (*Cygnus olor*) [21] with high HPAI mortality (> 60% in outbreaks). Order Charadriiformes has infection rates of LPAI between 10 to 25% in gulls and shorebirds, HPAI mortality rates can vary widely [22]. The high exposure of these animals is due to congregation in large colonies during breeding [23]. And migratory connectivity that facilitates global viral dissemination. Some examples are the Black-headed gulls (*Chroicocephalus ridibundus*) [24] which are LPAI carriers (20% prevalence) and the Ruddy turnstones (*Arenaria interpres*) [25] with an LPAI prevalence of 25%, with high exposure during coastal stopovers.

Orders Accipitriformes and Falconiformes present low infection rates (5%–15%), but high mortality rates (> 70%) with HPAI strains. They can contract the virus through the consumption of infected prey or scavenging [26]. Although the solitary behavior reduces transmission it can make individuals vulnerable to isolated outbreaks. Some examples are the Peregrine falcons (*Falco peregrinus*) [27] with mortality up to 80% upon infection with H5N1, and the Bald eagles (*Haliaeetus leucocephalus*) [28] that are frequent victims of secondary exposure via waterfowl prey.

Order Procellariiformes, presents infection rates between 5 to 20% during outbreaks in colonies, but mortality rates in some colonies exceed 50%. The infections occur due to the high-density nesting colonies that facilitate the rapid viral spread and the exposition of infected carcasses in marine environments [29]. Some examples are the Northern fulmar (*Fulmarus glacialis*) [30] with 10% infection rates observed and the Black-browed albatross (*Thalassarche melanophris*) with high susceptibility in breeding colonies [31]. Order Gruiformes (including species such as cranes and rails) can present HPAI mortality that can exceed 70% during outbreaks [32]. The wetland species with close contact with infected waterfowl populations, and the aggregative behavior of the species during migration increases exposure to the virus. One example is the Common crane (*Grus grus*) that presented 80% of mortality rates in H5N1 outbreaks in Serbia [33].

Wild animals from the Order Galliformes have a LPAI prevalence (< 5%), but high mortality (90%) in HPAI outbreaks [34]. These animals have lower natural resistance compared to waterfowl and are often infected via proximity to domestic poultry farms. One example is the Wild turkeys (Meleagris *gallopavo*) that showed extremely high mortality (95%) when infected with H5N1 [35]. The Order Sphenisciformes, commonly known as penguins, are rare in wild populations, though outbreaks in managed colonies report infection rates of 10 to 15 [36]. Their susceptibility is likely due to immunological naïveté and close colony proximity an example is the mortality associated with H5N8 in African penguins (*Spheniscus demersus*) [37] managed settings in Namibia, and H5N1 in Humboldt penguins (*Spheniscus humboldti*) in Chile [38]. **Table 1** presents a summary with the infection rate, mortality rate, and key traits by different wild bird orders regarding avian influenza.

Table 1. Infection rate, mortality rate, and key traits by different wild bird orders regarding avian influenza.

Order	Typical infection rate (%)	Mortality rate (HPAI) (%)	Key traits
Anseriformes	10–30 (LPAI)	60–80	Asymptomatic carriers, wetland dwellers
Charadriiformes	10–25(LPAI)	Up to 50	Colony breeders, global migrants
Accipitriformes	5–15	70–90	Scavengers/predators, isolated outbreaks
Procellariiformes	5–20	50	High-density colonies
Gruiformes	Rare	70–80	Wetland aggregation
Galliformes	<5	90	Proximity to poultry
Sphenisciformes	Rare	50–70	Immunological naïveté

4. Strains of avian influenza in wild birds

Some of the most pathogenic strains in wild birds are H5N1, H5N6, H5N8, H5Nx. H5N1 is the most prominent highly pathogenic avian influenza strain, causing widespread mortality in wild birds and domestic poultry [39]. It is associated with mass die-offs in waterfowl, raptors, and seabirds, and poses a zoonotic potential poses public health risk. Detected globally, with notable outbreaks in Asia, Europe, Africa, and the Americas [40].

H5N6 showed high mortality rates in geese, swans, and cranes; ecological consequences for wetland habitats [41]. Predominantly observed in Asia but spreading westward [42].

H5N8 has been associated with large-scale outbreaks in wild birds, with high mortality among waterfowl and scavengers feeding on carcasses. This strain has been observed in Europe, Asia, and Africa [43].

H5Nx is a strain that results from the genetic mixing of H5 strains with other subtypes, creating novel variants (e.g., H5N2, H5N3) [44,45]. Can cause significant mortality and spread rapidly among migratory birds and has a global distribution due to migratory patterns [46].

Some of the low pathogenic strains in wild birds are H7N9, H7N3, H7N7, H9N2, H6N1, and H10N8. H7N9 is low pathogenic and there are limited reports on wild bird infections, but with significant potential for spillover. Predominantly found in Asia [47]. H7N3 and H7N7 have variable pathogenicity, often associated with regional outbreaks. The strains have been detected in North America, Europe, and Asia [48]. H9N2 is predominantly low pathogenic but widely prevalent in wild birds. It is often asymptomatic in wild birds but contributes to viral evolution. This strain has been detected in Asia, Europe, and Africa [49]. H6N1 is common in wild birds and rarely causes significant disease but contributes to viral diversity. It has been isolated in North America, Europe, and Asia [50,51].

H10N8 has limited mortality reported in wild birds, but potential zoonotic risk. It has been detected in Asia [52].

It seems that the dominant subtype in Europe is H5N8 and H5N1, and the species associated with their introduction and spread are the Barnacle goose, Greylag goose, Eurasian wigeon, Black-headed gull, European herring gull and Mallard. The viral spread was associated with autumn migrations from northern Asian breeding grounds [53,54].

5. Clinical signs, postmortem and diagnosis techniques

The first symptoms can appear within a few hours after exposure, or up to 3 days later and can vary significantly depending on the strain of the virus. When wild birds serve as carriers of low pathogenic avian influenza they show no visible signs of illness. These birds can harbor and shed the virus without being affected, which makes them effective reservoirs for its spread [1,13]. Wild birds are infected with highly pathogenic avian influenza viruses, particularly may exhibit noticeable clinical signs. The symptoms in affected wild birds can include: lethargy, weakness, neurological signs (tremors, uncoordinated movements, or inability to fly), hyperaemia and oedema of the eyelids, trachea and conjunctiva, respiratory distress (coughing or difficulty breathing), ruffled feathers, swollen heads, congestion and/or cyanosis of the comb and wattles, diarrhoea and sudden death in severe cases without prior signs of illness [3,6,55].

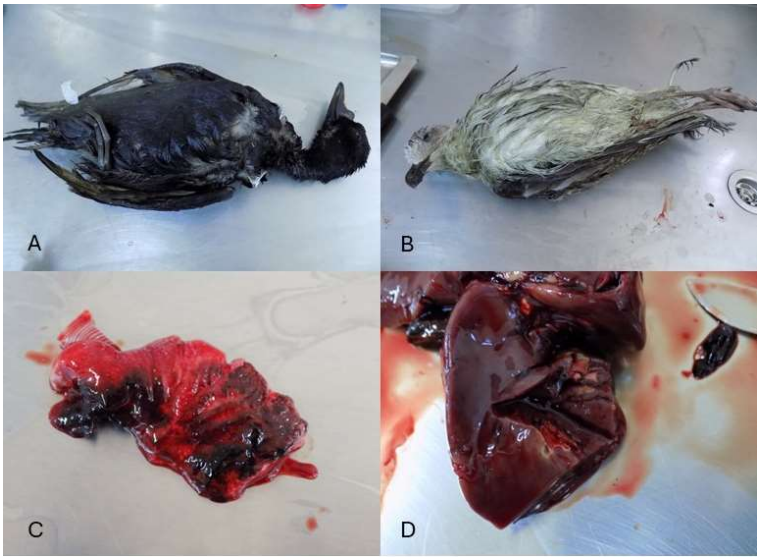

Figure 5. *Post mortem* lesions observed in birds infected with avian influenza: **(A)** *Melanitta negris* corpse found dead; **(B)** *Larus michaellis* corpse found dead; **(C)** Congestive lung; **(D)** Necrose in the liver.

In peracute infections of avian influenza, where death occurs within one to two days of infection, poultry typically show no visible gross lesions. However, certain strains, such as H5N1 and H5N2, can cause severe lung congestion, haemorrhage, and oedema, resulting in the tissue exuding fluid and blood upon excision. Brain oedema has also been reported in some cases [56] (**Figure 5**). During acute infections, where death occurs between days three to five, affected chickens may exhibit ruffled feathers, congestion, and cyanosis of the comb and wattles, with swollen heads due to subcutaneous oedema around the eyes and lower jaw. Some viruses cause hyperemia and oedema of the eyelids, conjunctiva, and trachea. In chickens that die, generalized congestion and hemorrhage are common, particularly in the comb and wattles, where petechial-to-ecchymotic haemorrhages, swelling from oedema, and necrotic areas from vascular infarction can be seen. Subcutaneous haemorrhages and oedema may also appear on the hocks, shanks, feet, and occasionally on feathered skin across the body. Certain pathological strains cause skin thickening in the legs due to gelatinous oedema. Hemorrhages can occur in various visceral organs, including the heart,

intestines, abdominal fat, and skeletal muscles. Primary lymphoid organs, like the cloacal bursa and thymus, may show severe atrophy, while the spleen can either remain normal, enlarge, or develop necrotic white foci. The pancreas often shows mottling, and in laying hens, ruptured ova with "yolk peritonitis" is sometimes observed.

Histological lesions vary in severity and location but typically include necrosis, haemorrhage, and inflammation in numerous visceral organs. The severity and distribution of these lesions depend on the virus strain and the bird species [57]. As the disease progresses, inflammation becomes more prominent, while necrosis or apoptosis (cell death) becomes less evident. The most affected organs include the brain (lymphohistiocytic meningoencephalitis with vasculitis and areas of tissue rarefication), heart (lymphohistiocytic myocarditis with hyaline necrosis of muscle fibers), pancreas (caseous necrosis), skin (dermal vasculitis with thrombosis and tissue infarction) and lymphoid tissue (severe lymphocytic apoptosis) [57,58].

Diagnosis of avian influenza in wild birds typically involves a combination of clinical observation, laboratory testing, and surveillance efforts. Since many wild birds, especially waterfowl, can carry the virus without demonstrating symptoms, routine testing and sampling are often necessary to detect the presence of the virus. Isolation of influenza viruses has been achieved by direct inoculation of 9–11 old embryonated chicken eggs with homogenates of the lung, trachea, faeces and internal organs of infected animals. Other methods of diagnosis include Polymerase Chain Reaction (PCR), Serology and Antigen Detection [7,13].

There is no specific treatment for avian influenza in wild birds [59]. Management focuses on prevention and control rather than direct intervention. Infected wild birds are generally not treated, as capturing and medicating wild populations on a large scale is impractical. Instead, efforts are aimed at monitoring and controlling outbreaks through the following measures: quarantine of infected animals, culling of infected populations, and biosecurity measures to prevent contamination from domestic to wild birds and vice versa. Vaccination is not commonly used in wild birds due to logistical challenges, but it may be considered in domestic flocks to reduce transmission risk [58,60].

6. Avian influenza and its impact on wild populations

The impact of avian influenza, particularly HPAI, on wild bird conservation is substantial and multifaceted [57]. Managing this virus in wild bird populations is extremely difficult. Traditional control measures like culling or vaccination are impractical for free-ranging wild birds, particularly migratory species [13]. As a result, conservation efforts are often reactive, focusing on monitoring and managing outbreaks rather than preventing them [59]. Migratory birds are natural reservoirs for AI, particularly LPAI, and can spread the virus over long distances as they travel between breeding and wintering grounds. This long-distance transmission is difficult to control and can introduce the virus into new populations and regions, potentially infecting other wildlife and domestic poultry, increasing the risk of further outbreaks [5,61].

HPAI outbreaks have resulted in mass die-offs of wild birds. Species like ducks, geese, swans, raptors, and shorebirds are particularly vulnerable. These mass mortality events can have severe consequences for species with already declining populations (especially those already facing other threats such as habitat loss or climate change) or those considered endangered. For example, in Peru, the first case of H5N1 was detected in dead Peruvian pelicans (*Pelecanus thagus*) on November 13, 2022. The virus quickly spread along the Peruvian coast, and by mid-March 2023, the impact on bird species was alarming. At least 100,485 wild birds from 24 species, including some threatened species, were found dead due to the virus. This situation is of significant conservation concern, as the virus killed around 20% of the pelican population in marine protected areas in Peru [5].

Wildbird species already endangered or with small population sizes are particularly at risk. Introducing HPAI into these populations can cause rapid declines, pushing some species closer to extinction [62]. Recent outbreaks of HPAI, caused by H5 subtype viruses, have significantly impacted the population of endangered hooded cranes (*Grus monacha*) and white-necked cranes (*Grus vipio*) in the Izumi plain of Kagoshima Prefecture [62]. Since April 2023, HPAI has caused death for 21 California condors (*Gymnogyps californianus*) in northern Arizona, a critically endangered species. This led to the approval from the US Government for the vaccination of the species to protect them [63].

Avian influenza besides mortality has other negative impacts in wild populations that are not so direct. Wild birds play crucial roles in ecosystems as predators, prey, and pollinators. Significant mortality due to avian influenza can disrupt these ecological roles, leading to cascading effects on other species and ecosystem processes [64]. For example, the loss of predatory birds could lead to an overpopulation of certain prey species, while a decline in seed-dispersing birds might affect plant regeneration in certain habitats [65]. Recurrent outbreaks of avian influenza can reduce genetic diversity in affected bird populations. Suppose large numbers of individuals from a population die in an outbreak. In that case, the surviving population may have reduced genetic variation, making them less resilient to future environmental challenges, including disease outbreaks or habitat changes [61].

Significant die-offs due to avian influenza can reduce biodiversity, leading to fewer birdwatching opportunities, thereby negatively impacting local economies related to ecotourism or birdwatching [66].

7. Conclusions

The presence of avian influenza in wild bird populations has profound implications for biodiversity, ecological stability, and public health. Here's why this work is critical. This virus, particularly highly pathogenic strains like H5N1, poses a dire threat to bird species, including those already endangered. Large-scale mortality events can disrupt entire ecosystems, as birds play crucial roles in their maintenance (e.g., predator-prey relations, pollinators, nutrition cycles, and seed dispersion). Wild birds act as natural reservoirs for influenza viruses, facilitating the spread of the disease across regions and species. Understanding and managing avian influenza dynamics in wild birds helps prevent spillover into domestic poultry and even humans,

reducing the risk of zoonotic outbreaks that could escalate into pandemics. Efforts to monitor and control avian influenza in wild birds are important not only to safeguard these populations but also to align with public health goals. By controlling the disease at its source, the risk of outbreaks in agriculture and the emergence of new, more virulent strains that could threaten human health is minimized. Addressing this threat requires increased monitoring, research, and collaboration between conservation organizations, governments, and health authorities to mitigate the impacts of avian influenza on wild bird populations and the ecosystems they inhabit. It is important an integrated approach to managing avian influenza that highlights the interdependence of wildlife conservation, ecosystem stability, and global health.

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Appendix

Table A1. Wild bird species affected by avian influenza according to FAO IN 2024 [16].

Anseriformes	**Galliformes**	**Psittaciformes**
• *Aix galericulata* (Mandarin Duck) • *Aix sponsa* (Wood Duck) • *Alopochen aegyptiaca* (Egyptian Goose) • *Anas bernieri* (Madagascar Teal)* • *Anas carolinensis* (American green-winged Teal) • *Anas clypeata* (Northern Shoveler) • *Anas crecca* (Common Teal) • *Anas cyanoptera* (Cinnamon Teal) • *Anas discors* (Blue-winged Teal) • *Anas falcata* (Falcated Duck) • *Anas flavirostris* (Andean Teal) • *Anas formosa* (Baikal Teal) • *Amazonetta brasiliensis* (Brazilian Teal)* • *Anas acuta* (Northern Pintail) • *Anas americana* (American Wigeon) • *Anas fulvigula* (Mottled Duck) • *Anas penelope* (Eurasian Wigeon) • *Anas platyrhynchos* (Mallard) • *Anas poecilorhyncha* (Indian spot-billed duck) • *Anas querquedula* (Garganey) • *Anas rhynchotis* (*Australasian* Shoveler) • *Anas rubripes* (American Black Duck) • *Anas strepera* (Gadwall) • *Anas undulata* (Yellow-billed Duck) • *Anas versicolor* (Silver Teal)* • *Anas zonorhyncha* (Chinese Spot-billed Duck) • *Anastomus oscitans* (Asian Openbill) • *Anser albifrons* (Greater white-fronted Goose) • *Anser anser* (Greylag Goose) • *Anser brachyrhynchus* (Pink-footed Goose) • *Anser caerulescens* (Snow Goose) • *Anser rossii* (*Ross's* Goose) • *Anser serrirostris* (Tundra Bean Goose) • *Aythya affinis* (Lesser Scaup) • *Aythya americana* (Redhead Duck) • *Anser cygnoides* (Swan Goose)* • *Anser erythropus* (Lesser white-fronted goose) • *Anser fabalis* (Tiaga Bean Goose) • *Anser indicus* (Bar-headed Goose) • *Aythya baeri* (Baer's pochard)* • *Aythya collaris* (Ring-necked Duck) • *Aythya ferina* (Common Pochard) • *Aythya fuligula* (Tufted Duck) • *Aythya marila* (Greater Scaup) • *Aythya nyroca* (Ferruginous Pochard)* • *Aythya valisineria* (Canvasback)	• *Alectoris rufa* (Red legged partridge) • *Centrocercus urophasianus* (Greater sage-grouse) • *Colinus virginianus* (Northern Bobwhite) • *Coturnix coturnix* (Common Quail)* • *Cracidae* (incognita)* • *Meleagris gallopavo* (Turkey) • *Alectura lathami* (Australian bushturkey) • *Bonasa umbellus* (Ruffed grouse) • *Callipepla californica* (California Quail) • *Numida meleagris* (Common Guineafowl) • *Pavo cristatus* (Peacock) • *Perdix perdix* (Grey Partridge)* • *Phasianus colchicus* (Common Pheasant) • *Syrmaticus reevesii* (Reeves's Pheasant) • *Cyrtonyx montezumae* (Montezuma Quail) • *Gallus gallus domesticus* (Chicken) • *Lagopus lagopus* (Willow Grouse) • *Lophura nycthemera* (Silver Pheasant) Charadriiformes • *Alca torda* (Razorbill) • *Alle alle* (Little auk) • *Arenaria interpres* (Ruddy Turnstone) • *Arenaria melanocephala* (Black turnstone) • *Calidris maritima* (Purple sandpiper) • *Calidris mauri* (Western Sandpiper) • *Calidris minuta* (Little stint) • *Calidris pusilla* (Semipalmated sandpiper) • *Cepphus grylle* (Black Guillemot) • *Calidris alba* (Sanderling) • *Calidris alpina* (Dunlin) • *Calidris canutus* (Red Knot) • *Calidris ferruginea* (Curlew sandpiper) • *Calidris fuscicollis* (White-rumped Sandpiper) • *Charadrius alexandrinus* (Kentish Plover) • *Charadrius dubius* (Little ringed plover) • *Charadrius hiaticula* (Common ringed plover) • *Charadrius mongolus* (Lesser Sand Plover) • *Charadrius nivosus* (Snowy plover) • *Charadrius pallidus* (Chestnut-banded Plover) • *Chlidonias hybrida* (Whiskered Tern) • *Chlidonias leucopterus* (White-winged Black Tern)	• *Ara macao* (Scarlet Macaw)* • *Ara militaris* (Military macaw)* • *Aratinga auricapillus* (Golden-capped Parakeet) • *Brotogeris versicolurus* (White-winged Parakeet) • *Agapornis personatus* (Yellow-collared Lovebird)* • *Agapornis roseicollis* (Rosy-faced Lovebird)* • *Ara cloropterus* (Green and red macaw)* • *Cacatua ducorpsii* (Solomons Corella)* • *Cyanoliseus patagonus* (Burrowing Parrot) • *Diopsittaca nobilis* (Northern Red-shouldered Macaw) • *Amazona farinosa* (Southern mealy amazon) • *Psittacula eupatria* (Alexandrine Parakeet)* • *Psittacula krameri* (Rose-ringed Parakeet) • *Psittacus erithacus* (Grey Parrot) • *Pycnonotus zeylanicus* (Straw-headed bulbul) • *Amazona farinose* (Amazon Parrot) • *Amazona ochrocephala* (Yellow-crowned Parrot)* • *Amazona oratrix* (Yellow-headed amazon) • *Ara ararauna* (Blue-and-yellow macaw) • *Enicognathus ferrugineus* (Austral Parakeet) • *Enicognathus leptorhynchus* (Slender-billed Parakeet) • *Loriculus spp.* (Hanging Parrot) • *Melopsittacus undulatus* (Budgerigar) • *Nymphicus hollandicus* (Cockatiel) • *Psittacula derbiana* (Lord Derby's Parakeet) Falconiformes • *Caracara cheriway* (Northern Crested Caracara) • *Caracara plancus* (Southern Caracara) • *Falco biarmicus* (Lanner Falcon) • *Falco cherrug* (Saker Falcon) • *Falco sparverius* (American Kestrel) • *Falco subbuteo* (Eurasian hobby)* • *Falco tinnunculus* (Common Kestrel) • *Falco columbarius* (Merlin) • *Falco mexicanus* (Prairie falcon) • *Falco peregrinus* (Peregrine Falcon) • *Falco rusticolus* (Gryfalcon) • *Falco vespertinus* (Red-footed Falcon)

Table A1. (*Continued*).

Anseriformes	**Galliformes**	**Psittaciformes**
• *Chroicocephalus brunnicephalus* (Brown-headed gull) • *Chroicocephalus cirrocephalus* (Grey Headed Gull) • *Chroicocephalus hartlaubii* (Hartlaub's Gull) • *Chroicocephalus maculipennis* (Brown-hooded gull) • *Gelochelidon nilotica* (Common Gull-billed Tern) • *Haematopus ater* (Blackish Oystercatcher) • *Haematopus moquini* (African Black Oystercatcher) • *Haematopus ostralegus* (Eurasian oystercatcher) • *Chroicocephalus ridibundus* (Black-headed Gull) • *Fratercula arctica* (Atlantic Puffin) • *Gallinago gallinago* (Common Snipe) • *Gallinago stenura* (Pin-tailed Snipe) • *Haematopus palliatus* (American oystercatcher) • *Himantopus himantopus* (Black-winged Stilt) • *Hydrocoloeus minutus* (Little Gull) • *Hydroprogne caspia* (Caspian Tern) • *Ichthyaetus ichthyaetus* (Pallas's Gull) • *Ichthyaetus melanocephalus* (Mediterranean Gull) • *Larosterna inca* (Inca tern) • *Larus argentatus* (Herring Gull) • *Larus armenicus* (Armenian Gull) • *Larus atricilla* (Laughing Gull) • *Larus audouinii* (Audouin's Gull) • *Larus belcheri* (Belcher's Gull) • *Larus brachyrhynchus* (Short-billed Gull) • *Larus brunicephalus* (Brown-headed Gull) • *Larus cachinnans* (Caspian Gull) • *Larus delawarensis* (Ring-billed Gull) • *Larus dominicanus* (Kelp Gull) • *Larus fuscus* (Lesser Black-backed Gull) • *Larus genei* (Slender-billed Gull) • *Larus glaucescens* (Glaucous-winged Gull) • *Larus glaucoides* (Iceland Gull) • *Larus californicus* (California Gull) • *Larus canus* (Mew Gull) • *Larus crassirostris* (Black-tailed Gull) • *Larus hyperboreus* (Glaucous Gull) • *Larus ichthyaetus* (Pallas's Gull) • *Larus marinus* (Great black-backed Gull) • *Larus michahellis* (Yellow-legged Gull) • *Larus novaehollandiae* (Silver Gull) • *Larus occidentalis* (Western Gull) • *Larus philadelphia* (Bonaparte's Gull) • *Larus pipixcan* (Franklin's Gull)	• *Chroicocephalus brunnicephalus* (Brown-headed gull) • *Chroicocephalus cirrocephalus* (Grey Headed Gull) • *Chroicocephalus hartlaubii* (Hartlaub's Gull) • *Chroicocephalus maculipennis* (Brown-hooded gull) • *Gelochelidon nilotica* (Common Gull-billed Tern) • *Haematopus ater* (Blackish Oystercatcher) • *Haematopus moquini* (African Black Oystercatcher) • *Haematopus ostralegus* (Eurasian oystercatcher) • *Chroicocephalus ridibundus* (Black-headed Gull) • *Fratercula arctica* (Atlantic Puffin) • *Gallinago gallinago* (Common Snipe) • *Gallinago stenura* (Pin-tailed Snipe) • *Haematopus palliatus* (American oystercatcher) • *Himantopus himantopus* (Black-winged Stilt) • *Hydrocoloeus minutus* (Little Gull) • *Hydroprogne caspia* (Caspian Tern) • *Ichthyaetus ichthyaetus* (Pallas's Gull) • *Ichthyaetus melanocephalus* (Mediterranean Gull) • *Larosterna inca* (Inca tern) • *Larus argentatus* (Herring Gull) • *Larus armenicus* (Armenian Gull) • *Larus atricilla* (Laughing Gull) • *Larus audouinii* (Audouin's Gull) • *Larus belcheri* (Belcher's Gull) • *Larus brachyrhynchus* (Short-billed Gull) • *Larus brunicephalus* (Brown-headed Gull) • *Larus cachinnans* (Caspian Gull) • *Larus delawarensis* (Ring-billed Gull) • *Larus dominicanus* (Kelp Gull) • *Larus fuscus* (Lesser Black-backed Gull) • *Larus genei* (Slender-billed Gull) • *Larus glaucescens* (Glaucous-winged Gull) • *Larus glaucoides* (Iceland Gull) • *Larus californicus* (California Gull) • *Larus canus* (Mew Gull) • *Larus crassirostris* (Black-tailed Gull) • *Larus hyperboreus* (Glaucous Gull) • *Larus ichthyaetus* (Pallas's Gull) • *Larus marinus* (Great black-backed Gull) • *Larus michahellis* (Yellow-legged Gull) • *Larus novaehollandiae* (Silver Gull) • *Larus occidentalis* (Western Gull) • *Larus philadelphia* (Bonaparte's Gull) • *Larus pipixcan* (Franklin's Gull)	• *Milvago chimango* (Chimango Caracara) Accipitriformes • *Accipiter atricapillus* (American goshawk) • *Accipiter brachyurus* (New Britain Sparrowhawk) • *Accipiter cooperii* (Cooper's Hawk) • *Accipiter gentilis* (Northern Goshawk) • *Accipiter gularis* (Japanese Sparrowhawk) • *Accipiter nisus* (Eurasian Sparrowhawk) • *Accipiter striatus* (Sharp-shinned Hawk) • *Aquila audax* (Wedge-tailed Eagle) • *Aquila rapax* (Tawny Eagle)* • *Buteo buteo* (Common Buzzard) • *Buteo jamaicensis* (Red-tailed Hawk) • *Buteo japonicus* (Eastern buzzard) • *Buteo lagopus* (Rough-legged Hawk) • *Aquila chrysaetos* (Golden Eagle) • *Aquila fasciata* (Bonelli's eagle) • *Aquila heliaca* (Eastern imperial eagle) • *Aquila nipalensis* (Steppe Eagle)* • *Buteo lineatus* (Red-shouldered Hawk) • *Buteo magnirostris* (Roadside Hawk) • *Buteo platypterus* (Broad-winged Hawk) • *Buteo polyosoma* (Red-backed Hawk)* • *Buteo regalis* (Ferruginous Hawk) • *Buteo rufofuscus* (Jackal Buzzard) • *Buteo swainsoni* (Swainson's Hawk) • *Buteogallus urubitinga* (Great Black Hawk) • *Cathartes aura* (Turkey Vulture) • *Circus aeruginosus* (Western Marsh Harrier) • *Circus assimilis* (Spotted Harrier) • *Circus cyaneus* (Hen Harrier) • *Circus hudsonius* (Northern Harrier) • *Circus pygargus* (Montagu's Harrier) • *Clanga pomarina* (Lesser Spotted Eagle) • *Geranoaetus polyosoma* (Variable Hawk) • *Gypaetus barbatus* (Bearded vulture) • *Gyps africanus* (White-backed vulture)* • *Gyps fulvus* (Griffon Vulture) • *Haliaeetus albicilla* (White Tailed Eagle) • *Coragyps atratus* (American Black Vulture) • *Geranoaetus melanoleucus* (Black-chested buzzard-eagle) • *Haliaeetus leucocephalus* (Bald Eagle) • *Haliaeetus pelagicus* (Steller's Sea Eagle) • *Parabuteo unicinctus* (Harris's Hawk) • *Sagittarius serpentarius* (Secretary Bird) • *Spilornis cheela* (Crested Serpent Eagle) • *Haliaeetus vocifer* (African Fish Eagle) • *Hieraaetus fasciatus* (Bonelli's Eagle) • *Milvus migrans* (Black Kite)

Table A1. (*Continued*).

Anseriformes	**Galliformes**	**Psittaciformes**
• *Tadorna ferruginea* (Ruddy Shelduck) • *Tadorna tadorna* (Common Shelduck) Gaviiformes • *Gavia immer* (Common Loon) • *Gavia pacifica* (Pacific Loon) • *Gavia stellata* (Red-throated Loon) Sphenisciformes • *Eudyptes chrysocome* (Southern Rockhopper *Penguin*) • *Spheniscus magellanicus* (Magellanic Penguin) • *Spheniscus demersus* (Jackass Penguin) • *Spheniscus humboldti* (Humboldt Penguin) Ciconiiformes • *Leptoptilos javanicus* (Lesser Adjutant)* • *Mycteria americana* (American Wood Stork) • *Mycteria leucocephala* (Painted Stork) • *Ciconia boyciana* (Oriental Stork) • *Ciconia ciconia* (White Stork) • *Ciconia nigra* (Black Stork) Procellariiformes • *Ardenna gravis* (Great Shearwater) • *Ardenna grisea* (Sooty Shearwater) • *Ardenna tenuirostris* (Short-tailed Shearwater) • *Pachyptila desolata* (Antarctic Prion) • *Phoebastria irrorata* (Waved Albatross) • *Procellaria aequinoctialis* (White-chinned Petrel) • *Fulmarus glacialis* (Northern Fulmar) • *Fulmarus glacialoides* (Southern Fulmar) • *Macronectes giganteus* (Southern Giant Petrel) • *Macronectes halli* (Northern Giant Petrel) • • *Pterodroma macroptera* (Great-winged Petrel) • *Puffinus gravis* (Great Shearwater) • *Puffinus puffinus* (Manx Shearwater) • *Thalassarche melanophris* (Black-browed Albatross) Suliformes • *Fregata magnificens* (Magnificent Frigatebird) • *Fregata minor* (Great Frigatebird) • *Leucocarbo atriceps* (Imperial Shag) • *Leucocarbo georgianus* (South Georgia Shag) • *Microcarbo coronatus* (Crowned Cormorant) • Morus bassanus (Northern Gannet) • *Morus capensis* (Cape Gannet) • *Nannopterum auritum* (Double-crested Cormorant)	• *Larus ridibundus* (Black-headed Gull) • *Larus schistisagus* (Slaty-backed Gull) • *Larus scopulinus* (Silver Gull) • *Larus smithsonianus* (Arctic Herring Gull) • *Larus thayeri* (Thayer's gull) • *Leucophaeus atricilla* (Laughing Gull) • *Leucophaeus modestus* (Grey gull) • *Leucophaeus pipixcan* (Franklin's Gull) • *Numenius sp.*(Curlew) • *Numenius arquata* (Eurasian Curlew) • *Pagophila eburnean* (Ivory Gull) • *Phalaropus lobatus* (Red-necked phalarope) • *Pluvialis dominica* (American Golden Plover) • *Pluvialis squatarola* (Grey Plover/Black-bellied Plover) • *Numenius phaeopus* (Whimbrel) • *Recurvirostra avosetta* (Pied avocet) • *Rissa tridactyla* (Black-legged Kittiwake) • *Rynchops niger* (Black skimmer) • *Scolopax rusticola* (Eurasian Woodcock) • *Stercorarius antarcticus* (Brown skua) • *Stercorarius chilensis* (Chilean Skua) • *Stercorarius maccormicki* (South Polar Skua) • *Stercorarius parasiticus* (Arctic Skua) • *Stercorarius skua* (Great Skua) • *Sterna dougallii* (Roseate Tern) • *Sterna forsteri* (Forster's Tern) • *Sterna hirundinacea* (South American Tern) • *Sterna hirundo* (Common Tern) • *Sterna paradisaea* (Acrtic Tern) • *Sternula albifrons* (Little Tern) • *Thalasseus acuflavidus* (Cabot's Tern) • *Thalasseus bergii* (Swift Tern) • *Thalasseus elegans* (Elegant Tern) • *Thalasseus maximus* (Royal Tern) • *Thalasseus sandvicensis* (Sandwich Tern) • *Tringa flavipes* (Lesser Yellowlegs) • *Tringa glareola* (Wood Sandpiper) • *Tringa melanoleuca* (Greater Yellowlegs) • *Tringa ochropus* (Green Sandpiper) • *Tringa semipalmata* (Willet) • *Vanellus chilensis* (Southern Lapwing) • *Vanellus spinosus* (Spur-winged Lapwing) • *Vanellus vanellus* (Northern Lapwing) • *Tringa totanus* (Common Redshank) • *Uria aalge* (Common Murre) • *Uria lomvia* (Thick-billed Murre) • *Xema sabini* (Sabine's Gull) Podicipediformes • *Aechmophorus occidentalis* (Western Grebe) • *Podiceps auritus* (Horned Grebe)	• *Milvus milvus* (Red Kite) • *Nisaetus nipalensis* (Mountain Hawk Eagle) • *Pandion haliaetus* (Osprey) • *Spizaetus nipalensis* (Mountain hawk-eagle) • *Vultur gryphus* (Andean condor)* Cathartiformes • *Gymnogyps californianus* (California Condor) • *Sarcoramphus papa* (King Vulture) Strigiformes • *Aegolius acadicus* (Northern Saw-whet Owl) • *Asio flammeus* (Short-Eared owl) • *Bubo bubo* (Eurasian Eagle-Owl) • *Bubo scandiacus* (Snowy Owl) • *Asio otus* (Long Eared Owl) • *Athene noctua* (Little Owl) • *Bubo africanus* (Spotted Eagle-Owl) • *Bubo virginianus* (Great Horned Owl) • *Megascops asio* (Eastern Screech Owl) • *Strix aluco* (Tawny owl) • *Strix nebulosa* (Great grey owl) • *Strix uralensis* (Ural Owl) • *Strix varia* (Barred owl) • *Tyto alba* (Common Barn-Owl) • *Megascops choliba* (Tropical Screech-owl) • *Megascops kennicottii* (Western Screech-Owl) • *Otus scops* (Scops Owl) • *Tyto longimembris* (Eastern Grass-owl) * Caprimulgiformes • *Caprimulgus fossii* (Mozambique Nightjar) Columbiformes • *Columba guinea* (African rock pigeon) • *Columba livia* (Rock Pigeon) • *Columba palumbus* (Common Wood-Pigeon) • *Columbina inca* (Inca Dove) • *Streptopella senegalensis* (Laughing Dove) • *Streptopelia turtur* (European Turtle-dove) • *Streptopella decaocto* (Eurasian Collared Dove) Piciformes • *Dendrocopos major* (Great spotted woodpecker) • *Ramphastos cuvieri* (white-throated toucan)* • *Zenaida macroura* (Mourning Dove) • *Pteroglossus castanotis* (Chestnut-eared aracari)* Trogoniformes • *Harpactes erythrocephalus* (Red-headed Trogon) Passeriformes

Table A1. (*Continued*).

Anseriformes	**Galliformes**	**Psittaciformes**
• *Phalacrocorax brasilianus* (Neotropical Cormorant) • *Phalacrocorax capensis* (Cape Cormorant) • *Phalacrocorax carbo* (Great Cormorant) • *Phalacrocorax gaimardi* (Red-legged Cormorant) • *Phalacrocorax lucidus* (White-breasted Cormorant) • *Nannopterum brasilianum* (Neotropical Cormorant) • *Phalacrocorax auritus* (Double-crested Cormorant) • *Phalacrocorax bougainvillii* (Guanay Cormorant) • *Phalacrocorax magellanicus* (Rock Shag) • *Phalacrocorax neglectus* (Bank Cormorant) • *Phalacrocorax punctatus* (Spotted Shag • *Phalacrocorax pygmaeus* (Pygmy Cormorant) • *Sula capensis* (Cape Gannet) • *Sula leucogaster* (Brown Booby) • *Sula nebouxii* (Blue-footed Booby) • *Sula sula* (Red-footed Booby) • *Sula variegata* (Peruvian Booby) • *Urile penicillatus* (Brandt's Cormorant) Pelecaniformes • *Ajaia ajaja* (Roseate Spoonbill) • *Ardea alba* (Great Egret) • *Ardea cinerea* (Grey Heron) • *Ardea cocoi* (Cocoi heron) • *Ardea herodias* (Great Blue Heron) • *Ardea melanocephala* (Black-headed Heron) * • *Egretta caerulea* (Little Blue Heron) • *Egretta garzetta* (Little Egret) • *Egretta intermedia* (Intermediate Egret) • *Egretta thula* (Snowy Egret) • *Eudocimus albus* (American White Ibis) • *Eudocimus ruber* (Scarlet Ibis)* • *Geronticus eremita* (Northern Bald Ibis) • *Nyctanassa violacea* (Yellow-crowned Night-heron) • *Nycticorax nycticorax* (Black-Crowned Heron) • *Ardeola grayii* (Indian Pond-Heron) • *Bostrychia hagedash* (Hadada Ibis) • *Botaurus stellaris* (Eurasian bittern) • *Bubulcus ibis* (Western Cattle Egret) • *Butorides virescens* (Green Heron) • *Pelecanus crispus* (Dalmatian Pelican) • *Pelecanus erythrorhynchos* (American White Pelican) • *Pelecanus occidentalis* (Brown Pelican) • *Pelecanus onocrotalus* (Great White Pelican)	• *Podiceps cristatus* (Great Cested Grebe) • *Podiceps grisegena* (Red-necked Grebe) • *Podiceps major* (Great Grebe) • *Podiceps nigricollis* (Eared Grebe) • *Podilymbus podiceps* (Pied-billed Grebe) • *Tachybaptus ruficollis* (Little Grebe) Struthioniformes • *Struthio camelus* (Ostrich)* Rheiformes • *Rhea americana* (Greater rhea)* Casuariiformes • *Dromaius novaehollandiae* (Emu)* Phoenicopteriformes • *Phoenicopterus chilensis* (Chilean flamingo)* • *Phoenicopterus minor* (Lesser flamingo)* • *Phoenicopterus roseus* (Greater Flamingo) • *Phoenicopterus ruber* (American Flamingo)* Gruiformes • *Anthropoides virgo* (Demoiselle Crane) • *Antigone canadensis* (Sandhill Crane) • *Antigone vipio* (White-naped crane) • *Gallinula chloropus* (Common Moorhen) • *Grus canadensis* (Sandhill Crane) • *Grus grus* (Common Crane) • *Grus japonensis* (Red-crowned Crane) • *Grus leucogeranus* (Siberian crane) • *Balearica regulorum* (Crowned crane) • *Fulica americana* (American coot) • *Fulica armillata* (Red-gartered Coot) • *Fulica atra* (Common Coot) • *Grus monacha* (Hooded Crane) • *Grus paradisea* (Blue Crane) • *Grus vipio* (White-naped Crane) *Rallus aquaticus* (Water Rail)	• *Acridotheres cristatellus* (Crested Myna) • *Agelaius phoeniceus* (Red-winged Blackbird) • *Calamospiza melanocorys* (Lark Bunting) • *Carduelis carduelis* (European goldfinch) • *Carduelis chloris* (European Greenfinch) • *Chondestes grammacus* (Lark Sparrow) • *Coloeus monedula* (Eurasian Jackdaw) • *Corvus cornix* (Hooded Crow) • *Corvus corone* (Carrion Crow) • *Corvus frugilegus* (Rook) • *Corvus macrorhynchos* (Large-billed Crow) • *Corvus monedula* (Western Jackdaw) • *Copsychus saularis* (Oriental Magpie-robin) • *Corvus albus* (Pied Crow) • *Corvus brachyrhynchos* (American Crow) • *Corvus caurinus* (Northwestern Crow) • *Corvus corax* (Common Raven) • *Corvus ossifragus* (Fish Crow) • *Corvus splendens* (House Crow) • *Cyanocitta cristata* (Blue Jay) • *Cyanocorax chrysops* (Plush-crested Jay) • *Fringilla coelebs* (Common chaffinch) • *Garrulus glandarius* (Eurasian Jay) • *Hirundo rustica* (Barn Swallow) • *Junco hyemalis* (Dark-eyed Junco) • *Laniidae* (incognita) • *Lonchura striata* (White-rumped Munia) • *Motacilla alba* (Pied Wagtail) • *Passer domesticus* (House Sparrow) • *Passer montanus* (Eurasian Tree Sparrow) • *Pycnonotus sinensis* (Light-vented Bulbul) • *Pygochelidon cyanoleuca* (Blue-and-white Swallow) • *Pyrrhula pyrrhula* (Eurasian Bullfinch) • *Quiscalus major* (Boat-tailed Grackle) • *Phylloscopus trochilus* (Willow warbler) • *Pica hudsonia* (Black-billed Magpie) • *Pica pica* (Common Magpie) • *Piranga rubra* (Summer Tanager) • *Ploceus velatus* (Southern Masked-Weaver) • *Pycnonotus jocosus* (Red-whiskered Bulbul) • *Quiscalus mexicanus* (Great-tailed grackle) • *Quiscalus quiscula* (Common Grackle) • *Tachycineta bicolor* (Tree Swallow) • *Taeniopygia guttata* (Timor Zebra Finch)* • *Turdus iliacus* (Redwing) • *Turdus merula* (Eurasian Blackbird) • *Serinus canaria* (Island Canary) • *Sturnus vulgaris* (Common Starling)

Table A1. (*Continued*).

Anseriformes	Galliformes	Psittaciformes
• *Pelecanus philippensis* (Spot-billed Pelican) * • *Pelecanus rufescens* (Pink-backed Pelican) • *Plegadis falcinellus* (Glossy Ibis) • *Threskiornis aethiopicus* (Sacred Ibis) • *Threskiornis melanocephalus* (Black-headed Ibis) • *Pelecanus thagus* (Peruvian Pelican) • *Platalea leucorodia* (Eurasian Spoonbill) • *Platalea minor* (Black-faced Spoonbill) *Plegadis chihi* (White-faced Ibis)		• *Turdus migratorius* (American Robin) • *Turdus pilaris* (Fieldfare) • *Tyrannus verticalis* (Western Kingbird) • *Zosterops japonicus* (Warbling white-eye) • *Turdus pallidus* (Pale Thrush) *Turdus philomelos* (Song Thrush)