



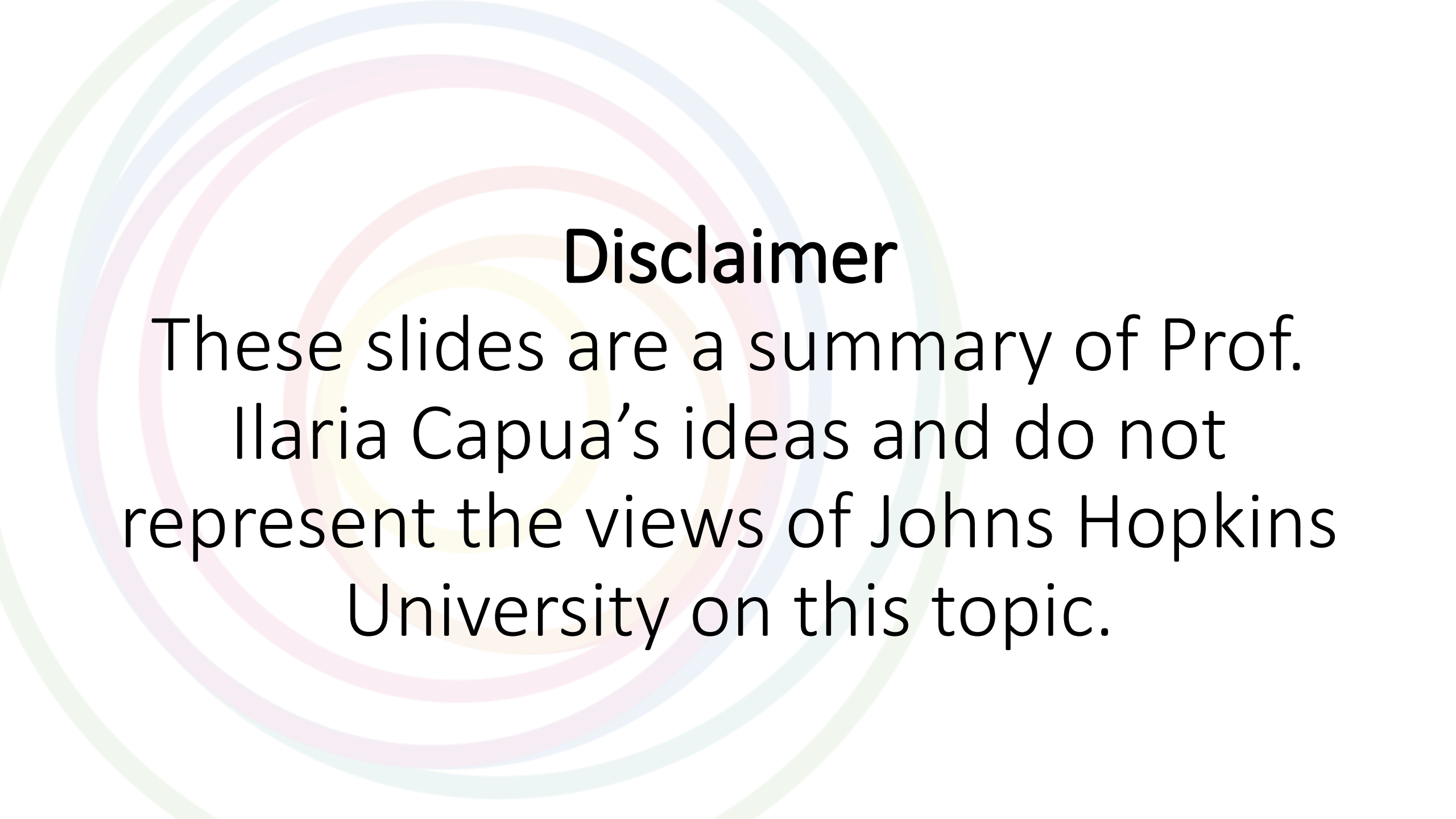
Circular Health: Advancing One Health and sustainability

The case of avian influenza

| SALUTE
CIRCOLARE |

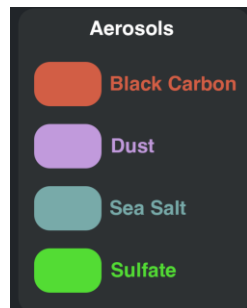
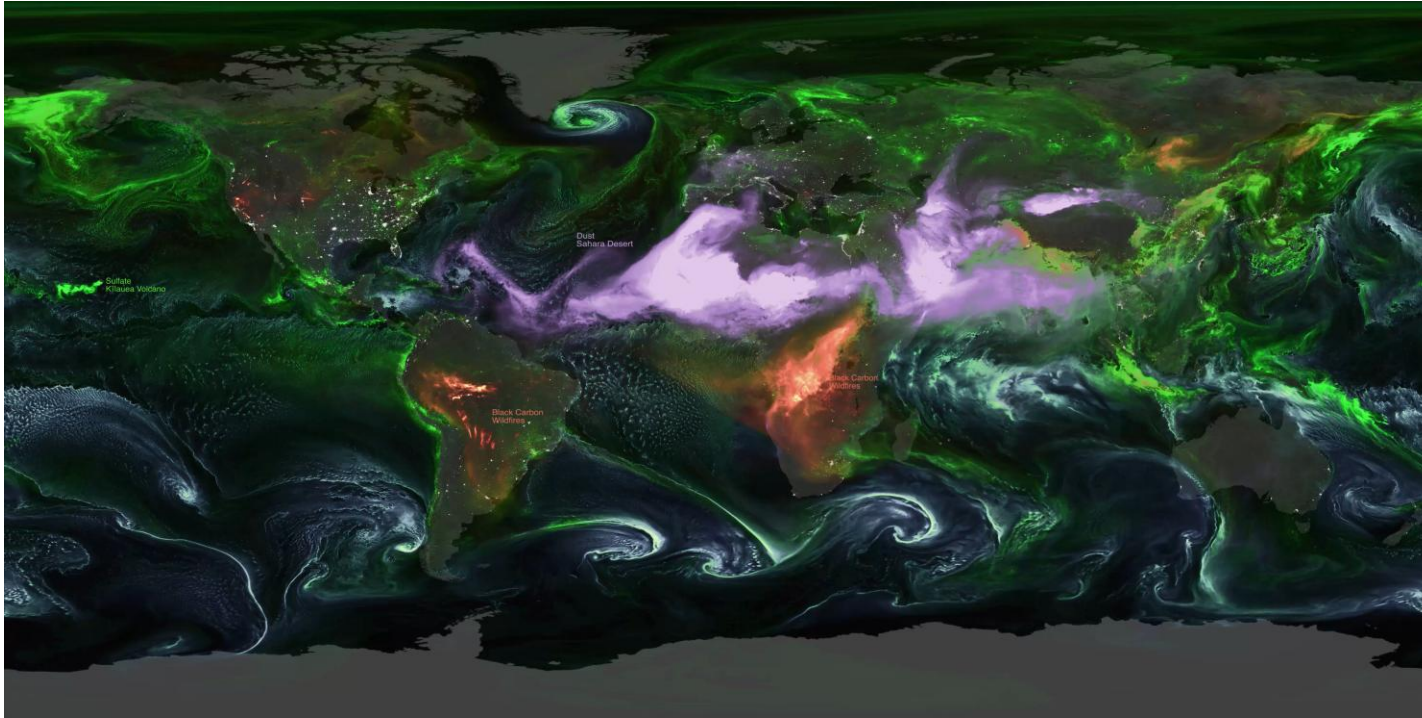
| CIRCULAR
HEALTH |

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Disclaimer

These slides are a summary of Prof. Ilaria Capua's ideas and do not represent the views of Johns Hopkins University on this topic.



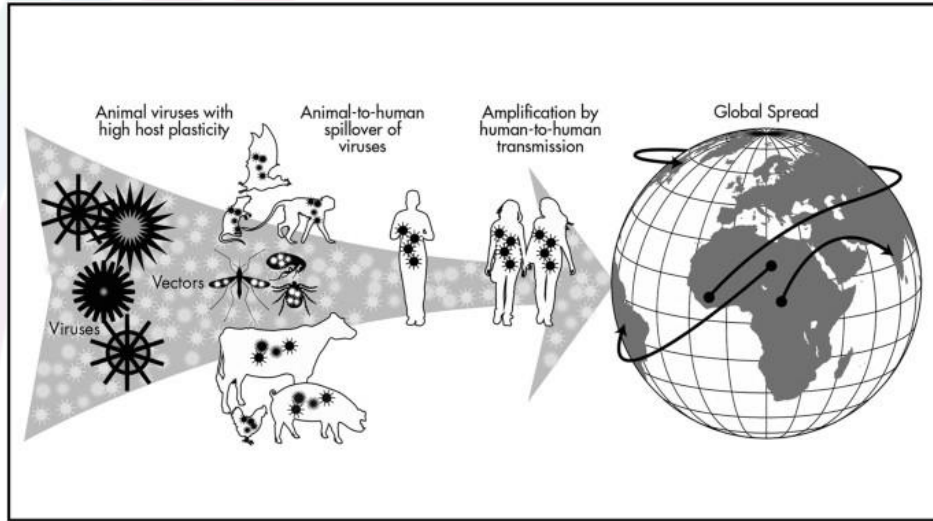
Source: NASA



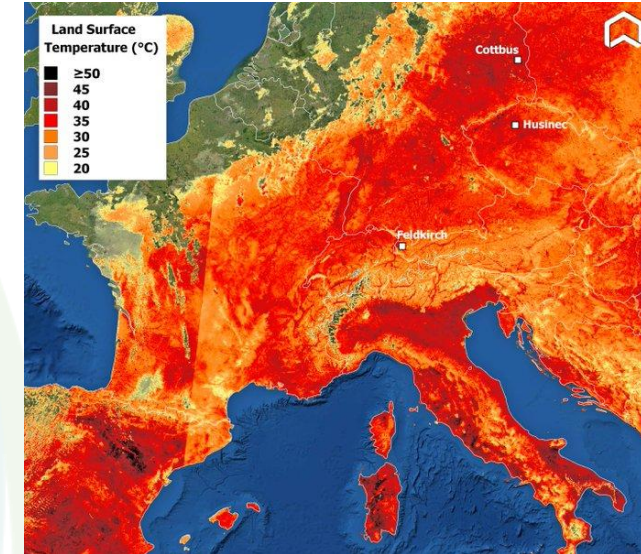
Source: La Rinascente

Convergence of crises inside the terrarium

Source: Nature (2015)



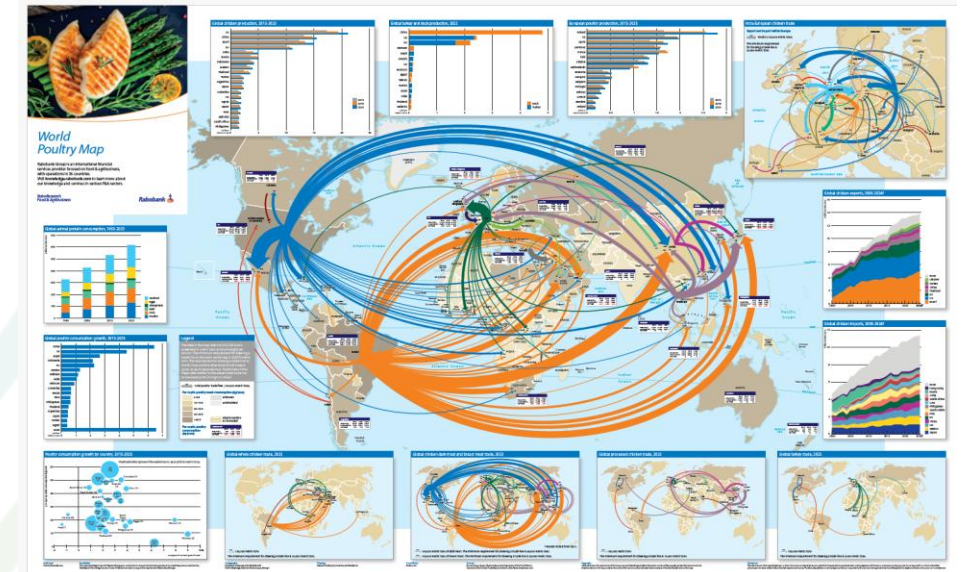
Source: Copernicus.eu



Source: Sky News



Source: Rai News



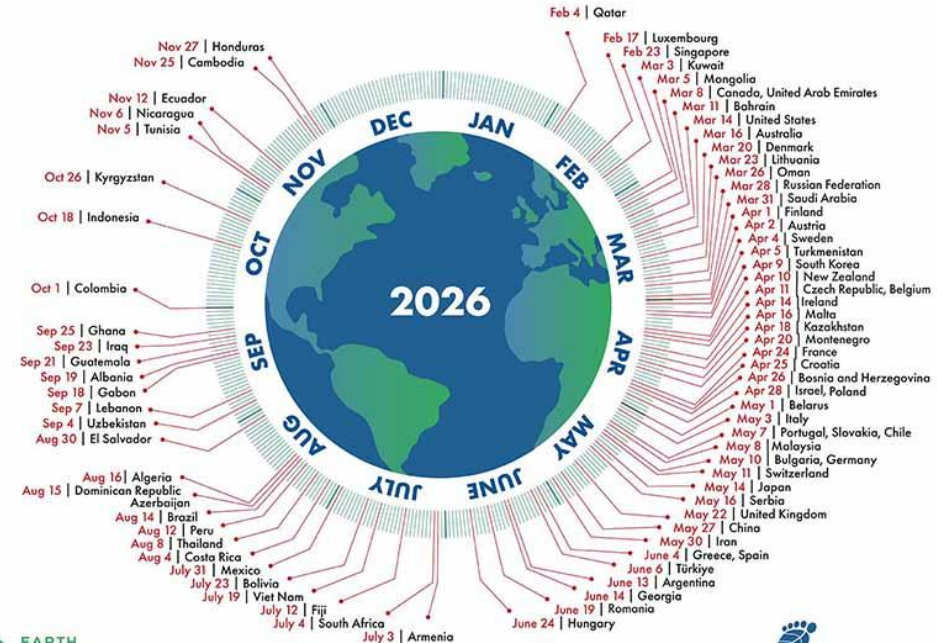
World Poultry Map 2025 - Rabobank

Earth Overshoot Day marks the date **when humanity's demand for ecological resources** and services in a given year **exceeds what Earth can regenerate** in that year.

This ecological deficit spending is possible because we can **liquidate stocks of ecological resources** and accumulate **waste**, most prominently **carbon dioxide in the atmosphere**.

Country Overshoot Days 2026

When Earth Overshoot Day would land if all the people around the world lived like...



EARTH
OVERSHOOT
DAY

For more information, visit:

<https://overshootday.org/newsroom/country-overshoot-days>

Source: Country Overshoot Days 2026 are calculated using the National Footprint and Biocapacity Accounts' 2025 Edition (Lo et al. 2025), produced by York University for FoDaFo and Global Footprint Network, available at data.footprintnetwork.org



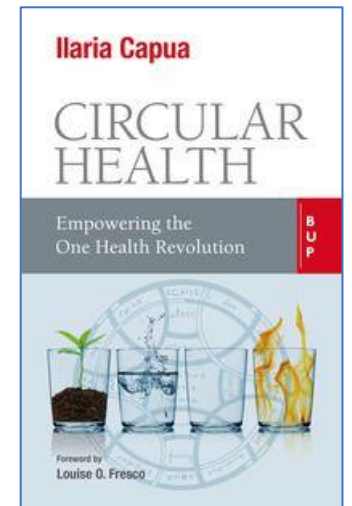
Circular Health (2019) is a systemic approach to health in line with the One Health approach.

It recognizes the need for a **multidisciplinary convergence** effort beyond the biomedical dimension of health. It includes social sciences, ethics, communication and sustainability.

It is implemented through the **Sustainable Development Goal roadmap** by exploiting **big data** and **artificial intelligence**.



| CIRCULAR
HEALTH |

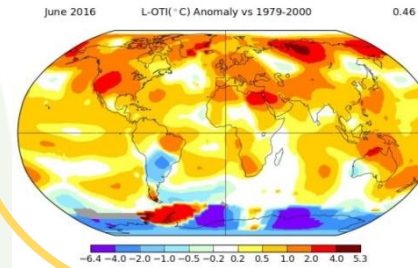
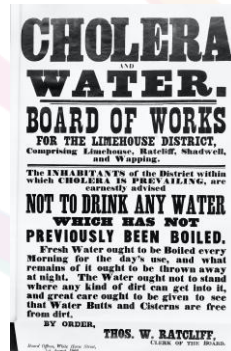




Circular Health Narrative



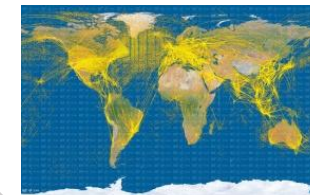
Earth



FIRE



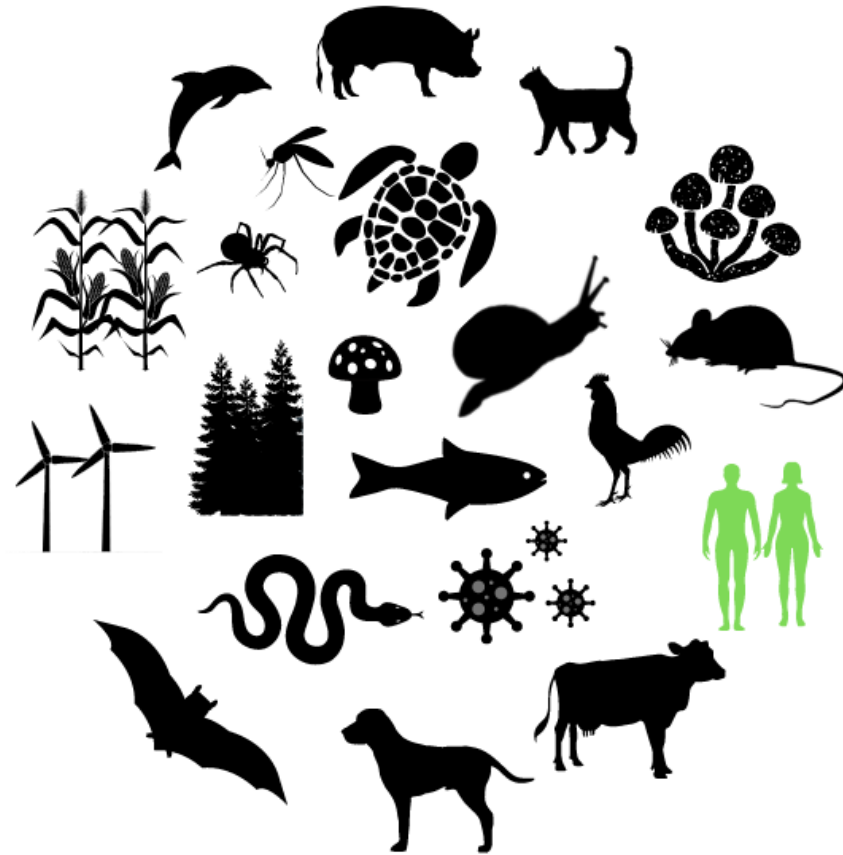
Air



EGO



ECO



Environmental Footprint of Meat Production

Cattle (beef) indexed to 100 — pork and poultry shown as a fraction of beef's impact per kilogram of meat

Metric	Cattle (Beef)	Pork	Poultry
Green water footprint (per kg of meat)	100	~34	~25
Blue water footprint (per kg of meat)	100	~83	~57
Land use (per kg of meat)	100	~5	~4
Greenhouse gas emissions (per kg of meat)	100	~12	~10

Sources: Water — Mekonnen & Hoekstra water footprint report (global averages, green + blue water). Land use & GHG emissions — Poore & Nemecek (2018), via Our World in Data (beef herd system).

Figures are global averages and vary by region, production system, and methodology (e.g. grass-fed vs. feedlot beef, or whether land-use change is included). Values illustrate relative order of magnitude, not precise conversion factors.

Avian Influenza:
from a minor animal health
issue to an **epidemic** which is
currently **out of control** and
impacts on sustainability and on
how the **poultry industry** is
perceived



Disease before year 2000

Table II
Reported highly pathogenic avian influenza isolates obtained from primary outbreaks in poultry, 1959 to 1995

Highly pathogenic avian influenza virus	Subtype	Number of infected farms	Approximate numbers of poultry involved in epizootic	Reference
A/chicken/Scotland/59	H5N1	1 small farm	Not known	9
A/turkey/England/63	H7N3	3 small farms	29,000	116
A/turkey/Ontario/7732/66	H5N9	1 farm	8,000	57
A/chicken/Victoria/76	H7N7	1 chicken farm, duck farm with LPAI H7N7 also slaughtered out	58,000	114
A/chicken/Germany/79	H7N7	1 chicken farm, 1 goose farm	600,000 chickens 80 geese	9
A/turkey/England/199/79	H7N7	3 small farms	9,000	10
A/chicken/Pennsylvania/1370/83	H5N2	356 farms HPAI plus 90 farms with LPAI or H5 antibodies	> 17,000,000	41
A/turkey/Ireland/1378/83	H5N8	3 farms (turkeys/chickens), one duck farm (270,000 ducks)	307,000	69
A/chicken/Victoria/85	H7N7	1 farm	240,000	17
A/turkey/England/50-92/91	H5N1	1 house on 1 farm	8,000	10
A/chicken/Victoria/1/92	H7N3	1 chicken farm, duck farm with H7 antibodies	18,000	117
A/chicken/Queensland/667-6/94	H7N3	1 farm	22,000	117
A/chicken/Mexico/8623-607/94	H5N2	Many farms LPAI H5N2 still enzootic	Not known	108, 114
A/chicken/Pakistan/447/94	H7N3	Many farms	> 6,000,000	70

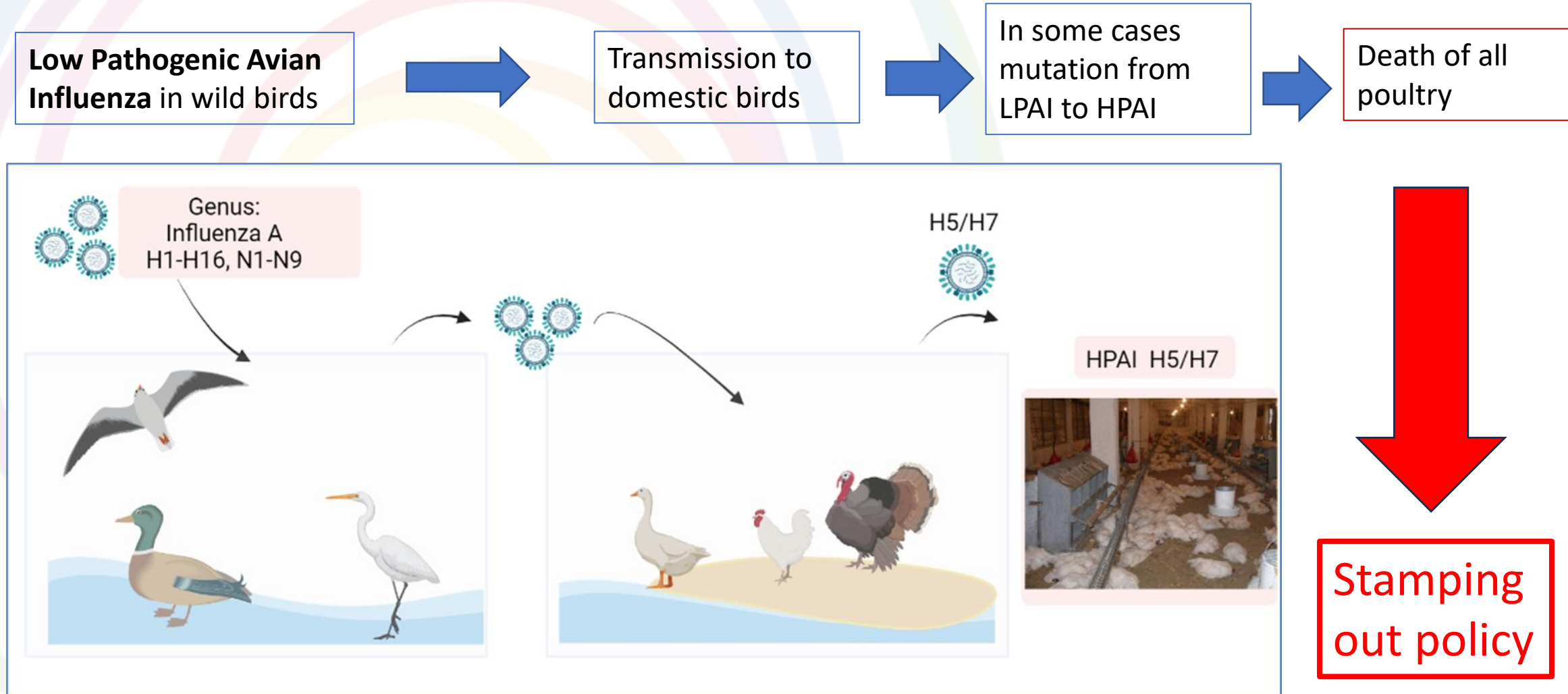
LPAI: low pathogenicity avian influenza
HPAI: highly pathogenic avian influenza

1959-1995
Few hundreds of
HPAI outbreaks in
40 years

Multiple AIV
subtypes



HPAI WAS a sporadic- self limiting disease



HPAI WAS a sporadic- self limiting disease



Global Avian Influenza Viruses with Zoonotic Potential situation update

Bird species affected by H5Nx HPAI

In orange are the new species since 2021
Last updated: 28/05/2025

Farmed bird species affected

- *Gallus gallus domesticus* (Chicken)
- *Anas platyrhynchos domesticus* (Duck)
- *Anserinae* sp. (Goose) *Meleagris gallopavo* (Turkey)

- *Cairina moschata* (Muscovy Duck)
- *Colinus virginianus* (Northern Bobwhite)
- *Columba livia domestica* (Domestic Pigeon)
- *Coturnix coturnix* (Common quail)
- *Coturnix japonica* (Japanese quail)

- *Dromaius novaehollandiae* (Emu)
- *Pavo cristatus* (Peacock)
- *Phasianus colchicus* (Common Pheasant)
- *Numida meleagris* (Common Guinea fowl)
- *Struthio camelus* (Ostrich)

Total of 13 farmed avian species

HPAI **WAS NOT** a disease of wild birds



Source: The Guardian



Source: DW



Source: The Poultry Site

Currently hundreds of species of wild birds have been infected and are the source of infection for poultry



In orange new avian species affected since 2021



Wild bird species affected

Anseriformes

- *Aix galericulata* (Mandarin Duck)
- *Aix sponsa* (Wood Duck)
- *Alopochen aegyptiaca* (Egyptian Goose)
- *Amazonetta brasiliensis* (Brazilian Teal)*
- *Anas acuta* (Northern Pintail)
- *Anas americana* (American Wigeon)
- *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)*
- *Anas fulvigula* (Mottled Duck)
- *Anas georgica* (Yellow-billed Pintail)
- *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)

Galliformes

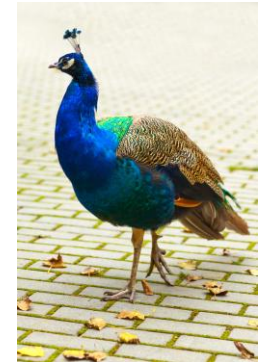
- *Alectoris rufa* (Red legged partridge)
- *Alectura lathami* (Australian bush turkey)
- *Bonasa umbellus* (Ruffed grouse)
- *Callipepla californica* (California Quail)
- *Centrocercus urophasianus* (Greater sage-grouse)
- *Colinus virginianus* (Northern Bobwhite)
- *Coturnix coturnix* (Common Quail)*
- *Cracidae* (incognita)*
- *Cyrtonyx montezumae* (Montezuma Quail)
- *Gallus gallus domesticus* (Chicken)
- *Lagopus lagopus* (Willow Grouse)
- *Lophura nycthemera* (Silver Pheasant)
- *Meleagris gallopavo* (Wild Turkey)
- *Numida meleagris* (Common Guinea fowl)
- *Pavo cristatus* (Peacock)
- *Perdix perdix* (Grey Partridge)*
- *Phasianus colchicus* (Common Pheasant)
- *Syrnaticus reevesii* (Reeves's Pheasant)*

Charadriiformes

- *Aethia cristatella* (Crested auklet)
- *Alca torda* (Razorbill)
- *Alle alle* (Little auk)
- *Arenaria interpres* (Ruddy Turnstone)
- *Arenaria melanocephala* (Black turnstone)
- *Calidris alba* (Sanderling)

Psittaciformes

- *Agapornis personatus* (Yellow-collared Lovebird)*
- *Agapornis roseicollis* (Rosy-faced Lovebird)*
- *Amazona farinosa* (Southern mealy amazon)*
- *Amazona farinosa* (Amazon Parrot)
- *Amazona ochrocephala* (Yellow-crowned Parrot)*
- *Amazona oratrix* (Yellow-headed amazon)*
- *Ara ararauna* (Blue-and-yellow macaw)*
- *Ara chloropterus* (Green and red macaw)*
- *Ara macao* (Scarlet Macaw)*
- *Ara militaris* (Military macaw)*
- *Aratinga auricapillus* (Golden-capped Parakeet)*
- *Brotogeris versicolurus* (White-winged Parakeet)*
- *Cacatua ducorpsii* (Solomons Corella)*
- *Cyanoliseus patagonus* (Burrowing Parrot)
- *Diopsittacus nobilis* (Northern Red-shouldered 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)*
- *Psittacula eupatria* (Alexandrine Parakeet)*
- *Psittacula krameri* (Rose-ringed Parakeet)*
- *Psittacus erithacus* (Grey Parrot)*



- *Anser albifrons* (Greater white-fronted Goose)
- *Anser anser* (Greylag Goose)
- *Anser brachyrhynchus* (Pink-footed Goose)
- *Anser caerulescens* (Snow Goose)
- *Anser cygnoides* (Swan Goose)*
- *Anser erythropus* (Lesser white-fronted goose)
- *Anser fabalis* (Tiaga Bean Goose)
- *Anser indicus* (Bar-headed Goose)
- *Anser rossii* (Ross's Goose)
- *Anser serrirostris* (Tundra Bean Goose)
- *Aythya affinis* (Lesser Scaup)
- *Aythya americana* (Redhead Duck)
- *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)
- *Branta bernicla* (Brent Goose)
- *Branta canadensis* (Canada Goose)
- *Branta hutchinsii* (Cackling Goose)
- *Branta leucopsis* (Barnacle Goose)
- *Branta ruficollis* (Red breasted goose)
- *Branta sandvicensis* (Nene)*
- *Bucephala albeola* (Bufflehead)
- *Bucephala clangula* (Common Goldeneye)
- *Bucephala islandica* (Barrow's goldeneye)*
- *Cairina moschata* (Muscovy Duck)
- *Callonetta leucophrys* (Ringed Teal)
- *Chauna torquata* (Southern Screamer)*
- *Chenonetta jubata* (Maned Duck)

- *Calidris canutus* (Red Knot)
- *Calidris ferruginea* (Curlew sandpiper)
- *Calidris fuscicollis* (White-rumped Sandpiper)
- *Calidris maritima* (Purple sandpiper)
- *Calidris mauri* (Western Sandpiper)
- *Calidris minuta* (Little stint)
- *Calidris pusilla* (Semipalmated sandpiper)
- *Cephus carbo* (Spectacled guillemot)
- *Cephus grylle* (Black Guillemot)
- *Cerorhinca monocerata* (Rhinoceros auklet)
- *Charadrius alexandrinus* (Kentish Plover)
- *Charadrius dubius* (Little ringed plover)
- *Charadrius hiaticula* (Common ringed plover)
- *Charadrius mongolus* (Lesser Sand Plover)
- *Charadrius nivosus* (Snowy plover)
- *Chionis albus* (Snowy Sheathbill)
- *Charadrius pallidus* (Chestnut-banded Plover)
- *Chlidonias hybrida* (Whiskered Tern)
- *Chlidonias leucopterus* (White-winged Black Tern)
- *Chroicocephalus brunnicephalus* (Brown-headed gull)
- *Chroicocephalus cirrocephalus* (Grey Headed Gull)
- *Chroicocephalus hartlaubii* (Hartlaub's Gull)
- *Chroicocephalus maculipennis* (Brown-hooded gull)
- *Chroicocephalus ridibundus* (Black-headed Gull)
- *Fratercula arctica* (Atlantic Puffin)
- *Gallinago gallinago* (Common Snipe)
- *Gallinago stenura* (Pin-tailed Snipe)
- *Gelochelidon nilotica* (Common Gull-billed Tern)
- *Haematopus ostralegus* (Blackish Oystercatcher)

Falconiformes

- *Caracara cheriway* (Northern Crested Caracara)
- *Caracara plancus* (Southern Caracara)
- *Falco biarmicus* (Lanner Falcon)
- *Falco cherrug* (Saker Falcon)
- *Falco columbarius* (Merlin)
- *Falco mexicanus* (Prairie falcon)
- *Falco peregrinus* (Peregrine Falcon)
- *Falco rusticolus* (Gryfalcon)
- *Falco sparverius* (American Kestrel)
- *Falco subbuteo* (Eurasian hobby)*
- *Falco tinnunculus* (Common Kestrel)
- *Falco vespertinus* (Red-footed Falcon)
- *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 novaehollandiae* (Grey Goshawk)
- *Accipiter poliocephalus* (Grey-headed Goshawk)
- *Accipiter striatus* (Sharp-shinned Hawk)
- *Aegypius monachus* (Cinereous Vulture)
- *Aquila audax* (Wedge-tailed Eagle)
- *Aquila chrysaetos* (Golden Eagle)
- *Aquila fasciata* (Bonelli's eagle)
- *Aquila heliaca* (Eastern imperial eagle)



- *Chloepnaga melanoptera* (Andean Goose)
- *Chloephaga picta* (Upland Goose)
- *Clangula hyemalis* (Long-tailed Duck)
- *Coscoroba coscoroba* (Coscoroba swan)
- *Cygnus atratus* (Black Swan)
- *Cygnus bewickii* (Tundra swan)
- *Cygnus buccinators* (Trumpeter Swan)
- *Cygnus columbianus* (Tundra Swan)
- *Cygnus cygnus* (Whooper swan)
- *Cygnus melancoryphus* (black-necked swan)
- *Cygnus olor* (Mute Swan)
- *Dendrocygna autumnalis* (Black-bellied whistling duck)
- *Dendrocygna bicolor* (Fulvous whistling Duck)
- *Dendrocygna eytoni* (Plumed Whistling-Duck)
- *Dendrocygna viduata* (White-faced Whistling-Duck)
- *Lophodytes cucullatus* (Hooded Merganser)
- *Mareca americana* (American wigeon)
- *Mareca falcata* (Falcated Duck)
- *Marmaronetta angustirostris* (Marbled Teal)
- *Melanitta americana* (Black scoter)
- *Melanitta deglandi* (White-winged Scoter)
- *Melanitta fusca* (Velvet Scoter)
- *Melanitta nigra* (Common Scoter)
- *Melanitta perspicillata* (Surf Scoter)
- *Mergellus albellus* (Smew)*
- *Mergus merganser* (Goosander)
- *Mergus serrator* (Red-breasted merganser)
- *Mergus squamatus* (Scaly-sided merganser)*
- *Netta rufina* (Red-crested Pochard)
- *Oxyura jamaicensis* (Ruddy Duck)
- *Plectropterus gambensis* (Spur-winged Goose)

- *Haematopus moquini* (African Black Oystercatcher)
- *Haematopus ostralegus* (Eurasian oystercatcher)
- *Haematopus palliatus* (American oystercatcher)
- *Himantopus himantopus* (Black-winged Stilt)
- *Himantopus mexicanus* (Black-necked 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 californicus* (California Gull)
- *Larus canus* (Mew Gull)
- *Larus crassirostris* (Black-tailed 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 hyperboreus* (Glaucous Gull)
- *Larus ichthyaetus* (Pallas's Gull)
- *Larus marinus* (Great black-backed Gull)
- *Larus michahellis* (Yellow-legged Gull)

- *Aquila nipalensis* (Steppe Eagle)
- *Aquila rapax* (Tawny Eagle)*
- *Buteo buteo* (Common Buzzard)
- *Buteo jamaicensis* (Red-tailed Hawk)
- *Buteo japonicus* (Eastern buzzard)
- *Buteo lagopus* (Rough-legged Hawk)
- *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)*
- *Coragyps atratus* (American Black Vulture)
- *Geranoaetus melanoleucus* (Black-chested buzzard-eagle)
- *Geranoaetus polyosoma* (Variable Hawk)
- *Gypaetus barbatus* (Bearded vulture)
- *Gyps africanus* (White-backed vulture)*
- *Gyps fulvus* (Griffon Vulture)
- *Haliaeetus albicilla* (White Tailed Eagle)
- *Haliaeetus leucocephalus* (Bald Eagle)
- *Haliaeetus pelagicus* (Steller's Sea Eagle)
- *Haliaeetus vocifer* (African Fish Eagle)
- *Hieraaetus fasciatus* (Bonelli's Eagle)



- *Plectropterus gambensis* (Spur-winged Goose)
- *Somateria mollissima* (Eider)
- *Somateria spectabilis* (King Eider)
- *Spatula clypeata* (Northern Shoveler)
- *Spatula cyanoptera* (Cinnamon Teal)
- *Spatula puna* (Puna Teal)*
- *Spatula querquedula* (Garganey)
- *Tachyeres pteneres* (Magellanic Steamerduck)
- *Tadorna ferruginea* (Ruddy Shelduck)
- *Tadorna tadorna* (Common Shelduck)

Gaviiformes

- *Gavia arctica* (Arctic Loon)
- *Gavia immer* (Common Loon)
- *Gavia pacifica* (Pacific Loon)
- *Gavia stellata* (Red-throated Loon)

Sphenisciformes

- *Aptenodytes patagonicus* (King Penguin)
- *Eudyptes chrysocome* (Southern Rockhopper Penguin)
- *Pygoscelis adeliae* (Adelie penguin)
- *Pygoscelis antarcticus* (Chinstrap penguin)
- *Pygoscelis papua* (Gentoo Penguin)
- *Spheniscus demersus* (Jackass Penguin)
- *Spheniscus humboldti* (Humboldt Penguin)
- *Spheniscus magellanicus* (Magellanic Penguin)

Ciconiiformes

- *Ciconia boyciana* (Oriental Stork)
- *Ciconia ciconia* (White Stork)

- *Larus michahellis* (Yellow-legged Gull)
- *Larus novaehollandiae* (Silver Gull)
- *Larus occidentalis* (Western Gull)
- *Larus philadelphia* (Bonaparte's Gull)
- *Larus pipixcan* (Franklin's Gull)
- *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)
- *Leucophaeus scoresbii* (Dolphin Gull)
- *Numenius sp.* (Curlew)
- *Numenius arquata* (Eurasian Curlew)
- *Numenius phaeopus* (Whimbrel)
- *Pagophila eburnea* (Ivory Gull)
- *Phalaropus lobatus* (Red-necked phalarope)
- *Pluvialis dominica* (American Golden Plover)
- *Pluvialis squatarola* (Grey Plover/Black-bellied Plover)
- *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/Arctic Jaeger)
- *Stercorarius skua* (Great Skua)
- *Sterna dougallii* (Roseate Tern)

- *Hieraaetus fasciatus* (Bohemian Eagle)
- *Hieraaetus pennatus* (Booted Eagle)
- *Milvus migrans* (Black Kite)
- *Milvus milvus* (Red Kite)
- *Nisaetus nipalensis* (Mountain Hawk Eagle)
- *Pandion haliaetus* (Osprey)
- *Parabuteo unicinctus* (Harris's Hawk)
- *Sagittarius serpentarius* (Secretary Bird)
- *Spilornis cheela* (Crested Serpent Eagle)
- *Spizaetus nipalensis* (Mountain hawk-eagle)
- *Vultur gryphus* (Andean condor)*

Cathartiformes

- *Gymnogyps californianus* (California Condor)
- *Sarcorampus papa* (King Vulture)

Strigiformes

- *Aegolius acadicus* (Northern Saw-whet Owl)
- *Asio flammeus* (Short-Eared owl)
- *Asio otus* (Long Eared Owl)
- *Athene noctua* (Little Owl)
- *Bubo africanus* (Spotted Eagle-Owl)
- *Bubo bubo* (Eurasian Eagle-Owl)
- *Bubo magellanicus* (Lesser Horned Owl)
- *Bubo scandiacus* (Snowy Owl)
- *Bubo virginianus* (Great Horned Owl)
- *Megascops asio* (Eastern Screech Owl)
- *Megascops choliba* (Tropical Screech-owl)
- *Megascops kennicottii* (Western Screech-Owl)
- *Otus scops* (Scops Owl)
- *Strix aluco* (Tawny owl)
- *Strix nebulosa* (Great grey owl)



- *Ciconia ciconia* (White Stork)
- *Ciconia nigra* (Black Stork)
- *Leptoptilos javanicus* (Lesser Adjutant)*
- *Mycteria americana* (American Wood Stork)
- *Mycteria leucocephala* (Painted Stork)

Procellariiformes

- *Ardenna gravis* (Great Shearwater)
- *Ardenna grisea* (Sooty Shearwater)
- *Ardenna tenuirostris* (Short-tailed Shearwater)
- *Diomedea exulans* (Snowy albatross)
- *Fulmarus glacialis* (Northern Fulmar)
- *Fulmarus glacialis* (Southern Fulmar)
- *Macronectes giganteus* (Southern Giant Petrel)
- *Oceanites oceanicus* (Wilson's Storm-petrel)
- *Macronectes halli* (Northern Giant Petrel)
- *Pachyptila desolata* (Antarctic Prion)
- *Pelecanoides garnotii* (Peruvian Diving-petrel)
- *Phoebastria fusca* (Sooty Albatross)
- *Phoebastria irrorata* (Waved Albatross)
- *Procellaria aequinoctialis* (White-chinned Petrel)
- *Pterodroma macroptera* (Great-winged Petrel)
- *Puffinus gravis* (Great Shearwater)
- *Puffinus puffinus* (Manx Shearwater)
- *Thalassarche melanophrys* (Black-browed Albatross)

Suliformes

- *Fregata magnificens* (Magnificent Frigatebird)
- *Fregata minor* (Great Frigatebird)
- *Leucocarbo atriceps* (Imperial Shag)
- *Leucocarbo georgianus* (South Georgia Shag)

- *Sterna dougalli* (Roseate Tern)
- *Sterna eurygnatha* (Cayenne tern)
- *Sterna forsteri* (Forster's Tern)
- *Sterna hirundinacea* (South American Tern)
- *Sterna hirundo* (Common Tern)
- *Sterna paradisaea* (Arctic Tern)
- *Sternula albifrons* (Little Tern)
- *Synthliboramphus antiquus* (Ancient murrelet)
- *Thalasseus acutiflavus* (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)
- *Tringa totanus* (Common Redshank)
- *Uria aalge* (Common Murre)
- *Uria lomvia* (Thick-billed Murre)
- *Vanellus chilensis* (Southern Lapwing)
- *Vanellus spinosus* (Spur-winged Lapwing)
- *Vanellus vanellus* (Northern Lapwing)
- *Xema sabini* (Sabine's Gull)

Podicipediformes

- *Aechmophorus occidentalis* (Western Grebe)
- *Podiceps auritus* (Horned Grebe)
- *Podiceps cristatus* (Great Crested Grebe)
- *Podiceps grisegena* (Red-necked Grebe)
- *Podiceps major* (Great Grebe)
- *Podiceps nigricollis* (Eared Grebe)

- *Strix nebulosa* (Great grey owl)
- *Strix uralensis* (Ural Owl)
- *Strix varia* (Barred owl)
- *Tyto alba* (Common Barn-Owl)
- *Tyto longimembris* (Eastern Grass-owl)*

Caprimulgiformes

- *Caprimulgus fossii* (Mozambique Nightjar)

Columbiformes

- *Columba guinea* (African rock pigeon)
- *Columba livia* (Rock Dove)
- *Columba palumbus* (Common Wood-Pigeon)
- *Columbina inca* (Inca Dove)
- *Streptopella decaocto* (Eurasian Collared Dove)
- *Streptopella senegalensis* (Laughing Dove)
- *Streptopelia turtur* (European Turtle-dove)
- *Zenaida asiatica* (White-winged Dove)
- *Zenaida macroura* (Mourning Dove)

Piciformes

- *Dendrocopos major* (Great spotted woodpecker)
- *Picus viridis* (Eurasian Green Woodpecker)
- *Pteroglossus castanotis* (Chestnut-eared aracari)*
- *Ramphastos cuvieri* (white-throated toucan)*

Coraciiformes

- *Dacelo sp.* (Kookaburra)*

Trogoniformes



- *Leucocarbo atriceps* (Imperial Shag)
- *Leucocarbo georgianus* (South Georgia Shag)
- *Leucocarbo bransfieldensis* (Antarctic shag)
- *Microcarbo coronatus* (Crowned Cormorant)
- *Morus bassanus* (Northern Gannet)
- *Morus capensis* (Cape Gannet)
- *Nannopterum auritum* (Double-crested Cormorant)
- *Nannopterum brasilianum* (Neotropical Cormorant)
- *Phalacrocorax auritus* (Double-crested Cormorant)
- *Phalacrocorax bougainvillii* (Guanay Cormorant)
- *Phalacrocorax brasilianus* (Neotropical Cormorant)
- *Phalacrocorax capensis* (Cape Cormorant)
- *Phalacrocorax carbo* (Great Cormorant)
- *Phalacrocorax gaimardi* (Red-legged Cormorant)
- *Phalacrocorax lucidus* (White-breasted 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)

- *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

- *Phoenicopus chilensis* (Chilean flamingo)*
- *Phoenicopus minor* (Lesser flamingo)*
- *Phoenicopus roseus* (Greater Flamingo)
- *Phoenicopus ruber* (American Flamingo)*

Gruiformes

- *Anthropoides virgo* (Demoiselle Crane)
- *Antigone canadensis* (Sandhill Crane)
- *Antigone vipio* (White-naped crane)
- *Balearica regulorum* (Crowned crane)
- *Fulica americana* (American coot)
- *Fulica armillata* (Red-gartered Coot)
- *Fulica atra* (Common Coot)

Trogoniformes

- *Harpactes erythrocephalus* (Red-headed Trogon)

Passeriformes

- *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)
- *Copsychus saularis* (Oriental Magpie-robin)
- *Corvus albus* (Pied Crow)
- *Corvus brachyrhynchos* (American Crow)
- *Corvus caurinus* (Northwestern Crow)
- *Corvus corax* (Common Raven)
- *Corvus cornix* (Hooded Crow)
- *Corvus corone* (Carrion Crow)
- *Corvus frugilegus* (Rook)
- *Corvus macrorhynchos* (Large-billed Crow)
- *Corvus monedula* (Western Jackdaw)
- *Corvus ossifragus* (Fish Crow)
- *Corvus splendens* (House Crow)
- *Cyanocitta cristata* (Blue Jay)
- *Cyanocorax chrysops* (Plush-crested Jay)
- *Erithacus rubecula* (European Robin)
- *Euphagus cyanocephalus* (Brewer's Blackbird)
- *Fringilla coelebs* (Common chaffinch)
- *Furnarius rufus* (Rufous Hornero)



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)*
- *Ardeola grayii* (Indian Pond-Heron)
- *Bostrychia hagedash* (Hadada Ibis)
- *Botaurus stellaris* (Eurasian bittern)
- *Bubulcus ibis* (Western Cattle Egret)
- *Butorides virescens* (Green 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)
- *Pelecanus crispus* (Dalmatian Pelican)
- *Pelecanus erythrorhynchos* (American White Pelican)
- *Pelecanus occidentalis* (Brown Pelican)
- *Pelecanus onocrotalus* (Great White Pelican)
- *Pelecanus philippensis* (Spot-billed Pelican)*
- *Pelecanus rufescens* (Pink-backed Pelican)
- *Pelecanus thagus* (Peruvian Pelican)
- *Platalea leucorodia* (Eurasian Spoonbill)
- *Platalea minor* (Black-faced Spoonbill)

- *Gallinula chloropus* (Common Moorhen)
- *Grus canadensis* (Sandhill Crane)
- *Grus grus* (Common Crane)
- *Grus japonensis* (Red-crowned Crane)
- *Grus leucogeranus* (Siberian crane)*
- *Grus monacha* (Hooded Crane)
- *Grus paradisea* (Blue Crane)
- *Grus vipio* (White-naped Crane)
- *Rallus aquaticus* (Water Rail)



- *Garrulus glandarius* (Eurasian jay)
- *Haemorhous mexicanus* (House finch)
- *Hirundo rustica* (Barn Swallow)
- *Junco hyemalis* (Dark-eyed Junco)
- *Laniidae* (incognita)
- *Lonchura striata* (White-rumped Munia)
- *Melospiza lincolni* (Lincoln's sparrow)
- *Melospiza melodia* (Song Sparrow)
- *Motacilla alba* (Pied Wagtail)
- *Passer domesticus* (House Sparrow)
- *Passer montanus* (Eurasian Tree Sparrow)
- *Passerculus sandwichensis* (Savannah Sparrow)
- *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)
- *Pycnonotus sinensis* (Light-vented Bulbul)
- *Pygochelidon cyanoleuca* (Blue-and-white Swallow)
- *Pyrrhula pyrrhula* (Eurasian Bullfinch)
- *Quiscalus major* (Boat-tailed Grackle)
- *Quiscalus mexicanus* (Great-tailed grackle)
- *Quiscalus quiscula* (Common Grackle)
- *Sayornis saya* (Say's Phoebe)
- *Serinus canaria* (Island Canary)
- *Sturnus vulgaris* (Common Starling)
- *Sylvia atricapilla* (Eurasian Blackcap)
- *Tachycineta bicolor* (Tree Swallow)
- *Taeniopygia guttata* (Timor Zebra Finch)*
- *Turdus iliacus* (Redwing)
- *Turdus merula* (Eurasian Blackbird)
- *Turdus migratorius* (American Robin)



- *Pelecanus onocrotalus* (Great White Pelican)
- *Pelecanus philippensis* (Spot-billed Pelican)*
- *Pelecanus rufescens* (Pink-backed Pelican)
- *Pelecanus thagus* (Peruvian Pelican)
- *Platalea leucorodia* (Eurasian Spoonbill)
- *Platalea minor* (Black-faced Spoonbill)
- *Plegadis chihi* (White-faced Ibis)
- *Plegadis falcinellus* (Glossy Ibis)
- *Threskiornis aethiopicus* (Sacred Ibis)
- *Threskiornis melanocephalus* (Black-headed Ibis)*
- *Theristicus melanopis* (Black-faced Ibis)

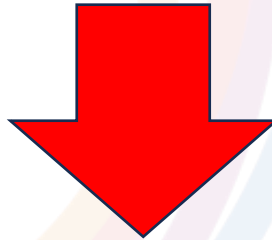


- *Sylvia atricapilla* (Eurasian Blackcap)
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- *Turdus migratorius* (American Robin)
- *Turdus pallidus* (Pale Thrush)
- *Turdus philomelos* (Song Thrush)
- *Turdus pilaris* (Fieldfare)
- *Tyrannus verticalis* (Western Kingbird)
- *Zonotrichia leucophrys* (White-crowned sparrow)
- *Zosterops japonicus* (Warbling white-eye)

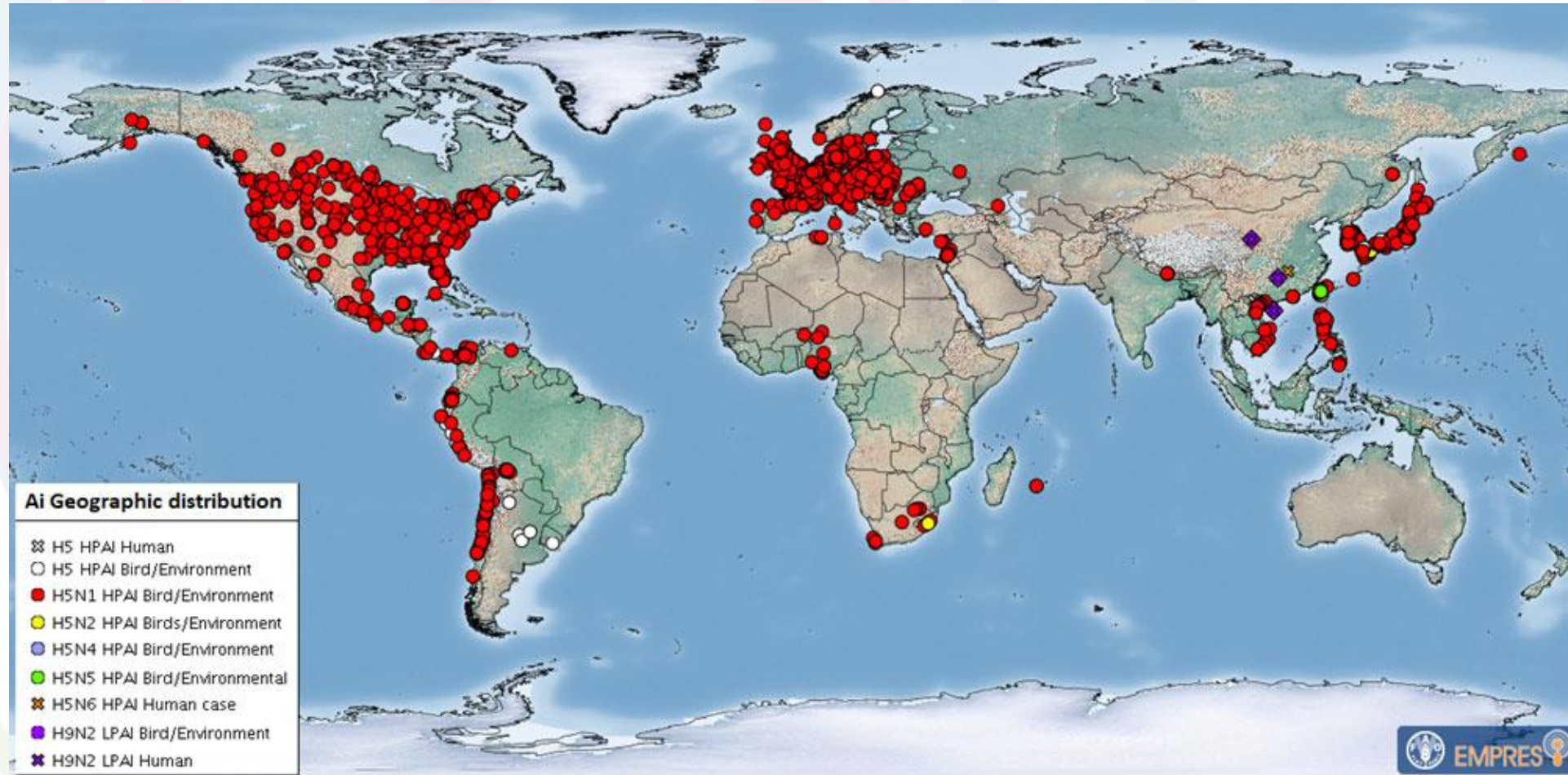


A completely new transmission
dynamic

Wild birds



HPAI H5N1 2022-2023



Hundreds of millions birds died or were culled following AI infection worldwide (2000-2025)



Source: The Guardian

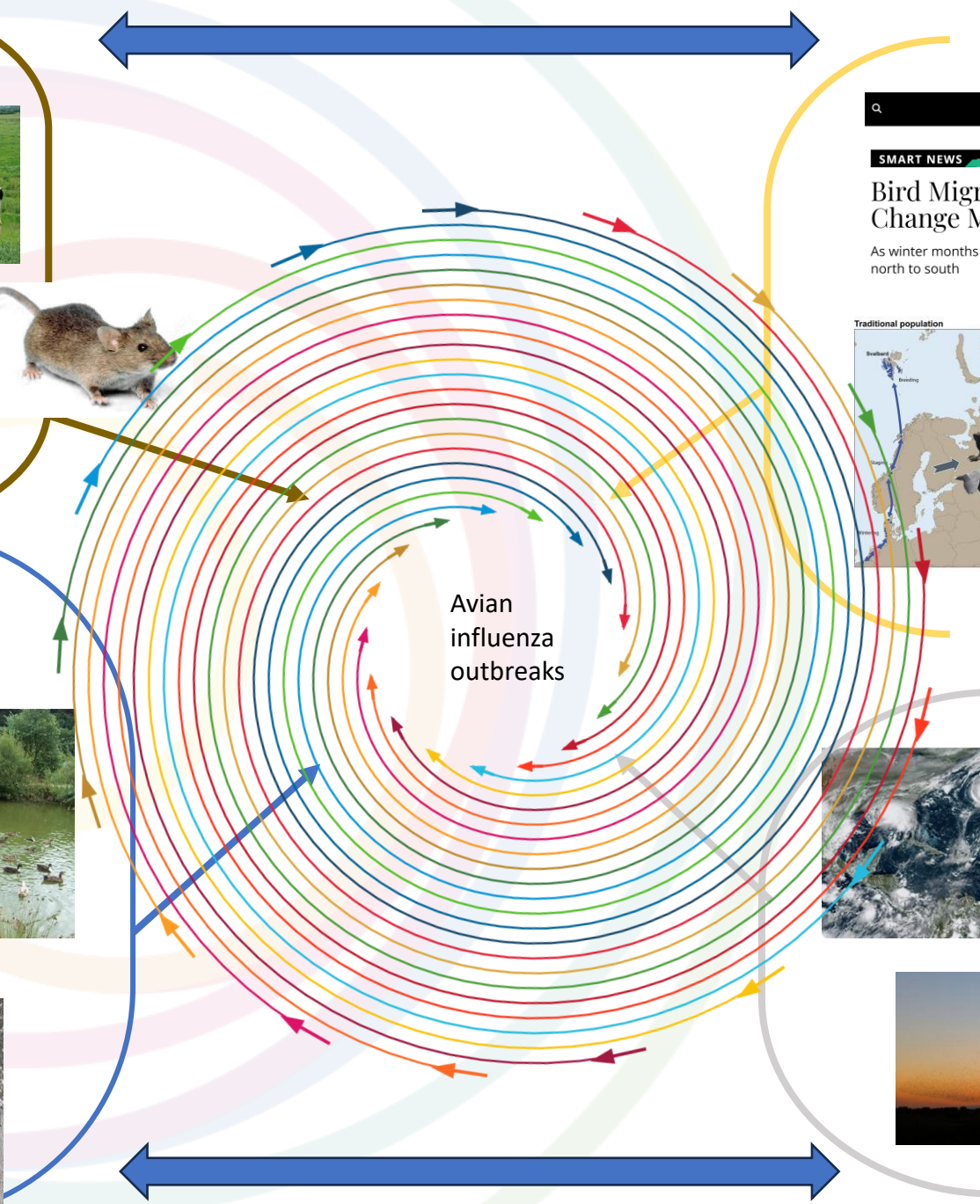
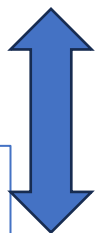


Source: BBC



Earth

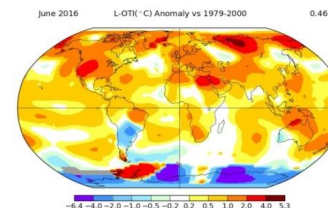
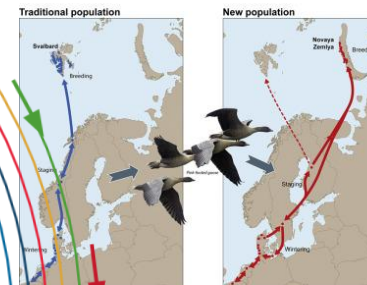
Water



SMART NEWS

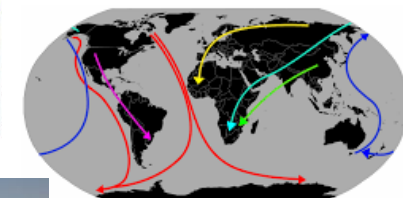
Bird Migration Patterns Are Changing—and Climate Change May Be to Blame

As winter months approach, some feathered friends have started migrating east to west instead of north to south



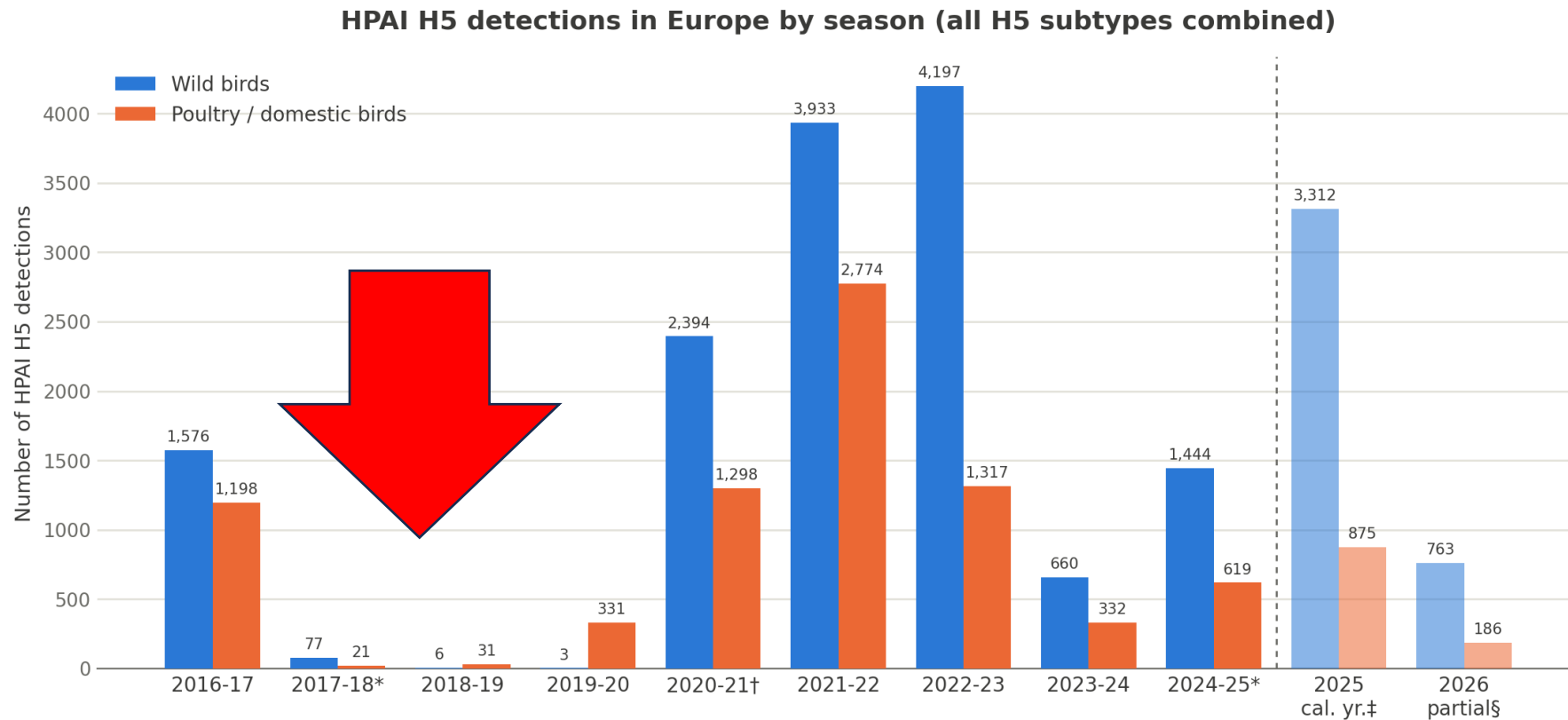
FIRE

Air



Cerantia oenanthe
Sterna bergii
Falco tinnunculus
Puffinus tenuirostris
Phalaropus lobatus
Buteo swainsoni





* 2017-18: partial season (2 of 4 quarterly reports retrieved). 2024-25: season not yet closed, data through 5 Sept 2025.

† 2020-21: wild bird / poultry split has not been independently re-confirmed against a primary EFSA source (combined season total: 3,777).

‡ 2025 calendar year: approximate, sums quarterly reports for 7 Dec 2024–28 Nov 2025 (excludes Dec 2025, includes ~25 days of Dec 2024) — EFSA does not publish a Jan-Dec total.

§ 2026: partial, covers only 28 Feb–4 Jun 2026 (the sole almost-fully-2026 report published so far); no data yet for Jun-Sep 2026 as of 18 Sept 2026, so this understates the year to date.

Europe's HPAI H5 Cases, 2016–2025

*Wild birds and domestic poultry, all H5 subtypes combined
(H5N1, H5N8, H5N6, H5N5, H5N3) — EFSA/ECDC/EURL avian
influenza reports*

HPAI is a HUGE problem

- For **public health** and **animal health** and **welfare** reasons viral circulation in poultry (and dairy cattle, in the US) should be reduced and eventually stopped
- Safe and efficacious vaccine is necessary to control infection
- Culling and depopulating hundreds of millions birds in 2020/2024 is unethical and unacceptable to stakeholders and the general public
- The poultry industry will have to react and develop innovative strategies to survive this challenge
- HPAI could circulate for decades if unmanaged
- HPAI causes conservation issues (wild bird species could become extinct)



Animal activists want mass killings to control avian flu to use more humane methods



According to international guidelines:

- All poultry species infected with HPAI must be culled (EU, Japan and US)
- No vaccination policy can be currently applied in the US.
- Vaccination in EU is allowed and has been successful in French ducks, however it is burdensome and costly
- Vaccination is being massively used in China, Egypt, Mexico
- Human cases remain sporadic

In the EU

- We have a Commissioner for Health and **Animal welfare**
- Animal welfare activists are more and more vocal and against mass culling
- Mass culling is horrible, unethical and impacts sustainability efforts
- Mass culling must end because it is unacceptable and makes the poultry industry look cruel



Wildlife reservoir and vaccination

A veterinary perspective

- We are dealing with a disease which has a **reservoir in wildlife**
- Other animal diseases with a reservoir in wildlife are/have been **controlled through the use of vaccines** (if available).
- These include Bluetongue, TB, rabies, Rinderpest (eradicated through vaccination!), Newcastle Disease

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 • *Zenaidura macroura* (Mourning Dove)

Piciformes

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 • *Ramphastos cavirostris* (white-throated toucan)*

Coraciiformes

• *Dacelo sp.* (Kookaburra)*

Trogoniformes



Conclusions - some good, some bad

- Avian influenza is NOT the disease it used to be
- It is influenced by the delicate balance between Earth, Air, Water and Fire
- Poultry farming is more sustainable than other meat production systems
- Vaccination for AI should become the rule and not the exception
- Animal welfare should become a priority and an asset
- Mass culling is a failure of the entire system
- **No-vax movements should be managed through appropriate communication and action before it is too late**





CIRCULAR
HEALTH

