Animal & Plant Health Agency

Great Britain Wildlife Health Partnership Annual Report for 2024

Disease surveillance and emerging threats

Contents

Introduction

The disease status of free-living wildlife in England, Wales and Scotland is monitored through a wildlife disease surveillance collaboration between government agencies and non-governmental organisations, known as the Great Britain Wildlife Health Partnership.

Since 1998, the Animal and Plant Health Agency (APHA) Diseases of Wildlife Scheme (DoWS) has delivered national surveillance for wildlife disease in England and Wales to government. The Great Britain Wildlife Disease Surveillance Partnership was formed in 2010, following publication of the England Wildlife Health Strategy and was tasked with overseeing wildlife disease surveillance in Great Britain. It was recently renamed as the Great Britain Wildlife Health Partnership and is chaired by APHA DoWS. Partner members include APHA, the Centre for Environment, Fisheries and Aquaculture, Forestry England, the Garden Wildlife Health Project, Natural England, Scotland's Rural College, the Veterinary Medicines Directorate, the Wildfowl and Wetlands Trust and the Zoological Society of London. Input is provided from policy customers: Defra Animal Health and Exotic Disease Policy, Defra Biodiversity, Scottish Government and Welsh Government.

The remit of the partnership covers infectious and non-infectious disease that affects native or non-native wild animals which are currently free-living in Great Britain. The partnership works collaboratively with other government and non-government projects in delivering wildlife health surveillance. The partnership provides advice to government on new and re-emerging threats to wildlife that may affect the health of humans, livestock, wildlife populations or biodiversity. Where appropriate to wildlife, the partnership works with government to help develop policy recommendations in relation to notifiable and reportable animal diseases.

This annual report summarises the work and results from the partnership, highlighting wildlife disease events of significance and surveillance activities in 2024.

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Photo: an adult red deer (*Cervus elaphus*). Image credit: Liz Nabb, APHA Starcross.

Photo on cover: adult grey seal (*Halichoerus grypus*) in sea off Pembrokeshire coast. Image credit: Jennifer Cantlay, APHA Weybridge.

Partner members and financing

Animal & Plant Health Agency

Animal and Plant Health Agency (APHA) Disease of Wildlife Scheme (DoWS)
APHA is an executive agency of the Department for Environment, Food and Rural Affairs (Defra) and works on behalf of the Welsh Government, the Scottish Government and the Food Standards Agency.

APHA carries out disease surveillance to identify new and re-emerging threats to animal and public health through statutory surveillance (for notifiable and reportable diseases) and scanning surveillance. The Surveillance Intelligence Unit (SIU) is responsible for managing scanning surveillance and providing diagnostic support services to veterinary surgeons. These activities are delivered by the national network of Veterinary Investigation Centres and surveillance pathology partners. Within the SIU, the Wildlife Expert Group oversees APHA DoWS for delivery of national wildlife disease surveillance in England and Wales. The APHA collates data from VIDA (Veterinary Investigation Diagnosis Analysis) coded submissions (carcases and diagnostic samples), which are incorporated into wildlife disease surveillance dashboards for internal use and World Organisation for Animal Health (WOAH) reporting. The veterinary leads of the Wildlife Expert Group also chair the Great Britain Wildlife Health Partnership (GBWHP) with meetings held biannually. Veterinary surgeons and the public can contact the APHA to get advice on unusual wildlife disease or mass mortality incidents.

Scotland's Rural College (SRUC)

SRUC Veterinary Services provides disease surveillance and analytical testing via their Veterinary and Analytical Laboratory and network of disease surveillance hubs situated throughout Scotland. SRUC offers national veterinary disease surveillance for the Scottish Government which includes wildlife diseases and collaborates with APHA to support statutory disease control schemes. More specifically, SRUC delivers wildlife disease surveillance and forensic investigations in Scotland through post-mortem examinations, diagnostic testing, site visits, wild bird surveillance for Avian Influenza Virus (AIV) and West Nile virus (WNV), and samples to SASA for chemical analysis of suspected poisoning cases. SRUC is a wildlife surveillance data partner and supplies VIDA coded data to the APHA for the wildlife dashboards.

Natural England

Natural England is an executive non-departmental public body, sponsored by Defra. It acts as the government's adviser for the natural environment in England. Natural England works to help conserve, enhance and manage the natural environment, thereby contributing to sustainable development. The agency commissions wildlife disease surveillance work through collaborations with other organisations.

Zoological Society of London (ZSL)
ZSL is a science-driven conservation charity working to restore wildlife in the UK and globally. ZSL conducts conservation and research activities through its zoos, work in the field and The Institute of Zoology (IoZ). There is a contract in place between APHA and the Institute of Zoology for the Provision of Wildlife Scanning Surveillance. These surveillance activities are delivered through the Garden Wildlife Health project for reporting services, specialist advice services to the wildlife expert group, post-mortem examinations and laboratory investigations, threat notification, and other communications. Additionally, the UK Cetacean Strandings Investigation Programme (CSIP) managed at ZSL, contributes information to the GBWHP and collaborates with APHA DoWS. CSIP coordinates the investigation of all cetaceans, marine turtles, basking sharks and seals that strand around the English and Welsh coastline, as funded by Defra and the devolved administrations. ZSL has a partnership with Natural England, the Disease Risk Analysis and Health Surveillance (DRAHS) project which investigates the risks from disease in undertaking conservation translocations, and other conservation interventions, mitigates risks through disease risk management and carries out post-release health surveillance. In addition, health surveillance is undertaken on small populations of threatened species.

Garden Wildlife Health project (GWH)

GWH is a collaborative project between the ZSL, the British Trust for Ornithology (BTO), Froglife and the Royal Society for the Protection of Birds (RSPB). The GWH project acts to monitor disease trends and investigate new and emerging threats to the health of garden wildlife, with focus on amphibians, reptiles, garden birds and hedgehogs. GWH receives funding from Defra and the Welsh Government through APHA's Diseases of Wildlife Scheme Scanning Surveillance Programme, in addition to other funding sources. GWH is also a wildlife surveillance data partner, supplying VIDA coded data to APHA for the wildlife dashboards. Sick or dead garden wildlife can be reported to GWH using their online system.

Wildfowl and Wetlands Trust (WWT)

WWT is on a mission to restore wetlands and unlock their power. Their vision is a world where healthy wetland nature thrives and enriches lives. Founded by Sir Peter Scott in 1946, the charity is dedicated to finding solutions and inspiring change. For wetlands. For life. Using scientific evidence, WWT delivers wildlife disease surveillance through post-mortem examinations and diagnostic testing of wild birds, and wild bird surveillance for AIV across its reserves in England, Wales and Scotland.

Centre for Environment, Fisheries and Aquaculture (Cefas)

Cefas is an Executive Agency of Defra that applies scientific expertise to support the health of marine and freshwater ecosystems. Cefas devises innovative solutions to ensure a sustainable future for rivers, seas and the ocean. More specifically, Cefas works to maintain the health of wild and farmed aquatic species, important for the protection of natural capital and the role of sustainable aquaculture in global food security. It provides data and advice to the UK government and overseas partners. Cefas hosts several external global designations including: the FAO International Reference Centre for Antimicrobial Resistance (AMR); the WOAH Collaborating Centre for Emerging Aquatic Animal Disease; WOAH Reference Laboratory for Koi Herpes Virus (KHV) and Spring Viraemia of Carp Virus (SVCV) and host the UK government's Fish Health Inspectorate.

Forestry England

Forestry England is an executive agency, sponsored by the Forestry Commission, responsible for managing and promoting publicly owned forests in England. It operates under the Forestry Act 1967 and other legislation in respect of management of the nation's forests. Forestry England manages forests to provide benefits for people, nature and the economy. These benefits include public access to outdoor locations for leisure activities, vital habitats for wildlife, a source of sustainable timber and a means of capturing carbon to help mitigate climate change. The agency collaborates with other organisations to facilitate wildlife disease surveillance activities.

Veterinary
Medicines
Directorate

Veterinary Medicines Directorate (VMD)

The VMD is an executive agency, sponsored by Defra that protects animal health, public health and the environment. The VMD promotes animal health and welfare by assuring the safety, quality and efficacy of veterinary medicines. Their work also helps the Food Standards Agency to protect and improve the safety of food for human consumption. The VMD has a wide range of responsibilities that include i) addressing reports of adverse events from veterinary medicines, ii) testing for residues of veterinary medicines or illegal substances in animals and animal products, iii) authorising companies to sell veterinary products, iv) controlling the manufacture and distribution of veterinary medicines, v) providing advice to government on developing veterinary medicines policy and vi) management and enforcement of the Veterinary Medicines Regulations. The VMD also takes a leading role in the cross-government Pharmaceuticals in the Environment (PiE) Group, created to enable discussion and knowledge exchange relating to pharmaceuticals in the environment from human, veterinary and, where relevant, agricultural and non-agricultural sources.

Overview

The role of wildlife disease surveillance in Great Britain

Disease surveillance of wild mammals, birds, amphibians and reptiles in Great Britain is mainly achieved by post-mortem examination and ancillary diagnostic testing of wild animals found dead, known as scanning surveillance. Carcases are submitted for mortality investigations to APHA DoWS in England and Wales via veterinary investigation centres and surveillance pathology partners, to SRUC in Scotland, and to other Great Britain Wildlife Health Partnership (GBWHP) members, as explained below. Additionally, targeted surveillance of wildlife is done by the proactive sampling of wild animal species aimed at detecting a particular disease or pathogen (virus, bacteria, parasite, fungi or prion). This type of surveillance often involves collaborations and is delivered within research projects.

The GBWHP provides pathological and diagnostic expertise for terrestrial and aquatic wildlife species that may be affected by a range of infectious and non-infectious diseases. Garden Wildlife Health (GWH) project focuses on garden birds, amphibians, reptiles and hedgehogs. UK Cetacean Strandings Investigation Programme (CSIP) investigates mortalities of cetaceans, seals, basking sharks and sea turtles. APHA DoWS and SRUC both receive wild mammals and wild birds. Wildfowl and Wetlands Trust (WWT) conducts disease surveillance of wild birds at its sites. The Centre for Environment, Fisheries and Aquaculture (Cefas) provides expertise for fish and shellfish to maintain the health of wild and farmed seafood.

Why is wildlife disease surveillance important? It is essential for the early detection and investigation of new or re-emerging threats to wildlife. These threats may be from novel diseases or pathogens, a change in endemic disease (an ongoing occurrence of disease in a population of animals within a country), a new pathogen variant, exotic (diseases that are not usually present in a country) or notifiable diseases (diseases that must be reported to the government by law), and zoonotic diseases (infectious diseases that are transmitted from animals to humans). Other threats include toxicities or unusual antimicrobial resistance patterns. Diseases of wildlife that can spread to domestic animals and humans are prioritised, and those affecting wildlife at population scale or threatened species of conservation concern. The information gained allows for the mitigation of impact on public health, domestic animal health, wildlife health and the environment under a One Health approach. At least 60% of human emerging infectious diseases are zoonotic, with an estimated 72% of these originating in wildlife (Jones and others, 2008). Wildlife disease surveillance improves our understanding of the epidemiology of zoonotic diseases at the wildlife-livestock-human interface.

References

Jones KE, Patel NG, Levy MA, Storeygard A, Balk D, Gittleman JL, Daszak P. Global trends in emerging infectious diseases *Nature* 2008;**451**:990 to 993.

Wildlife submissions 2024

APHA Diseases of Wildlife Scheme, SRUC and Garden Wildlife Health Project received 2123 wildlife submissions from carcases and samples in 2024, as part of the scanning disease surveillance programme.

The wildlife submissions are listed below, as the number of submissions per species, with 218 mammals (Table 1), 22 amphibians (Table 2), 8 reptiles (Table 2) and 1875 wild birds (Table 3). The count is by submission and not by carcase, in all the tables below and shows ranked data. A single submission may often contain multiple carcasses. This data set only includes routine diagnostic submissions and does not include project work that is not for the purpose of scanning surveillance. These submissions provide data on diagnosis of diseases using the VIDA (Veterinary Investigation Diagnosis Analysis) coding system, as shown in the Appendix, which only includes submission from APHA, SRUC and GWH.

Some wildlife samples are registered at other departments at APHA for targeted disease surveillance, such as Coronavirus testing of wildlife species, European bat lyssaviruses testing of bat species, *Trichinella* species testing of wild boar, *Echinococcus* and *Taenia* species testing of red foxes, *Mycobacterium bovis* testing of wildlife and avian influenza surveillance of wild mammals. These samples are not included in the wildlife submission tables below. Only a subset of the wild birds testing positive for avian influenza virus have been included in this summary of wild bird submissions (those received at the APHA Veterinary Investigation Centres). More information is provided in the Appendix.

Table 1: number of mammalian submissions by species

Common Name	Submission Count
European hedgehog	64
Grey seal	45
Fox	30
Red squirrel	22
Roe deer	11
Badger	8
Beaver	6
Eurasian otter	6
European rabbit	6
Brown hare	4
Common/harbour seal	4
Seal unspecified	3
Deer unspecified	2
Muntjac deer	2
Grey squirrel	1
Mountain hare	1
Pine marten	1
Red deer	1
Sika deer	1

Table 2: number of bird submissions by species[1]

Common Name	Submission count
Herring gull	298
Mute swan	297
Sparrowhawk	133
Common buzzard	132
Tawny owl	80
Canada goose	71
Mallard	58
Kestrel	51
Feral pigeon / Rock dove	49
Gull unspecified	44
Barn owl	41
Woodpigeon	40
Common gull	39
Red kite	35
Northern gannet	33
Lesser black-backed gull	29
Guillemot	25
Swan unspecified	23
Greylag goose	21
Blackbird, Whooper swan	20
Greenfinch	19
Black-headed gull	16
Kittiwake	15
Carrion crow, Common pheasant (feral)	13
Cormorant, Rook	12
Chaffinch, Curlew, Shag	10
Great black-backed gull, Peregrine	9
Siskin	8
Common starling, Dove unspecified, Golden eagle, Goldfinch, House sparrow	7
Duck unspecified, Goose unspecified, Hen harrier, Oystercatcher, Puffin	5
Arctic tern, Bird unspecified, Pigeon unspecified, Razorbill, Western osprey	4
Barn swallow, Bullfinch, Domestic duck (feral), Fulmar, Goshawk, Great spotted woodpecker, Grey heron, Magpie, Red-legged partridge (feral), White-tailed eagle	3
Barnacle goose, Bewick's swan, Bird of prey unspecified, Black swan (feral), Blue tit, Common tern, Coot, Egyptian goose, Eider, Jackdaw, Lapwing, Mediterranean gull, Pink-footed goose, Red (willow) grouse, Shelduck, Teal, Woodcock, Wren	2
Brambling, Brent goose, Common scoter, Crow unspecified, Dunnock, Falcon unspecified, Goldcrest, Goosander, Goose (feral), Great crested grebe, Great northern diver, Great tit, Great white egret, Hawk unspecified, Heron unspecified, Hobby, House martin, Little egret, Long-eared owl, Manx shearwater, Montagu's harrier, Moorhen, Nightjar, Pied flycatcher, Quail, Robin, Sandwich tern, Short-eared owl, Shoveler, Song thrush, Thrush unspecified, Tufted duck, Waxwing, Yellow-legged gull	1

[1] For Table 2, where multiple species are listed in a row then the submission count is for each of the species listed, not a total.

Table 3: number of amphibian and reptile submissions by species

Common Name	Submission Count
Common frog	8
Great crested newt	5
Smooth newt	3
Palmate newt	1
Common toad	5
Slow worm	2
Adder	5
Grass snake	1

Hot topics

APHA and GWH Arterivirus infection in European hedgehogs

Following the detection of a novel hedgehog arterivirus associated with neurological disease and mortality in a wildlife hospital in Great Britain, a collaborative investigation was initiated to elucidate the impacts of this virus on hedgehog health.

Following a multiple mortality event of European hedgehogs (*Erinaceus europaeus*) displaying neurological signs at a wildlife rescue centre in England in autumn 2019, a novel hedgehog arterivirus 1 (HhAV-1) was detected in the affected animals (Dastjerdi and others, 2021). Subsequently, a collaborative investigation was initiated including the APHA, the International Zoo Veterinary Group, and GWH to investigate whether this virus was the cause of the observed encephalitis at this, and other, wildlife rehabilitation centres in England (Lean and others, 2024). Therefore, microscopic examinations were conducted in tandem with RNA *in situ* hybridisation to evaluate the association of HhAV-1 with neurological disease. HhAV-1 RNA was found to be present in areas with encephalitis, suggesting a link between viral infection and inflammation (Figure 1), which ultimately supports HhAV-1 as the potential cause of the observed neurological disease in these captive hedgehogs. Additionally, HhAV-1 RNA was detected in various other organ systems, including respiratory tract, kidney, and blood vessels, which indicates viral transmission might occur via bodily fluids.

HhAV-1 was also detected at comparatively lower viral load in a number of hedgehogs which were found dead due to road traffic collision or predation in the wild. In the subset of these animals where brain was examined, no evidence of histological lesions or viral labelling was observed, and therefore the significance of this viral presence to hedgehog health remains unknown in these cases. Since large numbers of hedgehogs are admitted to wildlife care centres in Great Britain for treatment and rehabilitation, and subsequent release into the wild each year (Mullineaux and Pawson, 2023), there is an urgent need to further investigate the threat that HhAV-1 infection may pose to this species of conservation concern. Meanwhile strict biosecurity measures (such as hygiene and quarantine) are recommended as a routine during hedgehog rehabilitation, combined with husbandry protocols to minimise stress and the duration of time in captive management, to mitigate the risks of pathogen transmission within and between wildlife species.

More information on arteriviruses in hedgehogs can be found in the Garden Wildlife Health hedgehog arterivirus factsheet.

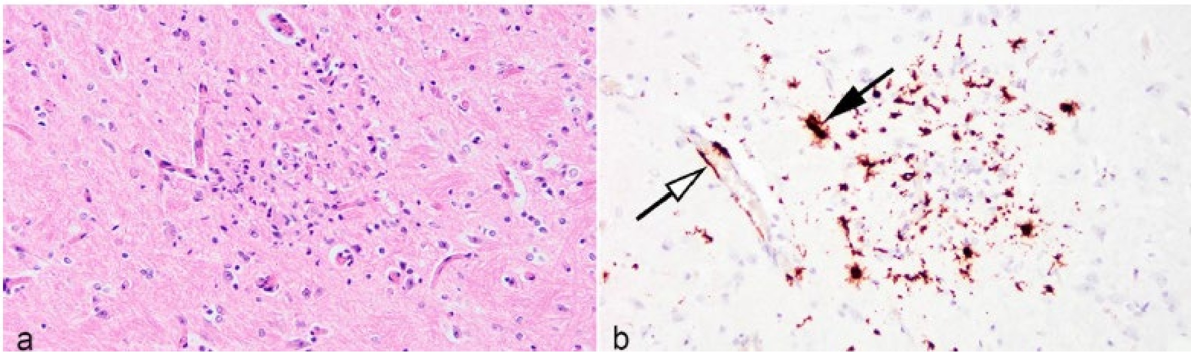

Figure 1: Histopathology images show the microscopic view of the cerebral neuropathology associated with hedgehog arterivirus 1 (HhAV-1) infection in a European hedgehog (*Erinaceus europaeus*). (a) Haematoxylin and eosin staining: Multifocal glial nodules in the neuroparenchyma; (b) HhAV-1 *in situ* hybridization: Localisation of viral RNA frequently seen in glial cells (solid arrow) and occasionally within the vascular endothelium (open arrow) (Lean and others, 2024).

References

Dastjerdi A, Inglese N, Partridge T, Karuna S, Everest DJ, Frossard JP, Dagleish MP, Stidworthy MF. Novel arterivirus associated with outbreak of fatal encephalitis in European hedgehogs, England, 2019. *Emerging Infectious Diseases* 2021;**27**(2):578 to 581.

Lean FZ, Stidworthy MF, Dastjerdi A, Partridge T, Smith S, Gough J, Núñez A, Lawson B, Seilern-Macpherson K. Colocalization of hedgehog arterivirus 1 (HhAV-1) and histologic lesions in the European hedgehog (*Erinaceus europaeus*) with neurological disease. *Veterinary Pathology* 2024;1 to 12.

Mullineaux E, Pawson C. Trends in admissions and outcomes at a British wildlife rehabilitation centre over a ten-year period (2012–2022). *Animals* 2023;**14**(1):86.

CSIP and APHA investigation of grey seal mortalities

An unusual mortality event in grey seals (*Halichoerus grypus*) along the North Yorkshire coastline triggered a rapid collaborative response to investigate the incident.

From mid-September to early October, the collaborative CSIP received reports of higher than normal numbers of dead grey seals along the North Yorkshire coastline. Over 30 seals were reported over this period (Figure 2), representing an approximately three-fold increase on the numbers reported over the same period during 2023 (data CSIP database). Anecdotal reports received from a variety of sources also suggested potential contemporaneous increases in seal mortality from Norfolk to Northumberland.

CSIP undertook field necropsies (6 seals) and sampling (10 seals) on grey seals from the North Yorkshire region that had been centrally recovered to Scarborough prior to disposal. There was a preponderance of adult males and examined animals appeared to be in good nutritional condition, with no evidence of recent feeding and no evidence of anthropogenic trauma. Three of 6 necropsied seals had extensive pyothorax and 4 had deeply congested lungs (Figure 2). *Streptococcus equi* subspecies *zooepidemicus* (*S. zooepidemicus*) was subsequently cultured in 4 of the necropsied seals in septicaemic distribution. Additional recoveries and necropsies of several adult grey seals stranded on the North Sea coast to the north and south of Scarborough did not find similar pathology. Numbers of reported cases of seal mortality across North Yorkshire declined rapidly and returned to more normal levels from mid-October.

This bacterium has been previously implicated in epidemic outbreaks in dogs (Priestnall and Erles, 2011), causing acute haemorrhagic pneumonia, which concurs with pathology observed during this event. *S. zooepidemicus* was also previously detected in North Sea seal populations during the phocine distemper virus (PDV) outbreak in European seals of 2002/03 (Akineden and others, 2007; Numberger and others, 2021). Given the prior evidence of *S. zooepidemicus* in European seals during the last PDV epizootic, there was some concern that infection in these cases may have been secondary to immunosuppression from another cause, such as viral co-infection or contaminant exposure.

CSIP subsequently sent samples from 9 seals (6 from North Yorkshire and 3 from elsewhere on the North Sea coast) to the APHA laboratories at Weybridge for further diagnostic testing. Test results were negative for High Pathogenicity Influenza A virus of avian origin and phocine morbillivirus. Next generation sequencing showed no pathogens commonly shared across all animals tested. Samples collected by CSIP during these investigations will also be provided for contaminant analyses, where available funding permits.

The identification of *S. zooepidemicus* has implications for public and animal health, since it is a zoonotic pathogen and cross-species transmission of infection to humans and dogs may potentially occur from close contact with seals.

This current minor incident reflects well on Great Britain's ability to detect seal disease outbreaks in the early stages through the established surveillance systems. The collaborative approach and cross-organisational communications enabled the escalation of key information through policy teams to government. However, this incident does highlight the challenges that another PDV epizootic would bring. Given that it has been over 20 years since the last outbreak (Lawson and Jepson, 2003), the vast majority of seals in Britain will have no immunity to PDV infection, with some literature suggesting "PDV re-introduction in this area may cause a major epizootic with infection of over 80% and mass-mortality of over 50% of the population." (Bodewes and others, 2013).

Consequently, the formulation of a strategy for dealing with a significant disease outbreak resulting in death of hundreds to thousands of seals along the British coastline is indicated. Carcase reporting, diagnostic testing, carcase disposal, clear lines of communication, and protection of public and companion animal health will all be essential for a large-scale mortality event.

Figure 2: Photograph of multiple dead adult grey seals recovered to Scarborough from the surrounding North Yorkshire coastline over a 2-week period, prior to field necropsies conducted on 3 October 2024 (left hand image). Post-mortem examination with the thorax opened to demonstrate pyothorax in the thoracic cavity of grey seal carcase SS2024/434 (right hand image). Images credit: CSIP, ZSL

References

Akineden Ö, Alber J, Lämmler C, Weiss R, Siebert U, Foster G, Tougaard S, Brasseur SMJM and Reijnders PJH. Relatedness of *Streptococcus equi* subsp. *zooepidemicus* strains isolated from harbour seals (*Phoca vitulina*) and grey seals (*Halichoerus grypus*) of various origins of the North Sea during 1988–2005. *Veterinary Microbiology* 2007;**121(1 to 2)**:158 to 162.

Bodewes R, Morick D, van de Bildt MW, Osinga N, Rubio García A, Sánchez Contreras GJ, Smits SL, Reperant LA, Kuiken T, Osterhaus AD. Prevalence of phocine distemper virus specific antibodies: bracing for the next seal epizootic in north-western Europe. *Emerging Microbes and Infections* 2013;**2(1):**e3.

Lawson B and Jepson PD. The investigation of a PDV epizootic in the UK during 2002/03. Published 2003 on Science Search.

Numberger D, Siebert U, Fulde M, and Valentin-Weigand P. Streptococcal Infections in Marine Mammals. *Microorganisms* 2021;**9(2)**:350.

Priestnall S and Erles K. *Streptococcus zooepidemicus*: an emerging canine pathogen. *The Veterinary Journal* 2011;**188(2)**:142 to 8.

APHA European brown hare syndrome in Cumbrian hares

In April 2024, 3 brown hares (*Lepus europaeus*) were found dead over a period of one week at a caravan site in Cumbria. Two female hares were subsequently submitted to Penrith Veterinary Investigation Centre for mortality investigations.

Post-mortem examination showed both hares were in good body condition (Figure 3), with lesions restricted to haemorrhages around the ovary and uterus (both animals were pregnant). Electron microscopy conducted at APHA Weybridge revealed both animals had calicivirus particles in their livers. This was later confirmed as European brown hare syndrome virus (EBHSV) by PCR at the Moredun Research Institute. The incident probably represents the first definitive detection of the virus in the county of Cumbria.

Figure 3: Two dead female brown hares submitted to Penrith VIC showing their external appearance prior to post-mortem examination of internal organs,

The virus was first detected in Great Britain by a predecessor agency of the APHA in 1989 (Chasey D and Duff P, 1990). EBHSV typically causes localised outbreaks of disease in hares, often with high mortality. European Brown Hare Syndrome (EBHS) is the most frequent causes of disease, often nervous disease, and death in wild brown hares in Great Britain. Affected animals show a variety of clinical signs indicative of nervous disease caused by hepatic encephalopathy (metabolic neurologic disorder that develops secondary to liver disease) and associated with liver pathology (Henriksen and others, 1989). Typical clinical signs include dullness, ‘lack of fear’, circling and convulsions. EBHSV can present as different epidemiological patterns, linked to population dynamics (Duff and others, 2024).

The diagnosis of EBHS by the APHA DoWS has been sporadic with occasional years when multiple deaths have been recorded (Figure 4), as the disease appeared to be most prevalent in years with long, dry summers. The years 1989 to 1990 had long, dry summers and were noteworthy for suspected EBHS epidemic incidents. Several of these were investigated and the average mortality in 8 incidents was 28 dead animals, with ‘most hares on the estate dead’ reported on several occasions (Duff and others, 2024).

Currently, the primary concern with EBHS disease is as a threat to the biodiversity of the brown hare. This species is protected in the UK under the Wildlife and Countryside Act, 1981. It is also listed as a Priority Species under the UK Post-2010 Biodiversity Framework due to long-term population declines of brown hares in England. Read more about EBHSV and other lagoviruses of interest in the recent [Veterinary Record Surveillance Focus article](#).

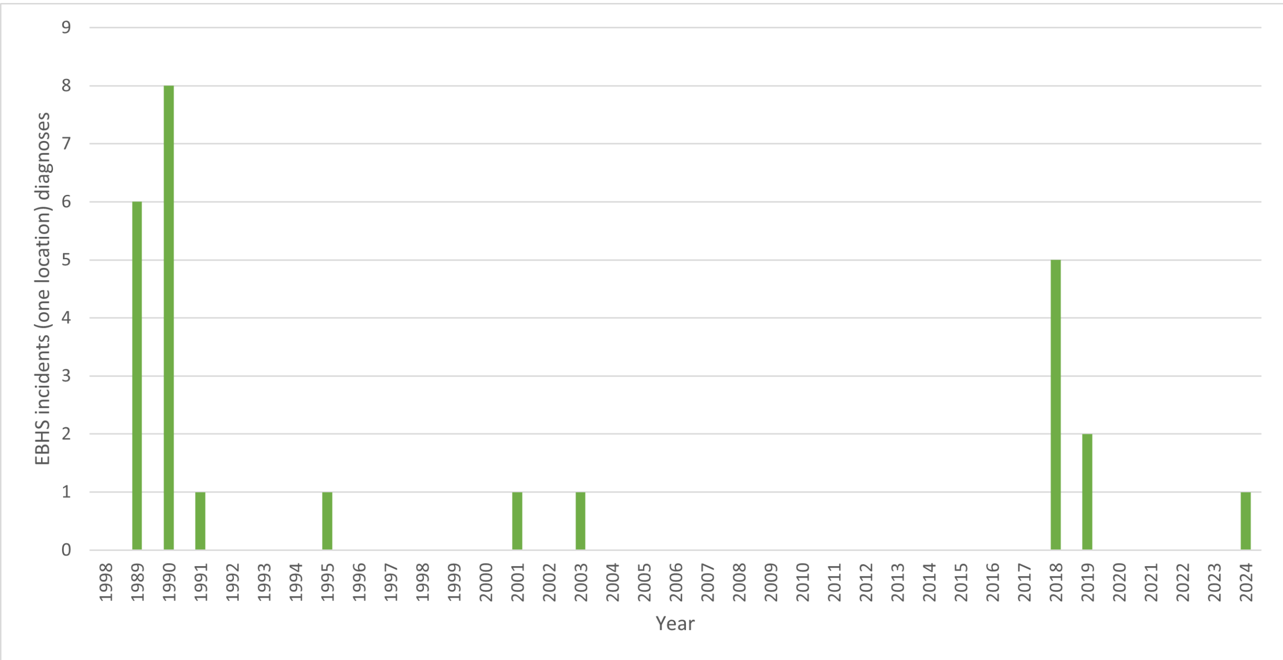

Figure 4: Histogram to show the APHA VIDA (Veterinary Investigation Diagnosis Analysis) diagnoses of EBHS incidents (from separate locations) sent to veterinary investigation centres from 1988 to 2024.

References

Chasey D and Duff J P. European brown hare syndrome and associated virus particles in the UK. *Veterinary Record* 1990;**126**(25):623 to 624.

Duff P, Everest D, Martindale L., Barlow A., Rocchi M. and Lavazza A. [European brown hare syndrome virus and other lagoviruses of interest.](#) *Veterinary Record* 2024;**195**:369 to 370.

Henriksen P, Gavier D. and Elling F. Acute necrotising hepatitis in Danish farmed hares. *Veterinary Record* 1989;**125**:486 to 487.

APHA Corvid reovirus in carrion crows

An investigation into the sudden deaths of 7 carrion crows held captive in a rescue centre diagnosed corvid reovirus – a rare cause of mortality of corvids in Great Britain.

In early August 2024, a corvid rescue and rehabilitation centre in England lost 7 carrion crows (*Corvus corone*) within 48 hours during a period of warm weather. Whilst many of these birds appeared to die suddenly with no apparent premonitory clinical signs, some were observed to become lethargic and recumbent shortly before death. It was noted that 14 crows had lost more than 5% of their body weight at their August weigh in, with half of these losing between 14% and 24% of their body weight. However, no abnormal droppings were seen in the aviaries and their food intake appeared normal. Four of the birds that died showed weight loss of 10 to 25% of their bodyweight preceding death. All those that survived showed an increase of body weight to ‘normal’ in the months following the deaths.

Birds were fed raw (minced meats and chicken hearts) and dry (dog and cat kibble and mealworms) pet foods with additional human food (cooked meats, egg and bread). The captive crows (Figure 5) had access to clean fresh water and the aviaries were enclosed with solid roofs allowing no direct or indirect contact with wild birds.

Three of the deceased crows (one male, 2 female, aged 5 months to 2 years) were submitted for post-mortem examination to the University of Liverpool Surveillance Pathology Centre under the APHA Diseases of Wildlife Scheme after suspicion of avian influenza had been ruled out.

Figure 5: Two adult carrion crows held in an aviary at the rescue centre.

The most significant pathology observed was in the spleen and intestine of each of the 3 birds submitted. Severe subacute multifocal fibrinonecrotising splenitis and severe subacute multifocal fibrinonecrotising and haemorrhagic enteritis was diagnosed. Comprehensive bacteriology was carried out on samples from one bird - *Enterococcus faecalis* and *Escherichia coli* were isolated in profuse growth from spleen and lung tissues. Histopathology indicated that this likely reflected either terminal bacteraemia post-mortem contamination or both. Parasitology demonstrated that the youngest bird had *Capillaria* sp. worms in the intestine. PCR was negative for West Nile virus and Usutu virus in all birds.

Previously necrotising enteritis and splenic necrosis have been described in association with orthoreovirus infection in corvids in a syndrome known as 'Winter Mortality of Crows' in North America (Forzán and others*,* 2019). For this reason, samples from these birds were tested with a pan-Reovirus PCR at APHA labs. Spleen, liver and intestine samples from each of the 3 birds were positive in the pan-Reovirus PCR. Virus particles of size, shape and available surface morphology consistent with orthoreoviruses were also detected by transmission electron microscopy in spleen, liver and intestinal samples (Figure 6). Follow up DNA sequencing confirmed the orthoreovirus and partial sigma C gene sequence analysis (237 nucleotides) showed matches to avian orthoreovirus from crows in North America and Japan (maximum identity of 84%).

Disease in wild corvids caused by avian orthoreovirus has previously been reported in magpies in the UK (Lawson and others, 2015). There is limited understanding of the disease epidemiology and impact, and the potential of transmission between wild birds and domestic poultry is unknown. In America incidents of orthoreovirus associated mortality in wild corvids appear to occur during cold weather, leading to the suggestion that subclinical infection may become clinically significant when birds are stressed, debilitated or immunosuppressed. Stress factors prior to rescue (for example, starvation, illness) and recent unseasonally high temperatures may have contributed to disease in these rescued crows. Whether this virus is present in non-symptomatic crows of the same cohort and the relationship of this virus to other orthoreoviruses of crows requires further study.

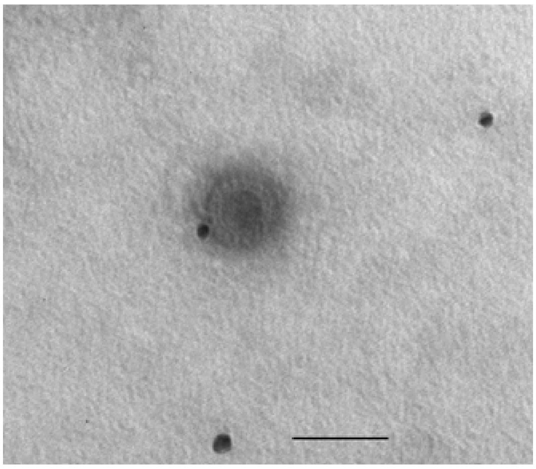

Figure 6: Transmission electron microscopy image to show the reovirus particle detected in spleen from one of the carrion crows submitted for post-mortem examination. The bar line is equal to 100 nanometres. Image credit: Dave Everest, APHA Weybridge.

This case was reported in the Vet Record (APHA, 2025).

References

APHA. Disease surveillance in England and Wales, April 2025. Corvid orthoreovirus identified in carrion crows. *Veterinary Record* 2025;**196**: 348-352.

Forzán MJ, Renshaw RW, Bunting EM, Buckles E, Okoniewski J, Hynes K, Laverack M, Fadden M, Dastjerdi A, Schuler K, Dubovi EJ. A novel orthoreovirus associated with epizootic necrotizing enteritis and splenic necrosis in American crows (*Corvus brachyrhynchos*). *Journal of Wildlife Diseases* 2019;**55**(4):812 to 822.

Lawson B, Dastjerdi A, Shah S, Everest D, Núñez A, Pocknell A, Hicks D, Horton DL, Cunningham AA and Irvine RM. Mortality associated with avian reovirus infection in a free-living magpie (*Pica pica*) in Great Britain. *BMC Veterinary Research* 2015;**11**:20.

Wildlife disease surveillance

APHA Avian influenza wild bird surveillance

During 2024, avian influenza (bird flu) continued to globally impact wild bird populations, causing mass mortality incidents of birds on multiple continents. In some countries, this led to occurrences of avian influenza infection spilling over into mammals, with subsequent disease outbreaks and deaths.

Highly pathogenic avian influenza (HPAI) H5N1 and H5N5 virus variants predominantly circulated in continental Europe leading to virus incursions into Great Britain. Both HPAI H5N1 and H5N5 cases occurred in British wild bird populations during 2024, predominantly in seabirds, waterfowl (Figure 7) and raptors.

APHA carries out year-round surveillance of dead wild birds submitted via public reports and warden patrols as part of its avian influenza wild bird surveillance programme. In 2024, the HPAI H5N1 variant was detected in 27 birds of 10 species, whilst the H5N5 variant was detected in 100 birds of 18 species in Great Britain. The APHA publishes reports (updated weekly) on findings of HPAI in wild birds in Great Britain that summarise the avian influenza data for 2024. These surveillance figures are based on passive surveillance of dead wild birds reported to Defra. As such, these figures may be affected by several factors including frequency of people visiting areas with bird populations, the potential for immunity in the wild bird population (which may result in fewer birds either developing clinical disease, dying with HPAI, or both), sensitivity of carcase detection due to the size and location of bird carcases. This means that wild bird surveillance cannot capture all HPAI cases that occur in wild birds.

In Great Britain members of the public are encouraged to report findings of dead wild birds using the online reporting tool or by calling the Defra helpline (03459 335 577). APHA triages reports and does not collect all birds. The collection thresholds for dead wild birds are adjusted for different species to increase or decrease the sensitivity of surveillance depending on the prevalence of HPAI at that time. APHA and their contractors then collect a proportion of birds and test them, not all dead wild birds are collected. This improves understanding of how avian influenza disease is distributed geographically and in different species of wild birds.

Further information on avian influenza in wild birds in Great Britain and across Europe are available via APHAs outbreak assessments. For visualisation of data, see the interactive map of reported wild bird mortality and findings of avian influenza virus in wild birds and wild mammals and an interactive data dashboard of findings of avian influenza virus in wild birds.

Find out more on disposing of dead wild birds not required for surveillance in APHAs Guidance on removing and disposing of dead wild birds.

Further guidance on wild bird incidents is available through the Mitigation strategy for avian influenza in wild birds in England and Wales.

Report dead wild birds in Northern Ireland to the DAERA Dead Wild Bird Online Reporting Tool.

Figure 7: Mute swans (*Cygnus olor*) are a waterfowl species commonly infected with HPAIV variants.

Reporting Suspicion of Influenza of Avian Origin in Wild Mammals

Avian influenza viruses can also infect mammals. Find out how we monitor spillover of Avian influenza (bird flu): infection in wild birds and wild mammals and our annual reporting for confirmed findings of influenza of avian origin in non-avian wildlife. In 2024, there were no findings of influenza of avian origin in non-avian wildlife in Great Britain.

If members of the public find a dead wild carnivore (for example, fox, otter, pine marten, stoat, weasel, pole cat, mink) or marine mammal (for example, seal, dolphin, porpoise, whale) where the cause of death is unknown, or the animal has shown signs of respiratory or neurological disease prior to death they should report it immediately to APHA by calling:
03000 200 301 if you're in England,
03003 038 268 if you're in Wales,
your local Field Services Office if you're in Scotland.

If you examine a wild mammal or a test a sample from a wild mammal and suspect or detect the presence of avian influenza virus or antibodies to avian influenza virus you must report it immediately to APHA using the telephone numbers above. If you do not report it, you're breaking the law. See our guidance on Influenza A (H5N1) infection in mammals: suspect case definition and diagnostic testing criteria.

WWT surveillance for avian influenza virus

WWT's role in Great Britian avian influenza targeted surveillance of wetland wild bird for threats such as highly pathogenic avian influenza virus (HPAIV) in 2024.

Throughout 2024, WWT continued to carry out passive surveillance of avian influenza (AI) across 9 reserves. Between January and December 2024, 183 dead wild birds were found across 9 WWT sites located in Gloucestershire, West Sussex, Greater London, Tyne and Wear, Lancashire, Norfolk, Somerset, Dumfriesshire and Carmarthenshire. Of the birds found 167 were sampled for avian influenza virus, with 16 carcases being too heavily predated, in an inaccessible location or in advanced decomposition to swab. Twenty priority target species were sampled during this period. These included species of swan, geese, grebes, ducks, gulls, herons, waders and rails. In addition, samples were also obtained from 8 non-priority species: 2 Eurasian cranes (*Grus grus*), 2 mandarin ducks (*Aix galericulata*), one carrion crow (*Corvus corone*), one cattle egret (*Bubulcus ibis*), one Eurasian curlew (*Numenius arquata*), one Egyptian goose (*Alopochen aegyptiaca*), one oystercatcher (*Haematopus ostralegus*) and one water rail (*Rallus aquaticus*).

HPAIV was confirmed by PCR in 4 dead wild birds, collected at 3 surveillance sites (Table 4). There were also 3 cases of low pathogenic avian influenza virus (LPAIV) detected at 4 surveillance sites (Table 5).

All carcases were swabbed and collected following recommended health and safety guidelines with full personal protective equipment, including FFP3 masks and goggles or face visors. Positive AI carcases were disposed of using an approved high-capacity incinerator for Category 1 animal by-products.

Table 4: Confirmed HPAIV H5N1 submitted cases in wild birds at different surveillance sites, detected in 2024

Site Location	Total HPAIV positive	Species	Strain
Tyne and Wear	1	1 x Black-headed gull	H5N5
Norfolk	2	1 x Mute swan 1 x Whooper swan	H5N1 H5N1
Carmarthenshire	1	1 x Mallard	H5N5

Table 5: Confirmed LPAIV HxNx submitted cases in wild birds at different surveillance sites, detected in 2024

Site Location	Total LPAIV positive	Species	Strain
West Sussex	1	1 x Canada goose	H5N1 (low pathogenicity)
Gloucestershire	1	1 x Mute swan	H9N2
Dumfriesshire	1	1 x Whooper swan	HxNx

WWT passive surveillance of waterbirds

Post-mortem examinations were performed on 160 wild birds (Figure 8) originating from 6 WWT sites (Arundel, West Sussex; Llanelli, Carmarthenshire; London Wetland centre, Greater London; Slimbridge, Gloucestershire; Martin mere, Lancashire and Welney). A total of 23 target species were examined, which included:

- 42 mallards (*Anas platyrhynchos*)
- 23 greylag geese (*Anser anser*)
- 13 whooper swans (*Cygnus cygnus*)
- 7 mute swan (*Cygnus olor*)
- 7 Eurasian moorhens (*Gallinula chloropus*)
- 6 Canada geese (*Branta canadensis*)
- 4 black-headed gull (*Chroicocephalus ridibundus*)
- 4 herring gulls (*Larus argentatus*)
- 4 tufted duck (*Aythya fuligula*)
- 4 Egyptian geese (*Alopochen aegyptiaca*)
- 3 pink-footed geese (*Anser brachyrhynchus*)
- 3 common pochard (*Aythya farina*)
- 3 northern lapwings (*Vanellus vanellus*)
- 3 Eurasian coots (*Fulica atra*)
- 2 common shelduck (*Tadorna tadorna*)
- One grey heron (*Ardea cinerea*)
- One great cormorant (*Phalacrocorax carbo*)
- One barnacle goose (*Branta leucopsis*)
- One Northern pintail (*Anas acuta*)
- One peregrine falcon (*Falco peregrinus*)
- One little grebe (*Tachybaptus ruficollis*)
- One lesser black-backed gull (*Larus fuscus*)
- One black-tailed godwit (*Limosa limosa*)

Eight non-target species were also examined: 10 rock pigeons (*Columba livia*), 3 oystercatchers (*Haematopus ostralegus*), 3 pheasants (*Phasianus colchicus*), 3 wood pigeons (*Columba palumbus*), 2 Eurasian cranes (*Grus grus*), one European robin (*Erithacus rubecula*), one Eurasian siskin (*Spinus spinus*) and one jackdaw (*Coloeus monedula).*

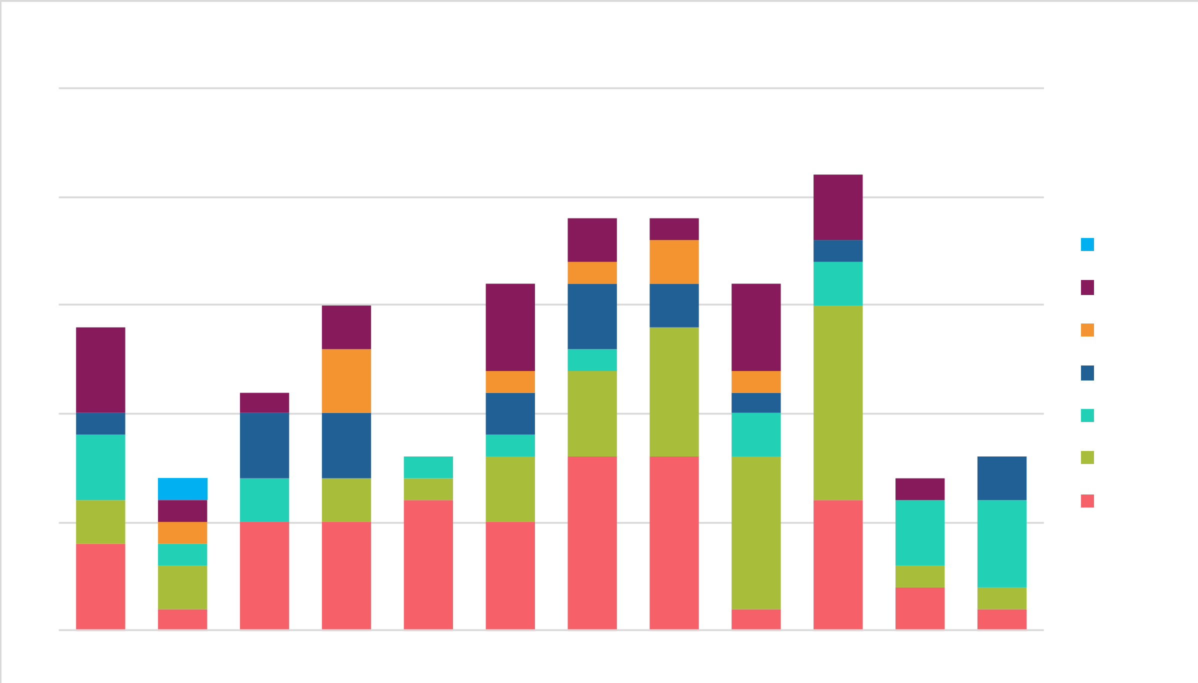

Figure 8: A bar chart showing the monthly ratio of bird groups submitted for post-mortem examinations in 2024. Duck species were the most frequently presented carcasses during the breeding season (spring and summer), while goose submissions increased towards the end of summer and early autumn. Swans were the predominant species examined in November and December. In the key, BOP refers to birds of prey.

The primary causes of death for the above mentioned species are summarised below (Table 6 and Figure 9). The most frequently identified aetiology was trauma-related mortality (34%). This category included cases of both intra- and inter-species aggression, suspected shooting incidents, and collisions. Predation was identified as another predominant primary cause of mortality (13%) for bird species listed in Table 6. The pattern of injuries suggested predation primarily by gulls and birds of prey, with mustelids and foxes implicated in fewer cases.

Lesions suggestive of avian mycobacteriosis were identified in 17 birds (11%), primarily among waterfowl and, less commonly, in 2 lapwings with all species listed in Table 6.

Severe enteric disease was identified in approximately 9% of the birds examined (Figure 9), with nearly half of these cases occurring in goose species during the autumn. These birds (species listed in Table 6) displayed clinical signs consistent with acute gastrointestinal disorder and systemic inflammation. Eight species of Columbiformes had large obstructive lesions in the upper digestive tract caused by trichomonosis (commonly known as 'canker') (Table 6).

Post-mortem examination of 6 whooper swans and one pink-footed goose (4%) revealed findings consistent with aspergillosis and air-sacculitis (Table 6). All individuals showed signs of widespread respiratory involvement and poor body condition. Concurrent conditions, such as pododermatitis or ‘bumblefoot’ were also observed in some cases.

A small proportion of cases (9%) exhibited less common causes of mortality (Figure 9). Notable examples included suspected botulism in a mallard, lead intoxication in a greylag goose, and electrocution in another greylag found beneath power lines. Other isolated findings included internal parasitism, reproductive complications, and suspected systemic infections. Species and notes on mortality are summarised in Table 6.

Table 6: Confirmed and suspected causes of wild bird mortality (including morbidity meriting euthanasia on welfare grounds) at WWT reserves between January and December 2024.

Primary cause of death or post-mortem findings	Total	Species (and notes)
Trauma (TR)	55	23 x mallard, 4 x Egyptian goose, 4 x greylag goose, 3 x tufted duck, 3 x whooper swan, 2 x mute swan, 2 x Eurasian coot, 2 x herring gulls, 2 x black-headed gull, 1 x Northern lapwing, 1 x grey heron, 1 x barnacle goose, 1 x Eurasian moorhen, 1 x peregrine, 1 x pheasant, 1 x racing pigeon, 1 x wood pigeon, 1 x European robin, 1 x European siskin
Predation (TP)	20	4 x mallard, 3 x pochard, 3 x Eurasian moorhen, 2 x greylag goose, 2 x rock pigeon, 1 x pink-footed goose, 1 x mute swan, 1 x black-tailed godwit, 1 x little grebe, 1 x shelduck,1 x oystercatcher
Avian tuberculosis (TB)	17	7 x mallard, 3 x greylag goose, 2 x Northern lapwing, 1 x common shelduck, 1 x Eurasian coot, 1 x Canada goose, 1 x Northern pintail, 1 x herring gull
Necrotic enteritis or severe enteritis (NE/EN)	15	4 x greylag goose, 2 x Canada goose, 2 x black-headed gull, 2 x oystercatcher, 2 x mute swan (+ 1 x LPAIV), 1 x great cormorant, 1 x mallard, 1 x pheasant,
Trichomonosis (TM)	8	6 x rock pigeon, 2 x wood pigeon
Aspergillosis and airsacculitis (AF/AS)	7	6 x whooper swan, 1x pink-footed goose
Visceral/articular gout (VG)	5	3 x greylag goose, 1 x mallard, 1 x pheasant
Malnutrition (starvation) (ST)	3	1 x mute swan, 1 x tufted duck, 1 x greylag goose,
Other (OT)	15	1 x greylag goose (cardiomegaly, bruised keel and internal parasite), 1 x mallard (egg peritonitis), 1 x whooper swan (vasculitis), 1 x greylag goose (hepatic bleed), 2 x Eurasian crane (possible pneumonia and septicaemia), 1 x whooper swan and 1 x mallard (internal parasites), 1 x mallard (botulism), 1 x Eurasian moorhen (drowned), 1 x greylag goose (electrocution), 1 x greylag goose (anaemia), 1 x rock pigeon (septicaemia), 1 x greylag (respiratory/intestinal obstruction), 1 x greylag goose (lead intoxication),
No diagnosis (ND) - due to decomposition or lack of or inconclusive gross abnormalities	15	4 x mallard, 2 x E.moorhen, 2 x whooper swan, 2 x Canada goose, 1 x pink footed goose, 1 x mute swan, 1 x jackdaw, 1 x herring gull, 1 x lesser black-backed gull

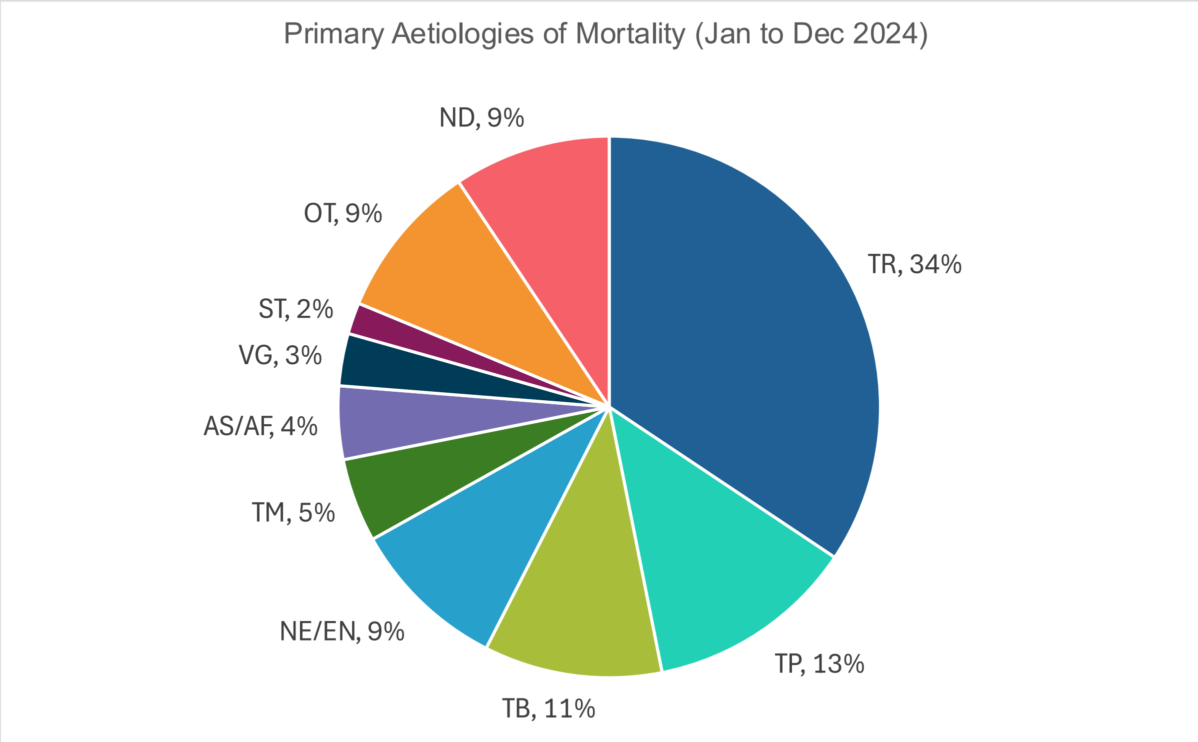

Figure 9: Pie chart to show the percentage ratio of confirmed and suspected primary causes of wild bird mortality at WWT reserves between January and December 2024. The highest percentage of mortality aetiology was due to trauma (34%).

APHA Coronavirus surveillance in GB wildlife

Coronaviruses (CoVs) are a diverse group of viruses capable of causing infections in animals and humans. Since the COVID-19 pandemic, the APHA acts as a National Reference Laboratory for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in animals in Great Britain (Seekings and others, 2024).

Bats are recognized as a natural reservoir species for CoVs, (Ruiz-Aravena and others, 2022) and many other wild species are known to be susceptible, potentially enabling spillover into human populations (Delahey and others, 2021). To mitigate these risks, APHA has implemented a CoV surveillance programme in wildlife, funded by Defra, with support from various stakeholders across Great Britain. Wildlife CoV surveillance is essential for early detection, understanding prevalence, identifying potential spillover events, and monitoring viral dynamics, thus supporting wildlife management and conservation (Apaa and others, 2023; Tan and others, 2023).

Coronavirus Surveillance in Bats across Great Britain

In 2024, 548 oral and rectal swabs from bat carcases across various species (received for Lyssavirus passive surveillance) were tested for CoVs. PCR and sequencing tests confirmed 29 CoV positive bats including MERS-like CoVs (brown long-eared bats), Sarbecovirus (lesser horseshoe bats), Embecovirus (common pipistrelle bats) and Pedacovirus (common pipistrelle bats), bringing the total CoV positive bats detected, since surveillance began in 2021, to 61 out of 1,317 (Table 7, Figure 10). None was positive for SARS-CoV-2.

Coronavirus Surveillance in Other Wildlife Species

In 2024, a total of 776 oro-nasal swabs were collected from a range of other wildlife species, including red foxes, European badgers, grey squirrels, American mink, and muntjac, roe, fallow and sika deer. None of the samples tested were positive by PCR for SARS-CoV-2. However, serum samples from 7 out of 429 animals (2 European badgers, one grey squirrel, 3 roe deer and one fallow deer) were positive by SARS-CoV-2 ELISA. Currently, these serological results require confirmation by SARS-CoV-2 virus neutralisation tests (VNT). Since surveillance began in 2021 the number of seropositive serum samples confirmed by VNT is 38 out of 2,150.

To date, the APHA coronavirus surveillance programme has found no evidence of active SARS-CoV-2 infection in the wildlife species studied. However, evidence to date suggests potential exposure to SARS-CoV-2 or an antigenically similar virus in some species. The programme confirmed the presence of related Alpha, Embecovirus, Sarbecovirus and MERS-like CoVs in some bat species, which have been previously reported in Great Britain (Apaa and others, 2023; Tan and others, 2023). Continued surveillance is anticipated to ensure early detection, risk assessment, and mitigation of potential spillover threats.

Table 7: Summary of Coronavirus detection in bats from Great Britain, between 2021 and 2024

Species	Total positive bats	Total bats tested
Common Pipistrelle	29	798
Soprano Pipistrelle	8	96
Nathusius's Pipistrelle	0	3
Daubenton's bat	4	47
Natterer's bat	4	20
Whiskered bat	0	28
Brown long-eared bat	15	240
Bechstein's bat	0	2
Serotine bat	0	38
Greater horseshoe bat	0	13
Lesser horseshoe bat	1	20
Noctule bat	0	7
Leisler's bat	0	5
Overall Totals	**61**	**1317**

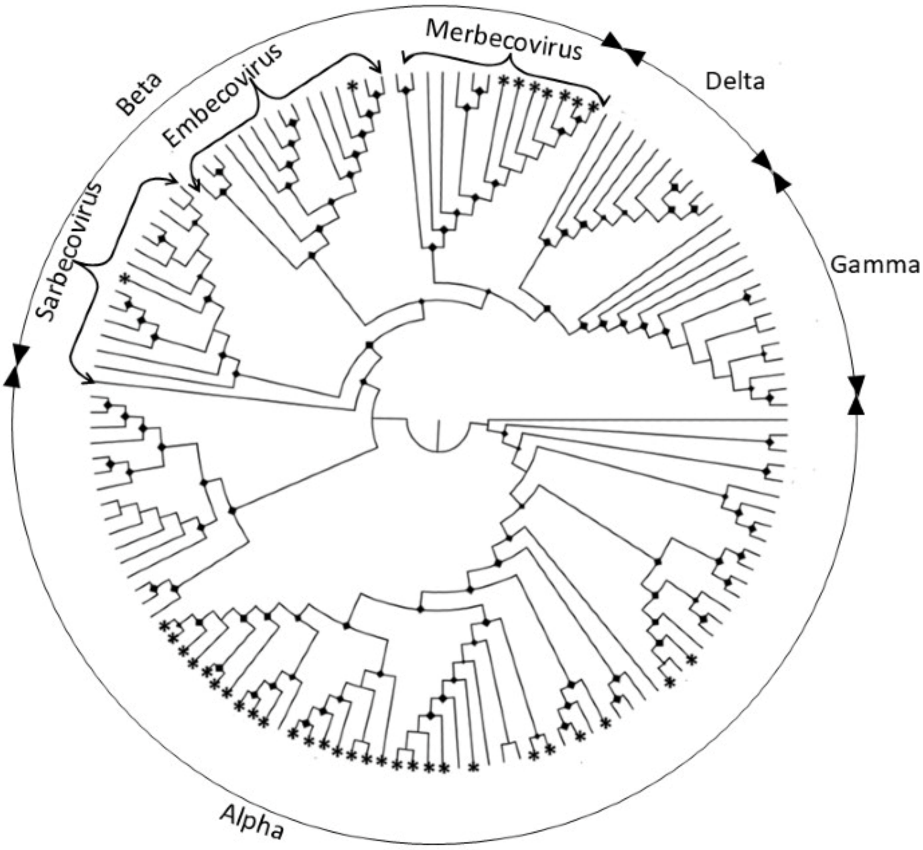

Figure 10: Phylogenetic tree using SARS-CoV-2 and other coronavirus reference sequences. Asterisks indicate MERS-like Merbecovirus, Embecovirus, and Sarbecovirus identified in this study. Diamond nodes represent bootstrap support values ≥70%.

References

Apaa T, Withers AJ, Staley C, Blanchard A, Bennett M, Bremner-Harrison S, Chadwick EA, Hailer F, Harrison SW, Loose M and Mathews F. Sarbecoviruses of British horseshoe bats; sequence variation and epidemiology. *Journal of General Virology* 2023;**104**(6):1859.

Delahay RJ, de la Fuente J, Smith GC, Sharun K, Snary EL, Flores Girón L, Nziza J, Fooks AR, Brookes SM, Lean FZX, Breed AC and Gortazar C. Assessing the risks of SARS-CoV-2 in wildlife | One Health Outlook | Full Text *One Health Outlook* 2021;**3**:7.

Ruiz-Aravena M, McKee C, Gamble A. et al. Ecology, evolution and spillover of coronaviruses from bats. *Nature Reviews Microbiology* 2022;**20**:299 to 314.

Seekings AH, Shipley R, Byrne AMP, Shukla S, Golding M, Amaya-Cuesta J, Goharriz H, Vitores AG, Lean FZX, James J, Núñez A, Breed A, Frost A, Balzer J, Brown IH, Brookes SM, and McElhinney LM. Detection of SARS-CoV-2 Delta Variant (B.1.617.2) in Domestic Dogs and Zoo Tigers in England and Jersey during 2021. *Viruses* 2021;**16**:4.

Tan CC, Trew J, Peacock TP, Mok KY, Hart C, Lau K, Ni D, Orme CDL, Ransome E, Pearse WD and Coleman CM. Genomic screening of 16 UK native bat species through conservationist networks uncovers coronaviruses with zoonotic potential. *Nature Communications* 2023;**14**(1):3322.

APHA Surveillance of wild bat populations for European bat lyssaviruses

In 2024, 10 wild bats native to the United Kingdom tested positive for European bat lyssavirus types 1 and 2.

Found dead wild bats routinely sent to APHA under the rabies passive bat surveillance programme are tested for lyssaviruses, a family of viruses that cause rabies disease. In 2024, 8 Serotine bats (*Eptesicus serotinus*) submitted from Southwest England (Dorset x 4, Somerset x 2 and Devon x 2) tested positive for European bat lyssavirus (EBLV) type 1, representing 25.8% of the 31 Serotine bats submitted. Some bats, whilst in rehabilitation centres, showed clinical signs of disease, including aggressive behaviour, lack of coordination and hyperactivity. Since the first detection of EBLV-1 in 2018 (Folly and others, 2021), the number of cases per annum has been increasing and geographically the virus has been spreading, albeit, localised to Southwest England (Figure 11).

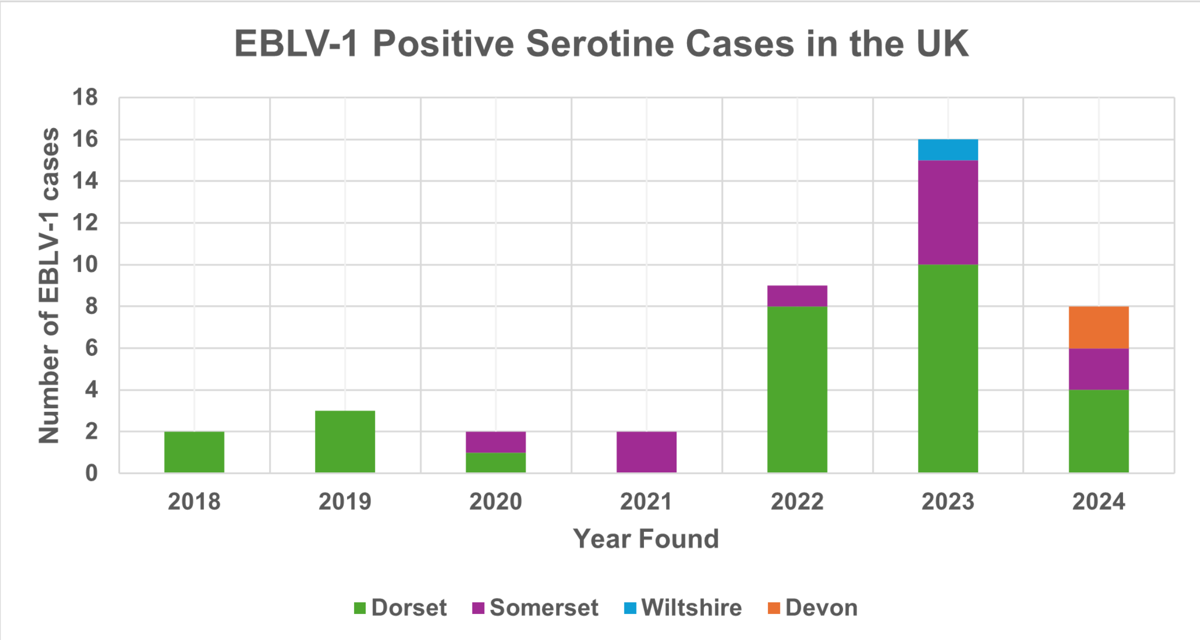

Figure 11: Graph showing the number and geographical location of EBLV-1 positive Serotine bats submitted annually to APHA since its first detection in 2018

Also in 2024, 2 Daubenton's bats (*Myotis daubentonii*) tested positive for EBLV type 2, representing 3.2% of the 63 Daubenton's bats submitted. Geographically, Daubenton's bats are found throughout the United Kingdom and subsequently, EBLV-2 is found more widespread as represented by these 2 cases (Lancashire and Somerset). Since the first case in 1996, EBLV-2 has routinely been found, at low levels, in the UK Daubenton's bat population (Wise and others, 2017). For further information on 2024 EBLV cases in UK wild bats, see Table 8.

Understanding the status of lyssavirus infection in bats allows Defra to manage risks posed by these viruses to human and animal health. The reported 4 animal contact cases in 2024 (Table 8), suggest a possible risk of spillover into animals, including domesticated cats and dogs, as reported previously (Dacheux and others, 2009). In previous years, submissions have been received with a report of human contact, that is, the bat has scratched or bitten an individual, suggesting a risk to public health (Regnault and others, 2022). Between 2007 and 2014 a cluster of EBLV-2 cases occurred at a tourist site in Shropshire. Public information notices were erected and regular sweeps of the area for bat carcasses were implemented to manage the risk of exposure to visitors and spillover to animals.

The rabies passive bat surveillance programme is funded by Defra through project SV3500. We would like to acknowledge the Bat Conservation Trust (BCT) for providing expertise on United Kingdom bat populations and supporting the passive surveillance programme and to the bat rehabilitators and public for submitting bats for testing. Further information on the rabies passive bat surveillance programme can be found on the Bat Rabies Dashboard.

Table 8: Supplementary information for the 10 lyssavirus positive bats submitted to APHA during 2024

Bat Species	Submitted From	Sex	Age	Clinical Observations	Contact
Serotine (EBLV-1)	Dorset	Male	Adult	Found dead	Animal
Serotine (EBLV-1)	Dorset	Female	Juvenile	None	Animal
Serotine (EBLV-1)	Somerset	Female	Juvenile	Biting	None
Serotine (EBLV-1)	Somerset	Male	Juvenile	None	None
Serotine (EBLV-1)	Devon	Male	Adult	Uncoordinated	None
Serotine (EBLV-1)	Devon	Female	Adult	Tremors, aggressive, uncoordinated	None
Serotine (EBLV-1)	Dorset	Female	Young Adult	Underweight, no swallowing	Animal
Serotine (EBLV-1)	Dorset	Female	Young Adult	Underweight, no swallowing	Animal
Daubenton’s (EBLV-2)	Lancashire	Male	Adult	Uncoordinated, biting	None
Daubenton’s (EBLV-2)	Somerset	Male	Juvenile	Biting, noisy	None

References

Dacheux L, Larrous F, Mailles A, Boisseleau D, Delmas O, Biron C, Bouchier C, Capek I, Muller M, Ilari F, Lefranc T, Raffi F, Goudal M, and Bourhy H. European bat lyssavirus transmission among cats, Europe. *Emerging Infectious Diseases* 2009;**15**: 280 to 284.

Folly AJ, Marston DA, Golding M, Shukla S, Wilkie R, Lean FZX, Nunez A, Worledge L, Aegerter J, Banyard AC, Fooks AR, Johnson N, and McElhinney LM. 2021. Incursion of european bat lyssaviruis 1 (EBLV-1) in Serotine bats in the United Kingdom. *Viruses* 2021;**13**(10):1979.

Regnault B, Evrard B, Plu I, Dacheux L, Troadec E, Cozette P, Chrétien D, Duchesne M, Vallat JM, Jamet A, Leruez M, Pérot P, Bourhy H, Eloit M, Seilhean D. 2022. First case of lethal encephalitis in Western Europe due to european bat lyssavirus type 1. *Clinical Infectious Diseases* 2022;**74**(3):461 to 466.

Wise EL, Marston DA, Banyard AC, Goharriz H, Selden D, Maclaren N, Goddard T, Johnson N, McElhinney LM, Brouwer A, Aegerter JN, Smith GC, Horton DL, Breed AC, Fooks AR. Passive surveillance of United Kingdom bats for lyssavirus (2005-2015). *Epidemiology and Infection* 2017;**145**(12):2445 to 2457.

APHA Orthoflavivirus surveillance in Great Britain

Repeated detection of Usutu virus in passerine hosts during the 2024 mosquito-active season.

Vector-borne disease is a term given to any disease where transmission between hosts is facilitated by another organism, for example, blood-feeding arthropods. Surveillance for vector-borne diseases under the Diseases of Wildlife Scheme, primarily focuses on arthropod-borne zoonotic viruses, especially Orthoflaviviruses, where wild birds are a primary host. Brain and kidney tissues from wild birds collected by APHA regional laboratories or SRUC are combined with submissions through the GWH project (co-ordinated by the Institute of Zoology - IoZ) for molecular screening undertaken by the Animal and Plant Health Agency. Since 2020, Usutu virus, a mosquito-borne viral zoonosis, which has been implicated in population decline of blackbird (*Turdus merula*) in Greater London, has established in southeast England (Folly and others, 2022; Lawson and others, 2022), highlighting the importance of continued surveillance to appraise risk to animal and public health. During 2024, samples from 835 wild bird post-mortem examinations were received through this sample stream and all submissions were negative for West Nile virus RNA. Three hundred and eighty-three of these submissions from passerines or raptors, species known to be susceptible to Usutu virus infection, were selected for additional testing: samples from these birds were also negative for Usutu virus RNA.

Since 2023 a United Kingdom Research Council funded 3 year project, independent from the Diseases of Wildlife Scheme, called 'Vector-Borne RADAR' (Real-time Arbovirus Detection And Response) has enhanced surveillance for mosquito-borne disease where wild birds are a primary host, in Great Britain**.** The project is a collaboration between APHA, British Trust for Ornithology, IoZ and United Kingdom Health Security Agency and undertakes active surveillance in free-living passerines and mosquitoes, combined with passive surveillance of passerines through engagement with wildlife rehabilitation centres and zoological collections. During 2024, 292 passerines were caught in collaboration with licensed bird ringers and sampled under a Home Office licence (Figure 12): of these, Usutu virus RNA was detected in 8 birds (feather samples from 2 blackcap (*Sylvia atricapilla*), 3 chiffchaff (*Phylloscopus collybita*) and one whitethroat (*Curruca communis*) and oral swab sample from a blackcap and a chiffchaff). Usutu virus seroconversion was detected in serum samples from 8 blackbirds and one willow warbler (*Phylloscopus trochilus*). These detections were in areas where Usutu virus was already known to be circulating and also in regions where there was no previous record of virus, thereby increasing our understanding of its current geographic range. A total of 13,870 mosquitoes were sampled in 2024 from across the south of England from a range of wetland, rural and urban habitats: molecular screening is ongoing. The risk of transmission and impact to the public from Usutu virus is deemed to be relatively low (Human Animal Infections and Risk Surveillance Group, 2023). However, these results indicate Usutu virus continues to circulate in southern England and highlights that this region may be suitable for the establishment of closely related mosquito-borne viral zoonoses, such as West Nile virus.

More information on Usutu virus can be found in the Garden Wildlife Health *Usutu virus* factsheet published by the Institute of Zoology 2024.

Figure 12. Active surveillance of free-living blackbird (*Turdus merula*). Contour feathers are removed using flat-tipped tweezers, moistened swabs are used for oral and cloacal sampling, and blood is collected by venepuncture of the basilic vein. Combined, samples provide insights into flaviviral exposure and infection. Image credit: VB-RADAR.

References

Folly AJ, Sewgobind S, Hernández-Triana LM, Mansfield KL, Lean FZX, Lawson B, Seilern-Moy K, Cunningham AA, Spiro S, Wrigglesworth E, Pearce-Kelly P, Herdman T, Johnston C, Berrell M, Vaux AGC, Medlock JM, and Johnson N. Evidence for overwintering and autochthonous transmission of Usutu virus to wild birds following its redetection in the United Kingdom. *Transboundary and Emerging Diseases* 2022;**69**: 3684 to 3692.

Human Animal Infections and Risk Surveillance Group. *HAIRS Risk assessment Usutu virus*. UK Health Security Agency 2023

Lawson B, Robinson RA, Briscoe AG, Cunningham AA, Fooks AR, Heaver JP, Hernández-Triana LM, John SK, Johnson N, Johnston C, Lean FZX, Macgregor SK, Masters NJ, McCracken F, McElhinney LM, Medlock JM, Pearce-Kelly P, Seilern-Moy K, Spiro S, Vaux AGC, and Folly AJ. Combining host and vector data informs emergence and potential impact of an Usutu virus outbreak in UK wild birds. *Scientific Reports* 2022;**12**:10298.

VECTOR-BORNE RADAR

APHA Trichinella and Echinococcus surveillance in Great Britain

The National Reference Laboratory (NRL) for Parasites is involved in the surveillance for the zoonotic roundworm (*Trichinella* sp.) and tapeworm (*Echinococcus multilocularis*) within Great Britain.

Although the last reported case of pork worm (*Trichinella spiralis*) in a domestic pig was recorded in 1979 in Northern Ireland, positive cases of both *T. spiralis* (2007 and 2009) and *Trichinella pseudospiralis* (2013) have been recorded more recently within red fox populations within the United Kingdom (Learmount and others, 2015; Zimmer and others, 2009), indicating that it remains a public health concern. Funded by the Food Standards Agency, the NRL tests feral wild boar and other species susceptible to *Trichinella* infection using the Magnetic Stirrer Method for Pooled Sample Digestion. Between April 2023 to March 2024, the NRL received 504 wild boar samples from Great Britain in addition to a sample from the carcase of a free-living beaver. All samples were confirmed as negative for *Trichinella*.

Following the adoption of Commission Delegated Regulation (EU) Number 1152/2011, Defra has funded APHA to conduct the *Echinococcus multilocularis* surveillance programme since 2012. The surveillance programme sets out to detect a 1% prevalence in a representative host population with 95% confidence to maintain 'disease-free' status in Great Britain. Similar programmes are also conducted by countries such as Malta, Republic of Ireland and Finland. Using the red fox population of Great Britain as the target species, the NRL uses the target population and test sensitivity to calculate the spatial distribution of samples, with an annual target sample size of at least 400 foxes. Foxes are collected all-year round from a network of over 50 landowners, pest controllers and hunters across England, Scotland and Wales. Once collected, faecal samples are taken from carcases during post-mortem at APHA-York. Using a flotation and sieving method (Learmount and others, 2012), *Taenia* spp. eggs are isolated and subsequently undergo molecular analyses to identify *E. multilocularis, Echinococcus granulosus*, and other *Taenia* species (Trachsel and others, 2009). Between March 2023 to February 2024, a total of 858 foxes were collected and processed. Of the 858 foxes, 428 faecal samples were selected based on their temporal and spatial parameters to be included in the surveillance (Figure 13). All samples were negative for *E. multilocularis.* Ten samples were positive for *E. granulosus* and 84 samples for other species within the family Taeniidae.

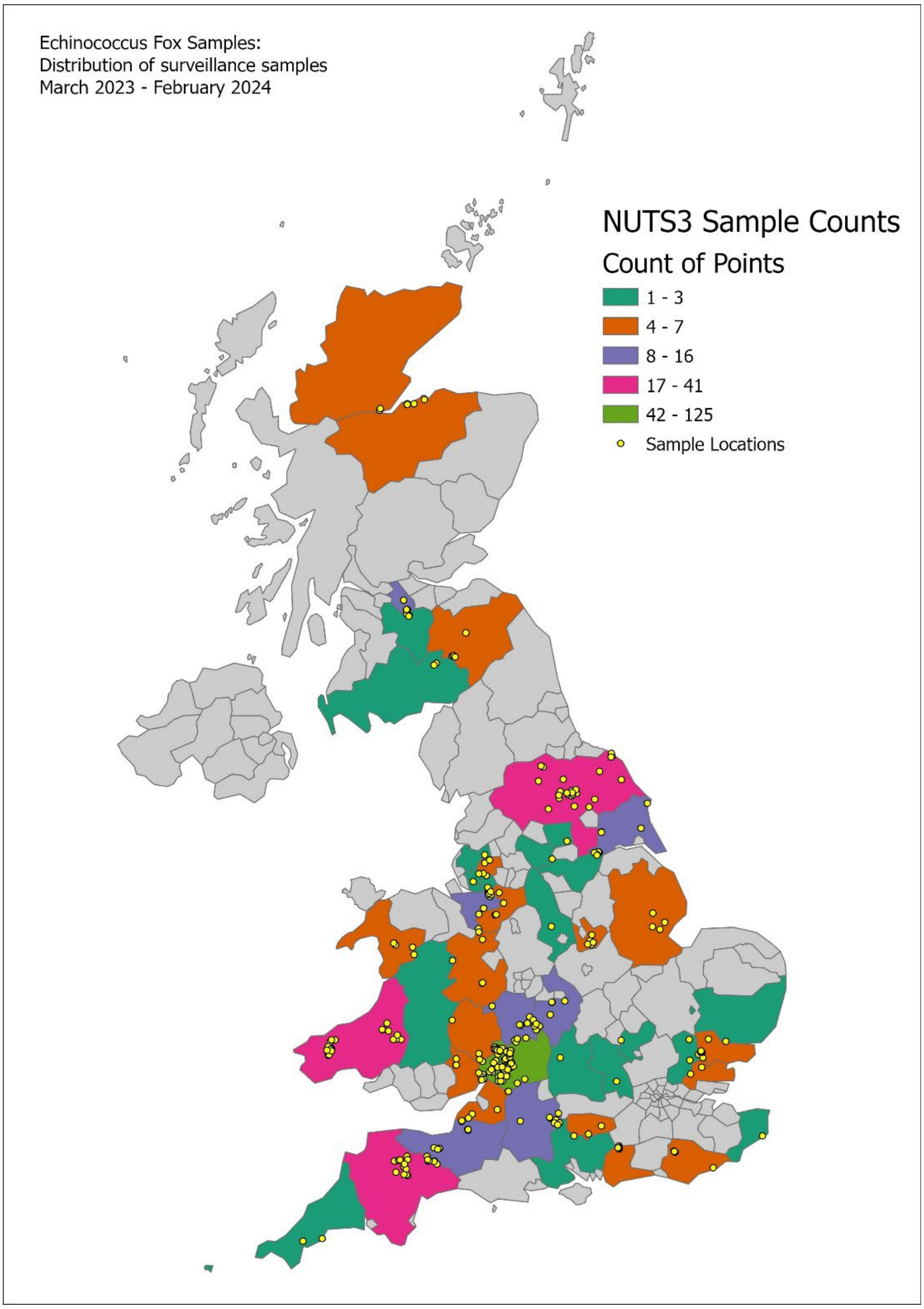

Figure 13: Map of the United Kingdom to show the NUTS3 sample counts of analysed faecal samples included within the 2023-2024 *E. multilocularis* surveillance.

References

Learmount J, Zimmer IA, Conyers C, Boughtflower VD, Morgan CP, Smith GC. A diagnostic study of Echinococcus multilocularis in red foxes (*Vulpes vulpes*) from Great Britain. *Veterinary Parasitology* 2012;**190**(3 to 4):447 to 453.

Learmount J, Boughtflower V, Allanson PC, Hartley KM, Gutierrez AB, Stephens NA, Marucci G, Smith GC. First report of *Trichinella pseudospiralis* in a red fox in mainland Britain. *Veterinary Parasitology* 2015; **208**(3 to 4):259 to 262.

Trachsel D, Deplazes P, Mathis A. Identification of taeniid eggs in the faeces from carnivores based on multiplex PCR using targets in mitochondrial DNA. *Parasitology* 2007; **134**(6):911 to 920.

Zimmer IA, Fee SA, Spratt-Davison S, Hunter SJ, Boughtflower VD, Morgan CP, Hunt KR, Smith GC, Abernethy D, Howell M, Taylor MA. Report of *Trichinella spiralis* in a red fox (*Vulpes vulpes*) in Northern Ireland. *Veterinary Parasitology* 2009; **159**(3 to 4):300 to 303.

APHA Salmonella isolates in wildlife

The APHA is the reference laboratory for *Salmonella* isolation and serotyping.

There is a legal requirement to report suspected Salmonella in farmed mammals and horses. There is no routine monitoring of *Salmonella* in wild birds or wild mammals. Therefore, all *Salmonella* isolates cultured from wildlife are usually from general disease surveillance, although *Salmonella* may often not be the primary cause of disease. Occasionally it is isolated from small-scale surveys. There were 13 cases of *Salmonella* species detected in wildlife in Great Britain during 2024.

Salmonella isolates of *S*. Enteritidis phage types PT11 (5 submissions from lung samples and a rectal swab) and PT9a (1 submission of intestinal contents) were reported in 6 European hedgehogs (*Erinaceus europaeus*). One hedgehog was found emaciated and dehydrated prior to death and post-mortem findings were generally unremarkable, with *S*. Enteritidis PT11 being diagnosed from a rectal swab. Intestinal contents from a rescued hedgehog that had diarrhoea were submitted under APHA DoWS and *S*. Enteritidis PT9a was diagnosed. Additional information regarding clinical findings or pathology are unavailable for lung samples from the other 4 hedgehogs. *Salmonella* infection has been described in free-living hedgehogs from Great Britain and continental Europe, including with *S*. Enteritidis PT9a and PT11 (Krawczyk and others, 2015; Nauerby and others, 2000). *S*. Enteritidis PT11 is reported to be the most common *Salmonella* spp. isolated from hedgehogs and is widespread in hedgehogs in England (Keymer and others, 1991; Lawson and others, 2018) and is likely to be endemic (Robinson and Routh 1999).

One European badger cub (*Meles meles*) submitted under APHA DoWS had 2 *Salmonella* serotypes isolated from liver samples: 4,5,12:b:- and Eboko. From post-mortem examination, it was not possible to establish a cause of death beyond starvation and flea infestation. A wide range of *Salmonella* spp. are known to be commonly present in badgers in the UK (O'Hagan and others, 2021; Wilson and others, 2003).

A collapsed red fox (*Vulpes vulpes*) was euthanased and submitted to an external partner pathologist for post-mortem examination under APHA DoWS. The renal lymph nodes were enlarged and multifocal creamy abscess like lesions were seen in both kidneys. *S.* Typhimurium PT2 was the cause of disease. Infection of red foxes with *S*. Typhimurium has been described as the result of ingestion of *Salmonella* infected, sick or dead small passerine birds during winter (Handeland and others, 2008).

There were 2 reports of *Salmonella* species in marine mammals. A pre weaned grey seal (*Halichoerus grypus*) pup with neurological signs was submitted under APHA DoWS for post-mortem examination, which revealed gingival disease, yellow joint fluid and an orange liver. *S.* Typhimurium PT75 was isolated from brain and blood swabs. It was suspected that salmonellosis had caused peracute septicaemia despite the lack of evidence for septicaemia and meningitis from histopathology. *S.* Typhimurium infection of free-ranging and stranded grey seals is recognised in UK waters and may occur via microbial marine pollution from wastewater (Baily and others, 2016). The University of Liverpool (under CSIP) conducted post-mortem examination of an adult harbour porpoise (*Phocoena*

phocoena) and Salmonella serotype 4,12: a:- was isolated from samples. Severe fibrinonecrotising peritonitis and extensive severe enteritis were the main post-mortem diagnoses. Since 1990, monophasic group B *Salmonella enterica* 4,12:a:- has been identified from harbour porpoise carcases stranded in England, Wales and Scotland (Foster and others, 1999; Valderrama Vasquez and others, 2008).

S. Typhimurium was diagnosed in 2 Herring gulls (*Larus argentatus*) and one Black-headed gull (*Chroicocephalus ridibundus*) submitted under APHA DoWS. *S.* Typhimurium PT193 was isolated from a lung swab of an immature Herring gull that had died due to a combination of air sacculitis and pneumonia. A liver swab from an adult Herring gull isolated *S.* Typhimurium PT RDNC, but further pathology information is unavailable. Septicaemia due to *S.* Typhimurium was the likely cause of death of the adult Black-headed gull. A wide range of *Salmonella* serotypes are carried by Herring gulls (Figure 14) that are also found in humans (including *S.* Typhimurium), and gulls may ingest these serotypes when feeding at untreated sewage outfalls on the coast (Butterfield and others, 1983).

Figure 14: A Herring gull standing on a cliff on the Welsh coastline. Image credit: Jennifer Cantlay, APHA Weybridge.

References

Baily JL, Foster G, Brown D, Davison NJ, Coia JE, Watson E, Pizzi R, Willoughby K, Hall, AJ and Dagleish MP. Salmonella in grey seals. *Environmental Microbiology* 2016;18:1078 to 1087.

Butterfield J, Coulson JC, Kearsey SV, Monaghan P, McCoy JH, Spain GE. The herring gull Larus argentatus as a carrier of salmonella. *Journal of Hygiene* 1983;**91**(3):429 to 436.

Foster G, Patterson IA, Munro DS. Monophasic group B *Salmonella* species infecting harbour porpoises (Phocoena phocoena) inhabiting Scottish coastal waters. *Veterinary Microbiology* 1999;**65**(3):227 to 231.

Handeland K, Nesse LL, Lillehaug A, Vikøren T, Djønne B, Bergsjø B. Natural and experimental Salmonella Typhimurium infections in foxes (*Vulpes vulpes*). *Veterinary Microbiology* 2008;**132**:129 to 34.

Keymer I, Gibson E and Reynolds D. Zoonoses and other findings in hedgehogs (*Erinaceus europaeus*): a survey of mortality and review of the literature. *Veterinary Record* 1991;**128**(11):245 to 249.

Krawczyk, AI, van Leeuwen, AD, Jacobs-Reitsma, W. and others. Presence of zoonotic agents in engorged ticks and hedgehog faeces from *Erinaceus europaeus* in (sub) urban areas. *Parasites Vectors* 2015:**8**:210.

Lawson B, Franklinos LHV, Rodriguez-Ramos Fernandez J, Wend-Hansen C, Nair S, Macgregor SK, John SK, Pizzi R, Núñez A, Ashton PM, Cunningham AA, M de Pinna E. Salmonella Enteritidis ST183: emerging and endemic biotypes affecting western European hedgehogs (*Erinaceus europaeus*) and people in Great Britain. *Science Reports* 2018;**8**(1):2449.

Nauerby, B, Pedersen, K, Dietz, HH & Madsen, M. Comparison of Danish isolates of *Salmonella enterica* serovar enteritidis PT9a and PT11 from hedgehogs (*Erinaceus europaeus*) and humans by plasmid profiling and pulsed-field gel electrophoresis. *Journal of Clinical Microbiology* 2000;**38**(10):3631 to 3635.

O'Hagan MJ, Pascual-Linaza AV, Couzens C, Holmes C, Bell C, Spence N, Huey RJ, Murphy JA, Devaney R, Lahuerta-Marin A. Estimation of the prevalence of antimicrobial resistance in Badgers (*Meles meles*) and Foxes (*Vulpes vulpes*) in Northern Ireland. *Frontiers in Microbiology* 2021;**12**:596891.

Robinson I and Routh A. Veterinary care of the hedgehog. *In Practice* 1999;**21**:128 to 37.

Valderrama Vasquez CA, Macgregor SK., Rowcliffe JM and Jepson PD. Occurrence of a monophasic strain of *Salmonella* group B isolated from cetaceans in England and Wales between 1990 and 2002. *Environmental Microbiology* 2008;**10**: 2462 to 2468.

Wilson JS, Hazel SM, Williams NJ, Phiri A, French NP, Hart CA. Nontyphoidal salmonellae in United Kingdom badgers: prevalence and spatial distribution. *Applied and Environmental Microbiology* 2003;**69**(7):4312 to 5.

APHA Red squirrel disease surveillance

Native Eurasian red squirrels (*Sciurus vulgaris*) were once widely distributed across the UK but are now confined to small areas with deciduous and coniferous woodlands. These include Whinfell Forest (Cumbria), Kielder Forest complex (Northumberland), Newborough and Pentraeth forests (Anglesey), the Formby coastal woodlands (Lancashire), Brownsea Island (Dorset) and many areas of Scotland.

The decline of red squirrel populations is primarily due to the introduction of North American Eastern grey squirrel (*Sciurus carolinensis*) into the UK from 1876. Grey squirrels outcompete red squirrels for both food and habitat and are the reservoir for squirrelpox virus (SQPV), the causative agent for squirrelpox in the native species, in which it is invariably fatal. Whilst grey squirrels have developed immunity to SQPV, red squirrels develop skin lesions of varying severity on the face, digits and body (Figure 15) before death. Since the first confirmed incident in the UK in 1980 (Scott and others, 1981), the rapid spread of squirrelpox is perhaps the most significant factor in the decline of red squirrel populations, now found in isolated colonies and threatened with extinction (Everest and others, 2021). The recent emergence of adenovirus (AdV) poses another significant disease threat to red squirrels, infecting the intestines and causing significant mortality (Everest and others, 2014). Although identified in 1983, the first documented outbreak was recorded during the 1997 translocation of red squirrels to Suffolk. Since then, cases have been detected across the UK in wild and captive squirrels (Everest and others, 2018). Hence disease surveillance in the remaining red squirrel populations is vital for disease mitigation strategies to be implemented.

Figure 15: A Red squirrel with severe skin lesions of crusts and scabs on its head due to squirrelpox. Image credit: W. Lee

From 1998 onwards, APHA DoWS has collaborated with Lancashire, Cumbria and Northumberland Wildlife Trusts, Red Squirrel Trust Wales, various red squirrel groups to obtain carcasses from both free-living and some captive squirrels (for release) for mortality investigations at Veterinary Investigation Centres. Whilst a variety of microbiology and histopathology diagnostic tests may be conducted, for suspect SQPV or AdV disease cases, transmission electron microscopy (TEM) and polymerase chain reaction (PCR) assays are used to confirm the diagnosis. TEM detects the presence of viral particles of both agents, with SQPV from visible skin lesion material (Figure 16) and AdV from intestinal or faecal material samples (Figure 16). Since SQPV generally causes observable skin disease in red squirrels then real-time PCR is less useful than TEM. PCR is used mainly for AdV, where the virus may be present as an asymptomatic infection in red squirrels. Maps showing all SQPV cases (from 1980 to 2024) and AdV cases (from 1983 to 2024) diagnosed in the UK are accessible in the publication (Everest and others, 2025). In 2024, SQPV was diagnosed from 11 red squirrel submissions to APHA and SRUC, with disease outbreaks recorded in Cumbria and Northumberland. However, there were no confirmed cases of AdV during 2024 in the UK.

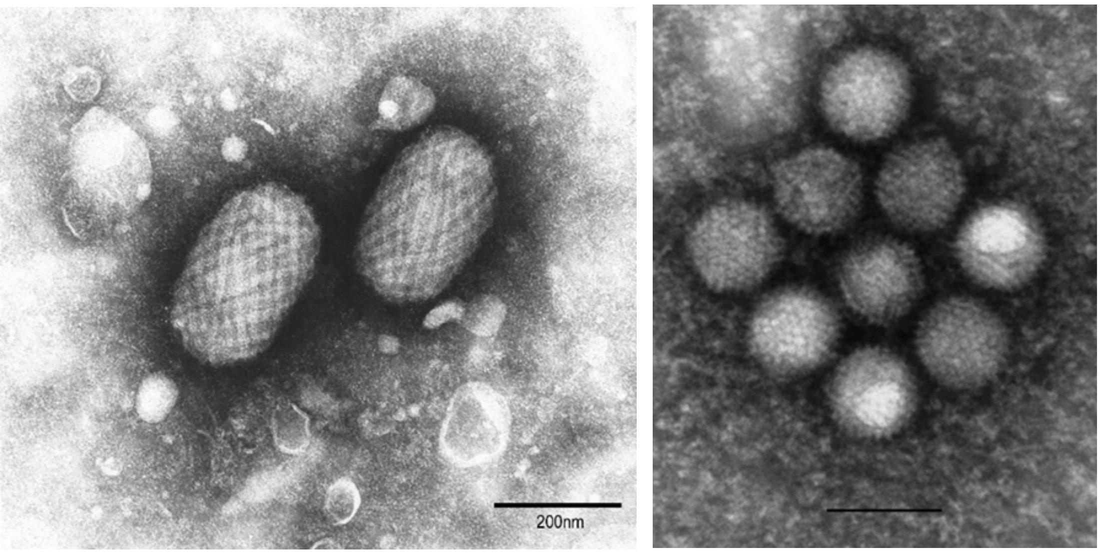

Figure 16: Transmission electron microscopy to detect squirrelpox virus particles (the 1980 index case in the left image), image credit APHA Laboratories, Weybridge and adenovirus particles with the bar line representing 100 nanometre in the right image, image credit APHA DoWS.

Recently, the development of non-invasive assay methods using PCR on hair or whisker samples to detect both SQPV and AdV DNA (Everest and others 2019) has enabled more dead squirrels unsuitable for post-mortem examination and live squirrels to be sampled. Using a wider range of samples for SQPV and AdV detection from live and dead squirrels will improve the assessment of infection presence in red squirrel populations. This information is essential for better understanding of these diseases in the largely fragmented red squirrel populations for their conservation.

References

Everest DJ, Floyd T, Holmes P, Duff P, Man C, Dunnett E, Locke R, Savage L, Sutcliffe S, Sapsford B, Shuttleworth CM. Disease monitoring and surveillance: case studies in the applied conservation of fragmented red squirrel (*Sciurus vulgaris*) populations in England and Wales. *Mammalian Biology* 2021;**101**:1079 to 1088.

Everest DJ, Holland S, Cantlay J, Duff JP, Holmes P. (In Preparation). The Animal and Plant Health Agency Diseases of wildlife Scheme (*APHADoWS*): Wildlife disease surveillance in England and Wales, with special reference to the Eurasian red squirrel (*Sciurus vulgaris*). Saving the red squirrel (eds N Robinson N and Shuttleworth CM) Red Squirrel Survival Trust.

Everest DJ, Shuttleworth CM, Grierson SS, Dastjerdi A, Stidworthy MF, Duff JP, Higgins RJ, Mill A, Chantrey J. The implications of significant adenovirus infection in UK captive red squirrel (*Sciurus vulgaris*) collections: How histological screening can aid applied conservation management. *Mammalian Biology* 2018;**88**:123 to 129.

Everest DJ, Shuttleworth CM, Stidworthy MF, Grierson SS, Duff JP, Kenward RE. Adenovirus: an emerging factor in red squirrel Sciurus vulgaris conservation. *Mammal Review* 2014;**44**:225 to 233.

Everest DJ, Tolhurst-Cherriman DAR, Davies H, Dastjerdi A, Ashton A, Blackett T, Meredith AL, Milne EL, Mill A, Shuttleworth CM. Assessing a potential non-invasive method for viral diagnostic purposes in European squirrels. *Hystrix, The Italian Journal of Mammalogy* 2019;**30**:44 to 50.

Scott AC, Keymer IF, Labram J. Parapoxvirus infection of the red squirrel (*Sciurus vulgaris*). *The Veterinary Record* 1981;**109**:202.

SRUC Surveillance activities

SRUC Veterinary Services (part of Scotland's Rural College) operates several post-mortem facilities and Disease Surveillance Hubs around Scotland, which carry out post-mortem examinations on wild birds and wild mammals.

Activities include the sampling of hundreds of wild bird carcases submitted under the Avian Influenza Wild Bird Surveillance scheme each year, with samples sent to APHA for testing. Due to SRUC's large and experienced network of veterinary investigation officers and pathologists, several Police forces, most prominently Police Scotland, also submit wildlife carcases for forensic examination in cases where wildlife crime is suspected.

SRUC Veterinary Services has longstanding relationships with various other organisations who may submit wildlife carcases to investigate a suspected disease, or another cause of morbidity or death (both in individual cases or mass mortalities). In addition to disease investigation, these cases may focus on exposure to toxic substances (whether accidental or intentional), may evaluate exposure to background residues of substances, or they may investigate issues impacting animal welfare. Some of these other organisations include: Science and Advice for Scottish Agriculture (SASA, who run the Wildlife Incident Investigation Scheme, WIIS, in Scotland), the Royal Society for the Protection of Birds, the British Trust for Ornithology, NatureScot, the John Muir Trust, the Moredun Research Institute, the National Trust for Scotland, and the Scottish Society for Prevention of Cruelty to Animals. Carcases may also occasionally be received directly from landowners and land managers, gamekeepers, farmers, or members of the public. Wildlife disease surveillance in most cases is funded directly by the Scottish Government.

The most common single diagnosis for the last few years in Scottish wildlife health surveillance has, of course, been avian influenza. In addition, a number of deaths due to wildlife crimes are seen each year, and further information on these cases can be found in the Scottish Wildlife Crime Report, published each year by the Scottish Government: Wildlife Crime in Scotland 2023. Our partner SASA publishes the WIIS report, using results from carcases submitted to SRUC, at Animal Poisoning Reports | SASA (Science & Advice for Scottish Agriculture). With regards to other diagnoses, simple failure to thrive in young birds of prey, injury leading to incapacitation (including intra-guild or intra-species conflict), parasitism (including Trichomonosis), infectious bacterial diseases (including commonly seen conditions such as avian tuberculosis, corvid respiratory syndrome, or Salmonellosis associated with bird feeders), and road traffic accidents or other collisions with moving or static objects such as trains, pylons, windows or wind turbines, are regular annual features.

IoZ DRAHS project overview

The Disease Risk Analysis and Health Surveillance (DRAHS) project is a collaborative initiative between the Zoological Society of London and Natural England, established to investigate the health and disease implications of interventions carried out for conservation purposes.

The DRAHS vision is for healthy and abundant free-living wildlife populations resulting from conservation interventions. The DRAHS project commenced in 1989 working alongside Natural England to undertake disease risk analysis and health surveillance for species included in the Species Recovery Programme. Since then, DRAHS has worked with over 40 species in England, including threatened and endangered native invertebrates, amphibians, reptiles, birds and mammals, as well as advising on international projects such as the Sihek, or Guam kingfisher, reintroduction project.

Translocations such as reintroductions are important conservation tools, but they engender risk from disease to the translocated and recipient populations due to changes in wild animal and parasite population dynamics. In 2012, a novel disease risk analysis method appropriate for wild animal interventions was developed and published (Sainsbury and Vaughan-Higgins, 2012). This method has since been adopted as part of the International Union for the Conservation of Nature (IUCN) Guidelines for Wildlife Disease Risk Analysis. Using applied research, the DRAHS team continue to develop structured evidence-based approaches to assessing the risk from conservation interventions.

In the last year, DRAHS has carefully monitored the health of introduced populations of chequered skippers in Rockingham Forest, wart-biter crickets on the South Downs, pool frogs and corncrake in Norfolk, sand lizards (Figure 17) in the southern counties of England, white-tailed eagles destined for the Isle of Wight and hazel dormice (Figure 18) across England. A third group of red kites was translocated to Spain to reinforce the threatened populations in Europe, and health examinations were conducted throughout the translocation process. In preparing curlew for reintroduction, we detected and investigated a novel feather disease which was sufficiently debilitating to prevent release of over 30% of the birds. The curlew feather disease is not previously described, and infectious and nutritional causes remain under investigation. In the United States, a group of Sihek were successfully released into the wild after years of work preparing for a novel translocation to Palmyra Atoll. Work also began on several new species translocations including the black-veined white butterfly, red-backed shrike, and water vole, using the techniques DRAHS has developed over 30 years to mitigate the risks from disease in these translocations.

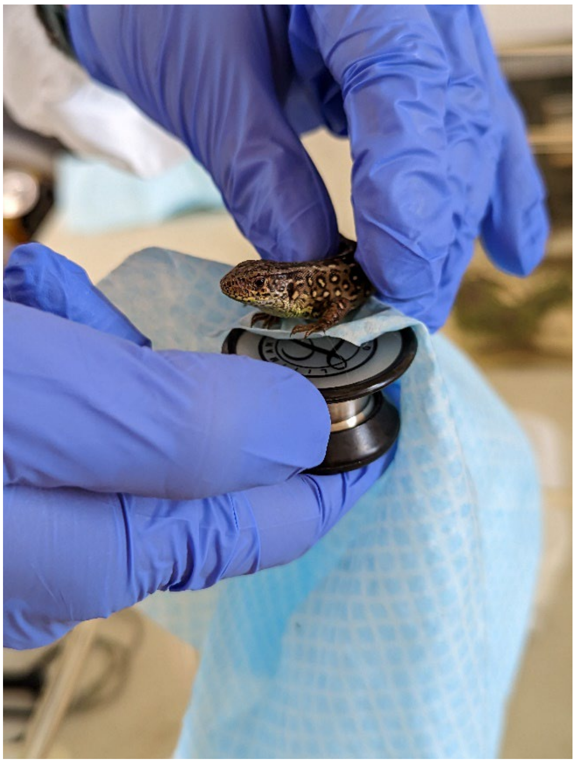

Figure 17: A sand lizard (*Lacerta agilis*) being held on a stethoscope during examination of its respiratory tract by the DRAHS team.

Figure 18: A hazel dormouse (*Muscardinus avellanarius*) having a health examination by the DRAHS team

References

Sainsbury AW, Vaughan-Higgins RJ. Analysing disease risks associated with translocations. *Conservation Biology* 2012;**26**:442 to 452.

GWH Detection of *Batracobdella algira*, a leech previously unknown in Great Britain, predating on amphibians

A report of severe leech infestation in a common toad (*Bufo bufo*) in southern England in 2020 initiated a collaborative investigation to learn more about the occurrence of such leech predation of amphibians in Great Britain and led to the detection of a leech species not previously reported in this country.

In summer 2020, the sighting of a common toad (*Bufo bufo*) in southern England with a severe leech infestation (Figure 19A), raised public concern on social media. To investigate the occurrence of leech parasitism of amphibians (which is a known behaviour by a variety of native leech species), a collaboration was formed between Garden Wildlife Health (GWH), the Amphibian and Reptiles Groups of the UK, Buglife, and the University of Silesia, Poland.

Reports of leech parasitism of amphibians were solicited from the general public from 2020 to January 2023 inclusive through social media and a citizen science survey. Incidents involving common toads (*Bufo bufo*) and common frogs (*Rana temporaria*) were observed in southern England (Devon, Greater London, Hampshire, the Isle of Wight, and Somerset) (Seilern-Macpherson and others, 2024). Where details were available, for affected common toads, leeches were typically observed to cover the eyes (Figure 19A) as well as attach to the throat, the axillae, and occasionally the ventral body. In common frogs, leeches were reported to be present over the entire body, on occasion also covering the eyes, although most notably on the underside, in the axillae and inguinal area (Figure 19B). Using a combination of morphological and molecular techniques, we identified *Batracobdella algira*, a leech species not previously reported in the UK, to be involved in the majority of cases. The native leech *Placobdella costata* was also identified in a small number of cases, exhibiting similar feeding behaviour, therefore expert identification is needed to differentiate between these leech species. Whether *B. algira* is a previously unrecorded or an introduced species in Great Britain has not yet been established, however, sequence data from multiple gene loci were found to be identical to *Batracobdella* cf. *algira* found in Tunisia, suggesting it to be a non-native leech species. Further work is required to elucidate the potential origin and distribution of *B. algira* in Great Britain, and whether it has any impact on amphibian populations.

More information can be found in the Garden Wildlife Health leech predation in amphibians factsheet.

Figure 19: Photos show a common toad (*Bufo bufo*) reported from Devon, England, in August 2020, with leeches covering both eyes (A) and a common frog (*Rana temporaria*) reported from the Isle of Wight, England, in 2020, with leeches attached to the flank and underside of the body (B). Leech samples from both cases were identified as *Batracobdella algira* (Seilern-Macpherson and others, 2024).
Image credit: Chryssa M.L. Brown (A) and Charis Hayles (B)

References

Seilern-Macpherson K, Lawson B, Macadam CR, West P, Reed N, Gibson L, Świątek P, Gajda Ł, Cunningham AA, Heaver J, Julian JM. Predation of anurans in southern England by *Batracobdella algira*, a leech previously unknown in the UK. *Herpetological Journal* 2024; **34**:221–227.

Cefas aquatic species surveillance

Wild finfish disease

A total of 8 river catchments were targeted under the routine wild fish *Gyrodactylus salaris* (Gs) surveillance programmes in 2024. Working with the Environment Agency and Natural Resources Wales, the Fish Health Inspectorate obtained samples of salmonid species from the following river catchments:

- River Aln
- River Avon (Hampshire)
- River Calder
- River Glaslyn
- River Kent
- River Mawddach
- River Seiont
- River Tyne

All samples were negative for Gs.

Wild mollusc disease

Longstanding disease controls remain in place in coastal zones for the listed bivalve mollusc diseases *Bonamia ostreae*, *Marteilia refringens* and OsHV-1 µvar. Details can be found at Controls of fish and shellfish diseases in England and Wales along with an interactive map.

Four samples of native oyster (*Ostrea edulis*) were collected for analysis by histopathology specifically for the listed parasitic diseases *Bonamia ostreae*/*exitiosa* and *Marteilia refringens*. Areas sampled included the Solent, Penryn river, Blackwater estuary and River Tamar. All samples were negative for listed diseases.

Wild crustacean disease surveillance and mortality investigations

In addition to the disease investigations carried out following reported mortalities in white-clawed crayfish in Northeast England as described in the Highlighted Cases section. A sample of white-clawed crayfish from the River Irfon was analysed following reported mortalities. The sample was positive for the WOAH listed disease *Aphanomyces astaci* (Crayfish plague).

Forestry England fieldwork

Tick (*Ixodes ricinus*) and Tick Disease

Forestry England is carrying out tick surveillance work on behalf of UKHSA to monitor tick presence, abundance, and disease prevalence in woodland areas. These data are highly valuable, as they contribute to risk assessments regarding potential exposure for staff, visitors, and volunteers.

Forestry England has supported Glasgow University in the licensed capture and release of GPS tagged deer in the New Forest. This research aims to enhance understanding of the relationship between tick-borne Lyme disease and deer movement patterns. A similar project is currently being undertaken in collaboration with Salford University and the Animal and Plant Health Agency (APHA) to investigate the role of small mammals, particularly grey squirrels (*Sciurus carolinensis*), in the ecology of ticks.

e-DNA Stomach Contents Sampling

Dr. Lucie Jerabkova of Forestry England in collaboration with Queen Mary University of London and the Blizard Institute is leading a pilot project seeking to address key questions regarding tree palatability and browsing behaviour. A frequently asked question concerns which tree species are more heavily browsed, as well as where and why these patterns occur. Currently, there is no definitive answer, as browsing behaviour varies depending on location and environmental factors.

The project aims to assess the feasibility of using environmental DNA (eDNA) analysis of stomach and gut contents to provide insights into these questions. Preliminary results from the study indicate that muntjac deer (*Muntiacus reevesi*) consume a greater variety of tree species and in higher quantities compared to roe (*Capreolus capreolus*) and fallow deer (*Dama dama*).

Future objectives include expanding the scope of the research, increasing the range of species studied, broadening the geographical coverage, and incorporating seasonal variations into the analysis.

Deer Genotyping Project

In a newly established collaboration with the APHA, Forestry England is undertaking fieldwork to validate a deer genotyping test originally developed in Canada. The primary objective of this research is to develop this test in-house to determine susceptibility and ultimately quantify the risk of Chronic Wasting Disease (CWD) to deer populations in the United Kingdom. As part of this initiative, tissue samples from all 6 UK deer species (Figure 20) are being provided for analysis by APHA.

The stress response of culled deer

Forestry England is collecting blood samples from culled deer for a University of Reading study aiming to examine the impact of shot placement, seasonality, and pursuit methods, among other factors on the stress response of culled deer. It is hoped that this research will contribute to a broader body of research that could inform and influence best practices in deer management in the future.

Figure 20: A herd of red deer (*Cervus elaphus*) in grassland habitat adjacent to woodland. Image credit: Lizz Nabb, APHA Starcross

Highlighted cases

APHA DoWS Parasitic gastroenteritis in wild roe deer

A chronic mixed parasitic gastroenteritis (PGE) with high worm burdens (including *Haemonchus* spp., *Trichostrongylus axei* and *Ostertagia* spp.) was identified as the most likely cause of death in 2 juvenile roe deer (*Capreolus capreolus*). They were submitted for investigation under APHA DoWS from an unexplained wild deer mortality event near Guildford in Surrey.

Residents had reported numerous sick and dead deer over a period of several weeks starting late summer on private land bounded by houses and roads. The land consisted of grazing for horses, rough grassland and natural woodland. Whilst it was not primarily agricultural land, a sheep flock was known to graze on some areas. More than 10 animals were reported as found dead (Figure 21) and many sick deer were seen in thin body condition, some with diarrhoea, and several appeared weak. The worst affected appeared disorientated with foam at their mouths and a few were reported to have swollen heads.

Once suspicion of notifiable diseases of bluetongue and epizootic haemorrhagic disease had been negated, the APHA wildlife expert group were able to accept 2 fresh carcases for investigation through DoWS. Partner post-mortem provider, the Royal Veterinary College, conducted post-mortem examinations on these deer that showed signs typical of the affected group. They were both emaciated, one had severe diarrhoea and the other had severe anaemia (lower than normal numbers of red blood cells or haemoglobin concentration) with normal faeces. *Haemonchus* spp. worms were present in significant numbers alongside other nematodes (*Trichostrongylus axei* and *Ostertagia* spp.) in both animals. The most likely cause of death in both cases was mixed parasitic gastroenteritis leading to hypoproteinaemia (low protein levels in the blood) due to protein losing enteropathy (protein loss through intestinal disease), anaemia and energy depletion. A marked lungworm burden and multiple external parasites were also seen.

The deer had reportedly had a ‘bumper’ season for fawns and this increased density, alongside a wet summer on this low-lying land, may have led to increased gastrointestinal parasitism in this population (Body G and others, 2011). Roe deer are predominantly browsers, but these young deer most likely picked up parasites while grazing infected land. *Haemonchus contortus* is predominantly a parasite of sheep and goats (though it can affect other ruminants), and this case is a clear illustration of shared disease at the wildlife and domestic animal interface.

Figure 21: A dead juvenile wild roe deer found lying on its side in the grass. No image credit.

References

Body G, Ferté H, Gaillard JM, Delorme D, Klein F. and Gilot-Fromont E. Population density and phenotypic attributes influence the level of nematode parasitism in roe deer. *Oecologia* 2011;167:635 to 646.

APHA DoWS Waterfowl mass mortality due to botulism

During the Autumn 2024, reports were received of large numbers of sick and dead waterfowl, including mute swans (*Cygnus olor*) and Canada geese (*Branta canadensis*) over part of the Grand Union Canal in Uxbridge, Middlesex.

These initial deaths were reported via Defra's online dead wild bird reporting tool and birds were collected for avian influenza testing under the government's avian influenza surveillance strategy. Over several weeks, the situation worsened with greater numbers of birds dying and a wider range of species impacted. Reports from the local Swan Support Group described finding both sick and dead waterfowl (Figure 22), some lying in the water with outstretched wings, looking weak with their heads and necks limp, others gasping for air before death. Diagnostic testing results from initial dead birds ruled out highly pathogenic avian influenza (HPAI) as being the cause of death, and potential toxicity became the main concern. The incident had already been reported to the local councils and Environment Agency, who sampled the canal water to test for common pollutants – none were identified. An APHA DoWS funded mortality investigation of 11 waterfowl was conducted at the Veterinary Investigation Centre in Bury.

Figure 22: A mute swan lying in the canal with its wings stretched into the water and its neck bent behind its body with its head in the water. Image credit: The Swan Support Group.

On receipt of a negative HPAI result, each bird carcase of suitable condition underwent post-mortem examination by APHA Veterinary Investigation Officers. Gross pathology of these birds' organs was unremarkable and whilst they had been in good body condition, with ample muscle and fat prior to death, they had not eaten well. These findings supported the suspicion of a toxin causing the incident, as toxicities can often cause no obvious changes to the organs. Diagnostic samples were taken and sent to SRUC for lead testing and Agri-Food and BioSciences Institute (AFBI) for botulism testing. Whilst the lead test results were negative, test results for the toxin from the bacteria *Clostridium botulinum* were positive in 2 birds, confirming avian botulism as the most likely cause of death. This disease leads to birds showing progressive flaccid paralysis and weakness that affects their mobility and prevents them eating or drinking, hastening their demise. Urban canals and lakes often contain stagnant water with putrefying organic material and lacking oxygen, which provides the ideal environment for *C. botulinum* to thrive. Waterfowl are commonly affected by avian botulism and outbreaks can last several weeks due to the toxin's persistence in the environment.

You can read more details about this botulism incident in the APHA Science blog 'What happened at a canal in Uxbridge?' and find additional disease resources there.

GWH Unusual presentation of severe avian pox in a house sparrow

An adult male house sparrow (*Passer domesticus*) found dead in North Yorkshire in spring 2024 was examined post-mortem and diagnosed with a severe presentation of avian pox.

In spring 2024, a house sparrow (*Passer domesticus*) was reported to Garden Wildlife Health after being found dead by a member of the public in North Yorkshire, and submitted for post-mortem examination. Upon gross examination, numerous, multifocal, raised, pale yellow skin lesions were observed across the majority of the body (Figure 23). Additionally, a firm, pale yellow, spherical mass of ~4mm in diameter was present in the right lung. The bacterium *Staphylococcus* sp. was isolated from the skin, lung, and small intestinal contents. Histopathological examination confirmed the presence of chronic dermatitis with epidermal changes and viral inclusions (Figure 24) consistent with avian pox, with secondary bacterial infection and concurrent fungal pneumonia (most likely *Aspergillus* sp.). Whilst chlamydiosis was considered as a potential underlying condition causing immunosuppression, therefore leading to this unusual severe presentation of avian pox, a liver sample tested qPCR negative for *Chlamydia psittaci/abortus*.

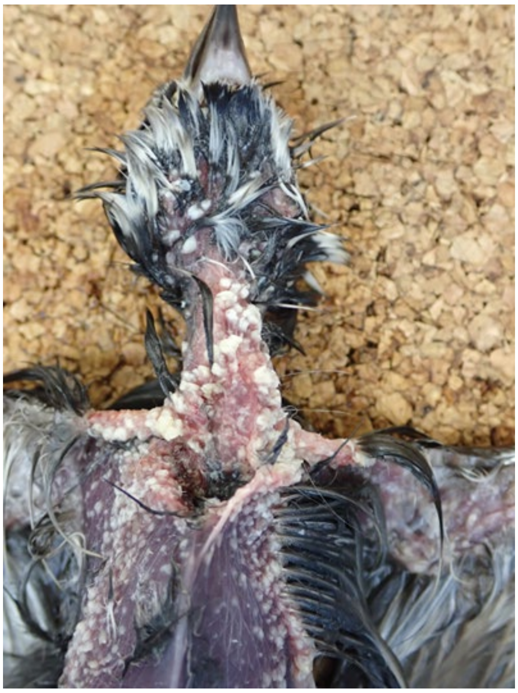

Figure 23: Photo shows the upper body of a house sparrow (*Passer domesticus*) examined post-mortem, with multifocal pale yellow, raised skin lesions, caused by avian pox.
Image credit: Institute of Zoology

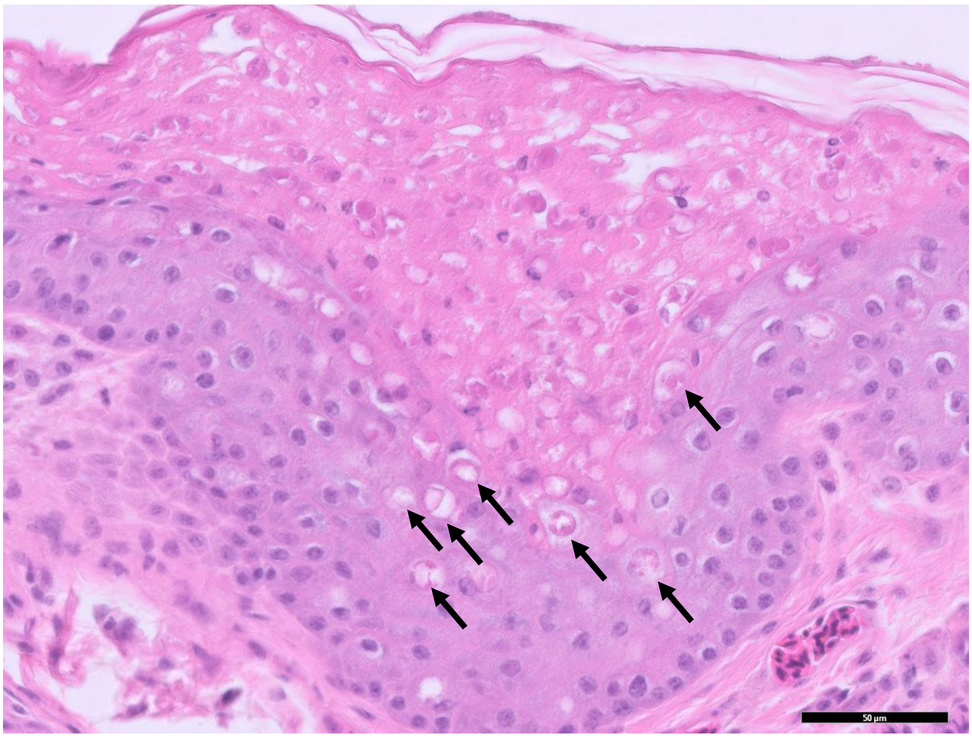

Figure 24: Photo shows the microscopic view of the skin of a house sparrow (*Passer domesticus*) with viral inclusions (black arrows) and pathological changes including epidermal necrosis and proliferation, consistent with a diagnosis of avian pox. Haematoxylin and eosin staining, 40x magnification. Image credit: Institute of Zoology

Avian poxvirus has been found to cause sporadic endemic disease in a range of garden bird species in Great Britain for many years, and lesions in species such as the house sparrow tend to be discrete, wart-like growths on the featherless regions of the head, legs and feet (Lawson and others, 2012; Ruiz-Martinez and others, 2016). The presentation of avian pox in the case of this house sparrow was unusually severe, therefore concurrent conditions were investigated as a potential predisposing factor, however no underlying cause was identified in this bird.

More information on avian poxvirus infection in garden birds can be found in the Garden Wildlife Health avian pox factsheet.

References

Lawson B, Lachish S, Colvile KM, Durrant C, Peck KM, Toms MP, Sheldon BC, Cunningham AA. Emergence of a novel avian pox disease in British tit species. *PLOS ONE* 2012; **7**(11):e40176.

Ruiz-Martinez J, Ferraguti M, Figuerola J, Martinez-de la Puente J, Williams, RAJ, Herrera-Duenas A, Aguirre JI, Soriguer R, Escudero C, Moens, MAJ and Perez-Tris J. Prevalence and Genetic Diversity of Avipoxvirus in House Sparrows in Spain. *PLoS One* 2016; **11**(12):e0168690.

DRAHS Feather disease in head-started Eurasian curlews

In 2023, investigations were conducted into an outbreak of feather disease in Eurasian curlew held in captivity as part of a conservation head-starting project in Norfolk.

During the 2023 rearing season, an outbreak of feather disease was reported in Eurasian curlew (*Numenius arquata*) being captive reared as part of a conservation head-starting project in Norfolk. Management of the outbreak was initiated, including clinical examinations and post-mortem examinations of curlew that either died or were euthanised due to the severity of the disease. Further investigations were undertaken, where possible, including blood sampling for haematological and biochemical analysis, virological investigations, bacteriology, mycology, and histopathology.

A total of 72.2% (52/72) of curlew were identified as suffering from some degree of feather disease, either through clinical or post-mortem examination. Of the affected curlew, 26 recovered from feather disease and were released. Twenty-one curlews were euthanised due to the severity of their feather disease. Two affected curlews were euthanised due to unrelated reasons. Three affected curlews died within the study period. Clinical signs were limited to the wing feathers and initially included follicular swelling or discolouration, calamus distortion or discolouration, crusting, bleeding of the calamus or rachis, and delayed feather growth (Figures 25 and 26). As the disease progressed and curlew recovered, signs progressed to brittle feathers with evidence of fault bars, and misshapen rachis and veins.

Further testing was undertaken with small sample sizes, and so more research is required to definitively rule in or out possible aetiologies. However, virological examinations, including next generation sequencing of tissues from 4 affected curlews and whole blood PCR for psittacine beak and feather disease virus from one affected curlew, were negative, suggesting that viral involvement was unlikely. Haematological and biochemical analysis from 3 curlews were also unremarkable, although blood zinc levels were variable. Post-mortem examinations did not reveal underlying causes, and no clear patterns of inflammation or structural change were noted on histopathological examination. There was evidence of secondary bacterial involvement in some cases, but no evidence to suggest this to be a primary cause.

Further investigations are ongoing, and a manuscript is in preparation for submission (Common and others, in preparation).


Figures 25: The photograph on the left shows a curlew wing with signs of narrowed and bent feathers.

Figure 26: The photograph on the right shows feathers taken from the wing of an affected curlew demonstrating calamus distortion and discolouration. Image credit: ZSL.

References

Common S, Foskett R, Kelley C, Rodriguez-Ramos Fernandez J, Rivett L, Simpson-Brown E, Guthrie A, Spiro S, John S, Macgregor S, and Sainsbury A. (In preparation). Description of an outbreak of Feather Disease of Unknown Etiology in Eurasian Curlew (*Numenius arquata*) within a Head-starting Facility in the United Kingdom.

DRAHS Limb abnormalities in head-started larval pool frogs

In 2024, investigations continued into limb abnormalities observed in head-started pool frog larvae between 2015 and 2023.

Northern clade pool frogs (*Pelophylax lessonae*) were reintroduced to Norfolk, England, using wild-to-wild translocations of pool frogs from Sweden. Head-starting was used to establish a second site in Norfolk, however limb abnormalities have been observed in 274 of 1722 larvae in 4 of 7 years of head-starting, thereby reducing the number of larvae successfully reared for release. Detailed management guidelines were followed for pool frog head-starting, which were developed using established methods which had not resulted in limb abnormalities in other contexts with the same and related species (Michales and Försäter, 2017).

The limb abnormalities were usually bilateral and often detected before forelimbs had developed. The abnormal limbs have been described as shortened, thin, and often taper to a point with no defined digits (Figure 27) or may be missing one or more digits (Figure 28). Diagnostic tests have not shown links to bacteria, fungi, or known amphibian viruses. Histopathology findings have been variable between years and the cause of the limb abnormalities has not been apparent, however there were possible signs of dyschondroplasia in 2015 and 2021. Although the clinicopathological findings have been similar across years, it is possible that diseases of more than one aetiology have been recorded. So far there have been indicators to suggest that metabolic bone disease and toxicities may be implicated either in part or as the sole diagnosis. Further tests are also being conducted on possible infectious aetiological agents including viruses and metazoan parasites.

Figure 27: A pool frog larva at 64 days post hatch with smooth pedes and without grossly differentiated digits (indicated by white arrows). Image credit: ZSL.

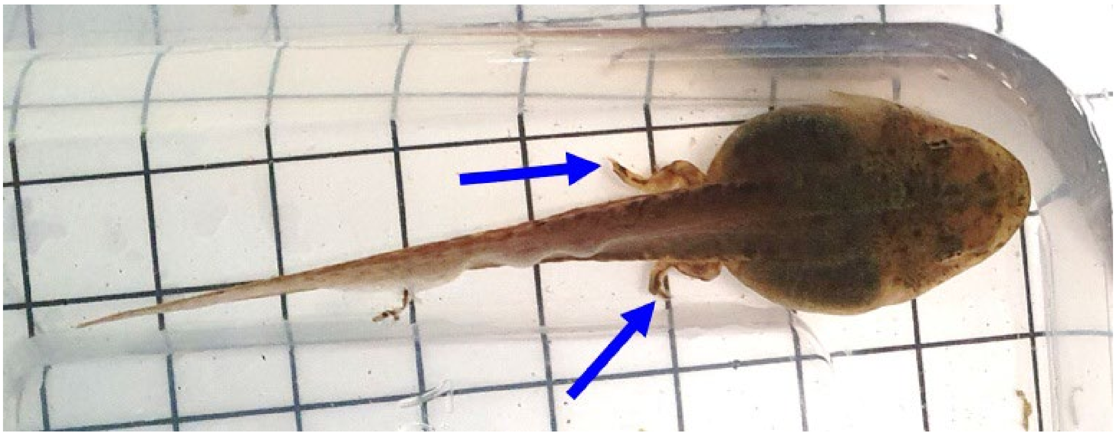

Figure 28: One of the pool frog larva from 2023, with only one defined digit on each hind limb (indicated by blue arrows) and the digit on the right hind limb is curled cranially. Image credit: ZSL.

References

Michaels CJ, Försäter, K. Captive breeding of Pelophylax water frogs under controlled conditions indoors. *The Herpetological Bulletin* 2017;**142**:29 to 34.

Cefas White claw crayfish mortalities

In August 2024 the Environment Agency (EA) reported unexplained mortalities of White Claw Crayfish (*Austropotomobius pallipes*) in Northeast England, samples were submitted to Cefas for analysis.

Mortalities of the endangered, White-clawed crayfish (WCC) were first reported to the EA in mid-August 2024, in Northeast England. WCC are currently listed as endangered on the International Union for Conservation (IUCN) Red List of threatened species. This catchment holds the biggest known colony of WCC anywhere in the country and potentially Europe. Crayfish were reported to display unusual shell deformities, brown or orange patches were noted on the shells, affected animals reported to be widespread across the catchment. The EA conducted field surveys to determine the likely extent of the outbreak, surveys identified 6 separate sites across the catchment where there were dead crayfish and/or crayfish showing signs of disease.

A total of 35 individual crayfish over 3 sample locations were submitted to Cefas for testing between the end of August and beginning of October 2024. Samples were tested for the World Organisation for Animal Health (WOAH) listed disease agent White Spot Syndrome Virus (WSSV) and Crayfish plague (*Aphanomyces astaci*), all samples testing negative. Out of the 35 crayfish submitted for analysis only 8 displayed shell abnormalities, lesions of varying size, shape and colour (Figure 29A and 29B). Tail muscle in 6 animals was noted to be white in appearance at time of dissection (Figure 29D) as compared to the normal appearance (Figure 29C).

Histopathological examination showed a viral infection in the hepatopancreas tissues of 22 animals (Figure 29E). This is likely to be infection with Austropotomobius pallipes bacilliform virus (Edgerton 2003; Edgerton and others, 2002). Similar bacilliform viral infections are frequently observed in the hepatopancreas of various crustacean species, including crayfish (Bateman and Stentiford, 2017), and given the low level of pathology observed in the tissues examined, it was thought that this was likely to be incidental and unlikely to be associated with mortality. The white musculature was shown to be due to a microsporidian infection; microsporidian spores were observed within the heart and muscle from the tail and body (Figure 29F). Two microsporidian species have been reported in WCC, *Astathelohania contejeani* and *Nosema austropotamobii*, infection from these animals was confirmed to be *A. contejeani* via PCR and sequencing.

Tests were also applied for Bunya-like brown spot virus, a virus which has been associated with brown spots and mortalities in WCC in Europe (Grandjean and others, 2019), all results were negative. Additional analysis via PCR using generic fungal primers on the carapace samples noted with lesions were also negative.

EA will continue to monitor the catchment and has contacted known river users (e.g. canoe clubs), landowners, and permit holders using the catchment to advise them of the ongoing incident and ask them to adhere to biosecurity measures. Cefas will continue to work with the EA to develop sampling plans to re-assess wild stocks when the temperatures increase and breeding season has finished, this is likely to take place in July 2025.

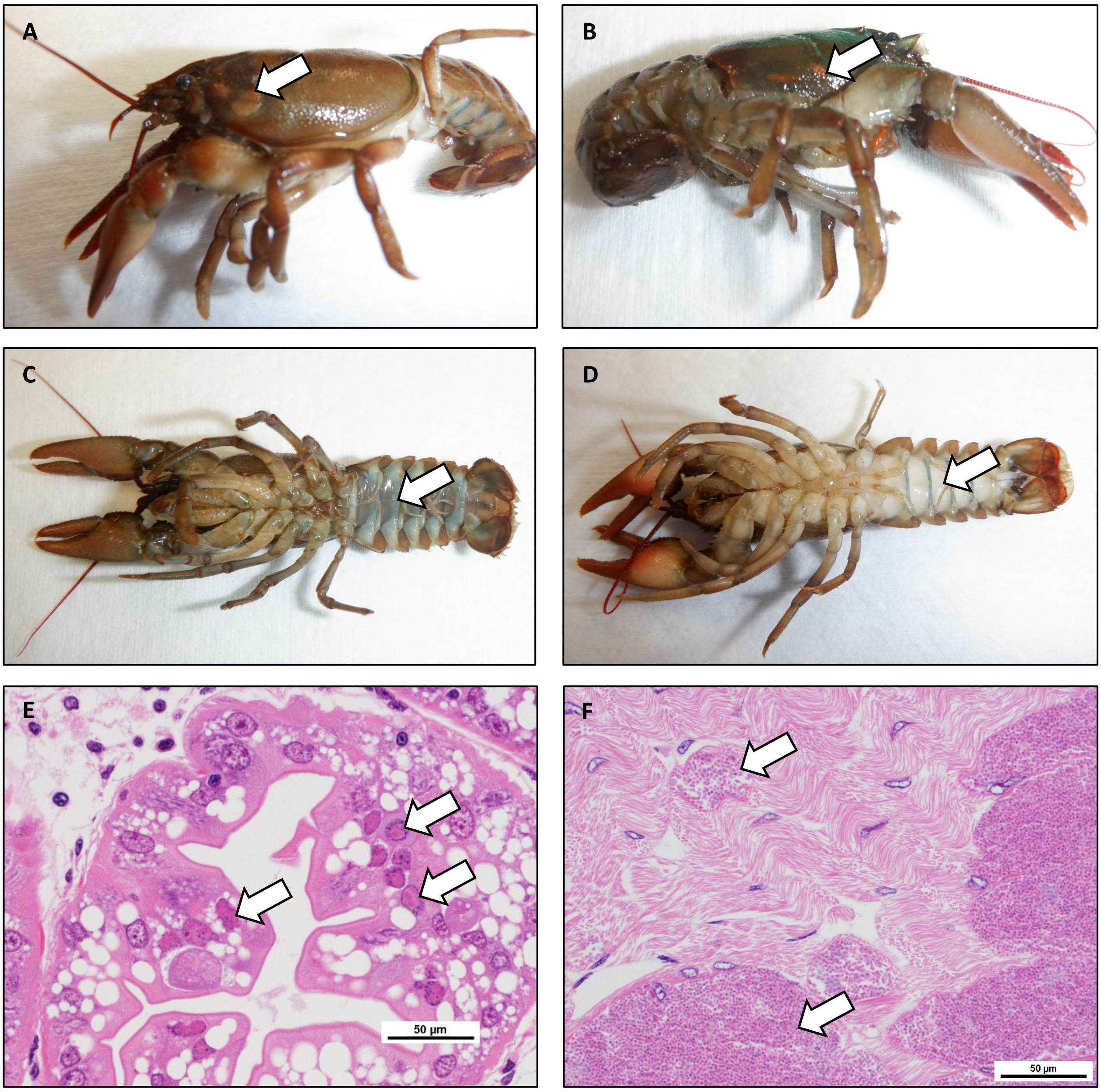

Figure 29: A) Photograph of white claw crayfish with brown shell lesions (arrow). B) Photograph of white claw crayfish with orange lesions on shell. C) Image of underside of white claw crayfish with normal, translucent muscle in the tail. D) Photograph of the underside of white claw crayfish, muscle in the tail appears white in colouration. E) Histology figure of a section of hepatopancreas tissues. Arrows indicate a viral infection in the nuclei within the tubule. F) Histology figure of muscle tissues infected with microsporidian parasite *Astathelohania contejeanii*. Normal muscle fibres are replaced with developing parasite spores (arrows) during the infection. Image credit: Cefas.

References

Bateman KS, Stentiford GD. A taxonomic review of viruses infecting crustaceans with an emphasis on wild hosts. *Journal of Invertebrate Pathology* 2017;**147:**86 to 110.

Edgerton BF. Further studies reveal that *Austropotamobius pallipes* bacilliform virus (ApBV) is common in populations of native freshwater crayfish in south-eastern France. *Bulletin of the European Association of Fish Pathologists* 2003;**23:**7 to12.

Edgerton BF, Watt H, Becheras J-M, Bonami J-R. An intranuclear bacilliform virus associated with near extirpation of *Austropotamobius pallipes* Lereboullet from the Nant watersed in Ardeche, France. *Journal of Fish Diseases* 2002;**25:**523 to 531.

Grandjean F, Gilbert C, Razafimafondy, F, Vucić M, Delaunay C, Gindre P, Bouchard J, Raimond M, Moumen B. A new bunya-like virus associated with mass mortality of white-clawed crayfish in the wild. *Virology* 2019;**533:**115 to 124.

SRUC Suspected distal extremity necrosis in a common buzzard

In March 2024, a common buzzard was found dead in the north of Scotland with lesions consistent with distal extremity necrosis, which were suspected to be the cause of death.

The adult common buzzard (*Buteo buteo*) was in a state of emaciation, and on the right foot digits one, 2 and 3 were grey-brown and appeared devitalised (Figure 30). The subcutaneous tissues were red and degenerate, with a completely different appearance to those of the left foot. SRUC Veterinary Services noted that the appearance was very unusual: these 3 toes on the right foot appeared necrotic, as if they had lost their blood supply, but no injury to the leg or foot was found, and no evidence of ischaemia or infarction was found in any other tissues. Distal extremity necrosis has been described in several captive birds (Calle and others, 1982). It can be primary where no cause is apparent or secondary, following frostbite or other injury, and it is fatal without surgical intervention. The buzzard had not fed recently, was emaciated at time of death, and no significant pathology, apart from the foot lesion, was found.

Figure 30: The photograph on the left shows an external view of both feet, with grey, devitalised tissue observed on the toes of the right foot. The photograph on the right shows the feet after incision and some reflection of the skin, to show the reddened subcutaneous tissues as described on the right foot, in comparison to the same tissues on the left foot. Image credit: Fiona Howie, SRUC.

References

Calle PP, Montali RJ, Janssen DL, Stoskopf MK, Strandberg JD. Distal extremity necrosis in captive birds. *Journal of Wildlife Diseases* 1982;**18(4)**:473 to 479.

SRUC Gastric haemangiomas in an osprey

In September 2024, an osprey was found dead in the north of Scotland with unusual lesions in the glandular stomach wall.

The adult female osprey *(Pandion haliaetus*) was submitted to SRUC Veterinary Services following the recovery of the carcase, which showed emaciation. The proventriculus (glandular stomach) contained blood clots and black fluid. There was a mass in the wall close to the pylorus of approximately 10 x 10 x 4 mm which appeared to have been the source of the blood, and the intestinal content was black (Figure 31). A second, smaller mass was found in the proventricular wall close to the first. Histopathology was adversely affected by both autolysis and freeze-thaw damage, however, both masses appeared to be foci of thin-walled blood vessels and resembled haemangiomas. These are well recognised in hens where they are linked to infection with an Avian Leukosis Virus (Lin and others, 2013), and there has been a description of multiple haemangiomas in the skin of a red grouse (De Las Mulas and others, 1993).

Figure 31: The photograph shows the mucosal surface of the proventriculus (the internal surface of the opened stomach) with a black mass within, and distending, the wall of the stomach to the left of the picture. There are multiple small round black blood clots adherent to the surface of the stomach wall throughout. The stomach wall also shows a thin layer of black fluid on the surface, which is likely to have been altered and digested blood. Image credit: Fiona Howie, SRUC.

References

De Las Mulas JM, Gomez-Villamandos JC, Perez J, Carrasco L, Mendez A. Multiple cutaneous capillary haemangioma in a red partridge (*Alectoris rufa*). *Avian Pathology* 1993;**22**(3):637 to 642.

Lin Y, Xia J, Zhao Y, Wang F, Yu S, Zou N, Wen X, Cao S, Huang Y. Reproduction of hemangioma by infection with subgroup J avian leukosis virus: the vertical transmission is more hazardous than the horizontal way. *Virology Journal* 2013;**10**:97.

SRUC Atypical pox virus lesions in a grey seal

Pox virus lesions on a seal pup in a rescue centre showed unusual intradermal proliferation of basal cells.

The approximately 12-week-old male grey seal (*Halichoerus grypus*) pup had been taken into a rescue at 3 days old, and had appeared healthy apart from some pox lesions on the end of the nose until it developed respiratory signs around a week before euthanasia was necessitated by a failure to improve with treatment. SRUC Veterinary Services noted a very good body condition at post-mortem examination, which revealed a severe interstitial pneumonia and bronchiolitis, consistent with a viral aetiology, as diagnosed on histopathology (Figure 32). It was noted that systemic spread of the poxvirus lesion was a possibility. Histopathological examination of the skin found that the poxvirus lesion was not typical – rather than causing epidermal hyperplasia, there appeared to be an intradermal proliferation of basal cells (Figure 33). These did have large cytoplasmic inclusions consistent with a poxvirus (Figure 33). SRUC Veterinary Services noted that pneumonia associated with a novel poxvirus infection has been described in a seal in Germany (Pfaff and others, 2023). Other differential diagnoses include phocine distemper (a morbillivirus), a coronavirus or an influenza virus. Phocine herpesvirus is present in seal populations in Scotland but would be expected to affect mainly the bronchi.

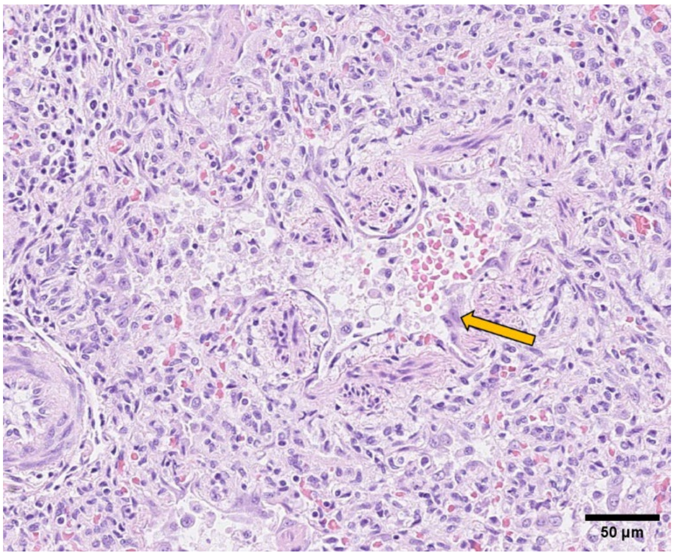

Figure 32: Histology image of seal lung tissue at high power to show bronchioles having marked epithelial loss and attenuation (yellow arrow). Image credit: Peter Richards-Rios, SRUC.

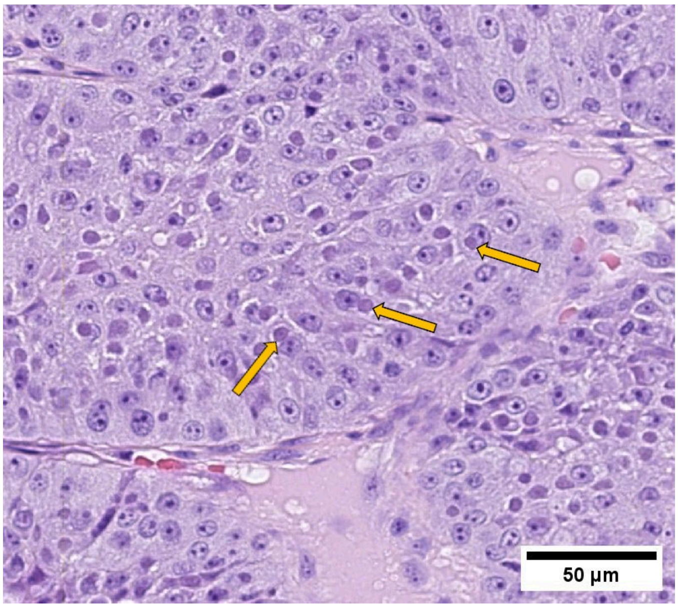

Figure 33: Histology image of the seal's skin from the nose showing common, round, basophilic, cytoplasmic inclusion bodies (yellow arrows) in neoplastic cells. Image credit: Peter Richards-Rios, SRUC.

References

Pfaff F, Kramer K, King J, Franzke, K, Rosenberger T, Höper D, König P, Hoffmann D, Beer M. Detection of Novel Poxvirus from Gray Seal (*Halichoerus grypus*), Germany. *Emerging Infectious Diseases*, 2023;**29**(6):1202 to 1205.

Publications and conference presentations from 2024

APHA DoWS and National Wildlife Management Centre

Publications

Albery GF, Becker DJ, Firth JA, Silk M, Sweeny AR, Vander Wal E, Webber Q, Allen B, Babayan SA, Barve S, Begon M, Birtles RJ, Block TA, Block BA, Bradley JE, Budischak S, Buesching CB, Burthe SJ, Carlisle AB, Caselle JE, Cattuto C, Chaine AS, Chapple T, Cheney BJ, Clutton-Brock T, Collier M, Curnick DJ, Delahay RJ, Farine DR, Fenton A, Ferretti F, Fielding H, Foroughirad V, Frere C, Gardner MG, Geffen E, Godfrey SS, Graham AL, Hammond PS, Henrich M, Heurich M, Hopwood P, Ilany A, Jackson JA, Jackson N, Jacoby DJ, Jacoby AM, Ježek M, Kirkpatrick L, Klamm A, Klarevas-Irby JA, Knowles S, Koren L, Krzyszczyk EW, Kusch JM, Lambin X, Lane JE, Leirs H, Leu ST, Lyon BE, MacDonald DW, Madsen AE, Mann J, Manser M, Mariën J, Massawe A, McDonald RA, Morelle K, Mourier J, Newman C, Nussear KN, Nyaguthii B, Ogino M, Ozella L, Papastamatiou Y, Paterson S, Payne E, Pedersen AB, Pemberton JM, Pinter-Wollman N, Planes S, Raulo A, Rodríguez-Muñoz R, Sabuni C, Sah P, Schallert RJ, Sheldon BC, Shizuka D, Sih A, Sinn DL, Sluydts V, Spiegel O, Telfer ST, Thomason CA, Tickler DM, Tregenza T, VanderWaal K, Walters EL, Wanelik KM, Wielgus E, Wilson-Aggarwal J, Wohlfeil C, Bansal S. Density-dependent network structuring within and across wild animal systems. *bioRxiv* 2024;06.28.601262.

Banks CJ, Sanchez A, Stewart V, Bowen K, Smith G, Kao RR. Machine learning augmented diagnostic testing to identify sources of variability in test performance. *arXiv Preprint* 2024. arXiv:2404.03678.

Barbour K, Smith S, McClune DW, Jones R, Moffat C, Lawton C, and others. Dead-reckoning facilitates determination of activity and habitat use: a case study with European badgers (*Meles meles*). *Animal Biotelemetry* 2024;**12**:28.

Beatham SE, Stephens PA, Goodwin D, Coats J, Thomas E, Rochester I, Massei G. An assessment of seasonal bait uptake by individual grey squirrels to develop a delivery system for oral contraceptives. *Pest Management Science* 2024;**80**:5597 to 5607.

Benton CH, Griffiths AL, Delahay RJ. Performance of fur clips and livestock markers for identifying vaccinated badgers. *European Journal of Wildlife Research* 2024;**70**:39.

Colloff A, Baker SE, Beausoleil NJ, Sharp T, Golledge H, Lane J, Cox R, Siwonia M, Delahay R. Use of an expert elicitation methodology to compare welfare impacts of two approaches for blood sampling European badgers (*Meles meles*) in the field. *Animal Welfare* 2024;**33**:e17.

ENETWILD-consortium, Croft S, Blanco-Aguiar JA, Acevedo P, Illanas S, Vicente J, Warren DA, Smith GC. Modelling wild boar abundance at high resolution. *EFSA Supporting Publication* 2024;**21**(7):EN-8965,29.

ENETWILD Consortium, Guerrasio T, Carniato D, Acevedo P, Apollonio M, Arakelyan M, Arnon A, Beatham S, Belova O, Berde L, Berdión O, Blanco-Aguiar JA, Bleier N, Burgui Oltra JM, Carvalho J, Casaer J, Dijkhuis L, Duniš L, Ertuk A, Dal Mas M, Ferroglio E, Forti A, Gačić D, Gavashelishvili A, Hillström L, Jenječić M, Ježek M, Keuling O, Licoppe A, Liefting Y, Martinez-Carrasco C, Olano I, Palencia P, Plis K, Podgorski T, Pokorny B, Rowcliffe M, Santos J, Smith GC, Sola de la Torre J, Stoyanov S, Zanet S, Vicente J, Scandura M. Generating wildlife density data across Europe in the framework of the European Observatory of Wildlife (EOW). *EFSA Supporting Publication* 2024;**21**(10):EN-9084 70.

ENETWILD Consortium, Occhibove F, Knauf S, Sauter-Louis C, Staubach C, Allendorf V, Anton A, Barron S, Bergmann H, Bröjer C, Buzan E, Cerny J, Denzin N, Gethöffer F, Globig A, Gethmann J, Gonzálvez M, García-Bocanegra I, Harder T, Jori F, Keuling O, Neimanis A, Neumann HJ, Pastori I, Parreira P, Rijks J, Schulz K, Trogu T, Plis K, Vada R, Vercher G, Wischnewski N, Zanet S, Ferroglio E. The role of mammals in avian influenza: a review. *EFSA Supporting Publication*. 2024;**21**(3):EN-8692 54.

ENETWILD-Consortium, Warren DA, Croft S, Rijks J, Vicente J, Blanco-Aguiar JA, Smith GC. Risk factors analysis of ASF in wild boar. *EFSA Supporting Publication*. 2024;**22**(12):e9095.

Duff P, Everest D, Martindale L, Barlow, A. Rocchi, M. and Lavazza, A. European brown hare syndrome virus and other lagoviruses of interest. *Veterinary Record* 2024;**195**(9):369 to 370.

Golding ME, Wu G, Wilkie R, Picard-Meyer E, Servat A, Marston DA, Aegerter JN, Horton DL, McElhinney LM. Investigating the emergence of a zoonotic virus: phylogenetic analysis of European bat lyssavirus 1 in the UK. *Virus Evolution* 2024;**10**(1):veae060.

Hassall RMJ, Purse BV, Barwell L, Booy O, Lioy S, Rorke S, Smith K, Scalera R, Roy HE. Predicting the spatio-temporal dynamics of biological invasions: Have rapid responses in Europe limited the spread of the yellow-legged hornet (*Vespa velutina nigrithorax*)? *Journal of Applied Ecology* 2024;**62**(1):106 to118.

Hinds J, Apaa T, Parry RH, Wither AJ, MacKenzie L, Staley C, Morrison J, Bennett M, Bremner-Harrison S, Chadwick EA, Hailer F, Harrison SWR, Lambin X, Loose M, Matthews F, Tarlinton R, Blanchard A. Multiple novel caliciviruses identified from stoats (*Mustela erminea*) in the United Kingdom. *Access Microbiology* 2024;**6**(7):000813

Jinks R, Hollingdale A, Avigad R, Velarde J, Pugsley C, de la Rua-Domenech R, Pritchard C, Roberts T, Clark J, Robinson N, Maynes R, Withenshaw S, Smith G. Estimating the seroprevalence of tuberculosis (*Mycobacterium bovis*) infection in a wild deer population in southwest England. *bioRxiv*. 2024;10.03.613747.

Konzen E, Delahay RJ, Hodgson DJ, McDonald RA, Pollock EB, Spencer SEF, McKinley TJ. Efficient modelling of infectious diseases in wildlife: a case study of bovine tuberculosis in wild badgers. *PLoS Computational Biology* 2024;**20**(11): e1012592.

Lean, FZX, Falchieri M, Furman N, Tyler G, Robinson C, Holmes P, Rei SM, Banyard AC, Brown IH, Man C, Núñez A. Highly pathogenic avian influenza virus H5N1 infection in skua and gulls in the United Kingdom, 2022. *Veterinary Pathology* 2024;**61**:421 to 431.

Matthews F, Tarlinton R, Blanchard A. Multiple novel Caliciviruses identified from stoats (*Mustela erminea*) in the United Kingdom. *Access Microbiology* 2024;**6**(7):000813.

Powell S, Dessi N, Bennett M, Wang B, Robertson R, Waller E, Smith G, Delahay R. Tuberculosis in found dead badgers at the edge of the expanding bovine tuberculosis epidemic. *Research Square Preprint (Version 1)* October 4, 2024.

Reid SM, Byrne AMP, Lean FZX, Ross CS, Pascu A, Hepple R, Banyard AC. A multi-species, multi-pathogen avian viral disease outbreak event: Investigating potential for virus transmission at the wild bird – poultry interface. *Emerging Microbes and Infections* 2024;13(1).

Ross CS, Byrne AMP, Mahmood S, Thomas S, Reid S, Freath L, Griffin LR, Falchieri M, Holmes P, Goldsmith N, et al. Genetic analysis of H5N1 high-pathogenicity avian influenza virus following a mass mortality event in wild geese on the Solway Firth. *Pathogens* 2024;**13**(1):83.

Withers AJ, Croft S, Budgey R, Warren DA, Johnson N. Using correlative and mechanistic species distribution models to predict vector-borne disease risk for the current and future environmental and climatic change: a case study of West Nile Virus in the UK. *bioRxiv* 2024;09.12.612656.

Wood AJ, Benton CH, Delahay RJ, Marion G, Palkopoulou E, Pooley CM, Smith GC, Kao RR. The utility of whole-genome sequencing to identify likely transmission pairs for pathogens with slow and variable evolution. *Epidemics* 2024;**48**:100787.

Zichello JM, DeLiberto ST, Holmes P. and others. Recent beak evolution in North American starlings after invasion. *Scientific Reports* 2024;**14**:140.

Conference presentations

Cantlay J. The Great Britain Wildlife Health Partnership. Presented at: *18th Garden Wildlife Health Forum Meeting*; October 2024; London, UK.

Cox R. Surveillance for coronaviruses in UK wildlife. Presented at: *Deer Farms and Parks Association meeting on surveillance for coronaviruses in wildlife*; April 2024; Oxford, UK.

Cox R, Powell S, Delahay R. Insights from a long-term wildlife disease ecology study: long-term temporal trends of Mycobacterium bovis infection in a wild badger (*Meles meles*) population over 50 years. Presented at: *International Wildlife Disease Association Conference*; December 2024; Canberra, Australia.

Cox R, Robertson A, Staff R, Delahay R. Evidence for badger visits to farm buildings and the risks of Bovine tuberculosis transmission to cattle: a review and meta-analysis.

Presented at: *International Symposium for Veterinary Epidemiology and Economics*; November 2024; Sydney, Australia.

Delahay, R. J. Ecological complexity and Wildlife Disease. Presented at: *Wildlife Disease Association Conference*; Dec 2024; Canberra, Australia.

Duff, JP, Smith, G, Delahay, R and Drewe, JA. How effective and efficient is your surveillance scheme? Poster presentation at: *15th European Wildlife Disease Association (EWDA) conference*; September 2024; Stralsund, Germany.

Holmes, JP. Avian Air Accident Investigation - *Sturnus vulgaris* – Starlings. Presented at: *15th European Wildlife Disease Association (EWDA) conference*; September 2024; Stralsund, Germany.

Seekings AH, Goharriz H, Bagley M, Martyn A, Arrowsmith K, Shukla S, Shipley R, Cox R, Delahay R, Brookes SM and McElhinney LM. Investigating neutralising antibodies to SARS-CoV-2 in domestic and wild animals. Presented at: *UK International Coronavirus Network (UK-ICN) Annual General Meeting*; September 2024; Edinburgh, UK.

Washtell K & Cox R. Territorial Changes of a Group-living Carnivore in the wake of culling pressure. Presented at: *35th European Mustelid Colloquium*; September 2024; Romania.

Institute of Zoology

Publications

Albrecht S, Minto C, Rogan E, Deaville R, O'Donovan J, Daly M, Levesque S, Berrow S, Brownlow A, Davison NJ, Slattery O, Mirimin L, and Murphy S. Emaciated enigma: Decline in body conditions of common dolphins in the Celtic Seas ecoregion. *Ecology and Evolution* 2024;**14**:e70325.

Allain SJ, Leech DI, Hopkins K, Seilern-Moy K, Rodriguez-Ramos Fernandez J, Griffiths RA, Lawson B. Characterisation, prevalence and severity of skin lesions caused by ophidiomycosis in a population of wild snakes. *Scientific Reports* 2024;Mar 2;**14**(1):5162.

Ball S, Petrovan S, Ashe-Jepson E, Dobson C, Lawson B, Morrison L, Garner T. Genetic study of an isolated population of adders (*Vipera berus*) founded by historic translocation: implications for conservation. *Herpetological Journal* 2024;**34**:197 to 210.

Gibson L, Shadbolt T, Pranab P, Gerard G, Wrigglesworth E, Sainsbury AW, Donald H, Jaffe JE, Januszczak I, Fitzpatrick LD, Burrell C, Davies H, Dastjerdi A and Spiro S. Prevalence and Molecular Analysis of Encephalomyocarditis Virus-2 in the Hazel Dormouse. *Ecohealth* 2024;**21**(1):112 to 122

Lean FZ, Stidworthy MF, Dastjerdi A, Partridge T, Smith S, Gough J, Núñez A, Lawson B, Seilern-Macpherson K. Colocalization of hedgehog arterivirus 1 (HhAV-1) and histologic lesions in the European hedgehog (*Erinaceus europaeus*) with neurological disease. *Veterinary Pathology* 2024;3009858241300553.

Seilern-Macpherson K, Lawson B, Macadam CR, West P, Reed N, Gibson L, Świątek P, Gajda Ł, Cunningham AA, Heaver J, Julian JM. Predation of anurans in southern England by *Batracobdella algira*, a leech previously unknown in the UK. *Herpetological Journal* 2024;**34**:221 to 227.

Conference presentations

Allain SJR, Leech E, Robinson RA, Hopkins K, Seilern-Moy K, Rodriguez-Ramos Fernandez J, Griffiths RA, Lawson B. Investigating the prevalence and impact of ophidiomycosis in barred grass snake (*Natrix helvetica*) in Great Britain. *European Wildlife Disease Association annual conference 2024*; 9 to 13 September 2024; Stralsund, Germany.

Fowkes S, Seilern-Moy K, Cunningham AA, Jones E, Toms M, Peach W, Wormald K, Lawson B. Evaluating the success of a citizen science approach to wildlife disease surveillance. *European Wildlife Disease Association annual conference 2024*; 9 to13 September 2024; Stralsund, Germany.

Hanmer H, Cunningham AA, John S, Macgregor S, Robinson RA, Seilern-Moy K, Siriwardena GM, Lawson B. Habitat-use influences severe disease-mediated population declines in two common garden bird species in Great Britain. *European Wildlife Disease Association annual conference 2024*; 9 to 13 September 2024; Stralsund, Germany.

Jones E. The Garden Wildlife Health project. *Sustainability in Education Conference*; 14 February 2024; University of Bedfordshire, Bedfordshire, UK.

Lawson B, Cunningham AA, Lewis DI, Robinson RA, Vaux AGC, Medlock JM, Bruce RC, Folly AJ. Vector-Borne RADAR: An enhanced surveillance programme for mosquito-borne viral diseases of wild birds in the UK. Poster presentation. *European Wildlife Disease Association annual conference 2024*; 9 to 13 September 2024; Stralsund, Germany.

Lean FZX, Stidworthy MF, Dastjerdi A, Partridge T, Smith S, Gough J, Núñez A, Lawson B, Seilern-Moy K. Hedgehog Arterivirus-Associated Encephalitis in Captive European Hedgehogs (*Erinaceus europaeus*) in Wildlife Rehabilitation Centres in England. *Cutting Edge Pathology Congress*; 29 August 2024; Madrid, Spain.

Seilern-Moy K. Garden Wildlife Health – an update on recent hedgehog disease investigations. *International Conference for Hedgehog Rehabilitators 2024*; 13 to 14 January 2024; Hartpury University, UK.

Seilern-Moy K, Lawson B, Charman S, Rainford J, Jones S, Kent AJ, Cunningham AA, Barnett L. Investigating pesticide and anticoagulant rodenticide exposure in two nontarget British mammals. *European Wildlife Disease Association annual conference 2024*; 9 to 13 September 2024; Stralsund, Germany.

Seilern-Moy K, Peach W, Toms M, Smart A. Celebrating 10 years of Garden Wildlife Health. ZSL Science and Conservation. ZSL Science and Conservation Event; 29 January 2024; London, UK.

Vecchiato MB, Lawson B, Seilern-Moy K, White M, Jones N, Brown F, Yaffy D, Medlock JM, Hansford KM. Limited occurrence of *Borrelia afzelli* in European hedgehog (*Erinaceus europaeus*) and *Ixodes hexagonus* in Great Britain. *European Wildlife Disease Association annual conference 2024*; 9 to 13 September 2024; Stralsund, Germany.

Natural England

Publications

Howe CV, Campbell-Palmer R, Donald H, Girling S, Common S, Sainsbury AW, Palphramand K, Smith G, Pizzi R. Eurasian Beaver Disease Risk Management and Post-Release Health Surveillance Protocol. *Natural England Joint Publication JP055* 2024. Natural England, The Beaver Trust, RZSS, ZSL, APHA, Five Sisters Zoo

SRUC

Publications

Baily JL, Paterson GK, Foster G, Davison NJ, Begeman L, Hall AJ and Dagleish MP. The first report of *Listeria monocytogenes* detected in pinnipeds. Journal of Comparative Pathology 2024;**208:**54 to 60.

Lean FZX, Falchieri M, Furman N, Tyler G, Robinson C, Holmes P, Rei SM, Banyard AC, Brown IH, Man C, Núñez A. Highly pathogenic avian influenza virus H5N1 infection in skua and gulls in the United Kingdom, 2022. *Veterinary Pathology* 2024;**61**:421 to 431.

Montano Valley de Las Nieves D, Berezowski J, Delgado Hernandez B, Hernandez A, Percedo M, Zamora PA, Carmo LP. Modeling Transmission of Avian Influenza Viruses at the Human-Animal-Environment Interface in Cuba. *Frontiers in Veterinary Science* 2024;**11**:1415559.

Pennycott T, Bignal EM, McCracken D. Significant helminthiasis, ocular defects and other disorders in an endangered population of red-billed choughs (*Pyrrhocorax pyrrhocorax*): A descriptive observational study. *Veterinary Record* 2024 Dec 26:e4961.

Conference presentations

Howie, F. Users' Guide to Wildlife Pathology and Forensic Testing. Paper presented at: *35th UK Wildlife Crime Enforcement Conference*; December 4 to 6, 2024; Woodlands Event Centre, Wyboston Lakes, Great North Road, Wyboston, Bedford MK44 3AR.

Points raised to policy

During 2024, the Wildlife Expert Group veterinary leads raised 5 points for information to the Vet Risk Group.

The Vet Risk Group is a cross-directorate body that provides a coordinated and systematic process for identifying, assessing, characterising, prioritising and escalating animal health and welfare risks (both new and re-emerging) across all 4 administrations.

The following points for information (PFIs) were raised:

Updated PFI: Amphibian disease of anurans in GB caused by an exotic non-native leech parasite *Batracobdella algira* (exotic non-notifiable disease) - route of entry into UK currently unknown. Date raised: April 2024.

Source: Garden Wildlife Health Project provided information from a paper prior to its journal publication: Lawson B, Seilern-Moy K, Cunningham A. Predation of anurans in southern England by *Batracobdella algira*, a leech previously unknown in the UK. *Herpetological Journal* 2024;**34**(4):221 to 227.

New PFI: First detection of Encephalomyocarditis Virus-2 (EMCV-2) in wild hazel dormice (*Muscardinus avellanarius*) in England. Date raised: August 2024.

Source: Gibson L, Shadbolt T, Pranab P, Gerard G, Wrigglesworth E, Sainsbury AW, Donald H, Jaffe JE, Januszczak I, Fitzpatrick LD, Burrell C, Davies H, Dastjerdi A and Spiro S. Prevalence and Molecular Analysis of Encephalomyocarditis Virus-2 in the Hazel Dormouse. *Ecohealth* 2024;**21**(1):112 to 122.

New PFI: First detection of Iberian myxoma variant in brown hares (*Lepus europaeus*) in Germany. Date raised: November 2024.

Source: New threat to the brown hare: Iberian myxoma virus variant detected in Germany for the first time | Friedrich-Loeffler-Institut (fli.de)

Updated PFI: Ophidiomycosis (snake fungal disease) detections in wild snakes in England – a potential biodiversity risk. Date raised: December 2024.

Source: Allain SJR, Leech DI, Hopkins K, Seilern-Moy K, Rodriguez-Ramos Fernandez J, Griffiths RA, Lawson B. Characterisation, prevalence and severity of skin lesions caused by ophidiomycosis in a population of wild snakes. *Scientific Reports* 2024:**14**(1):5162.

New PFI: Unexpected mortality event in North Sea Grey Seals with *Streptococcus zooepidemicus* isolated from seal carcases at post-mortem examination. Date raised: December 2024.

Source: Direct reports from Cetacean Strandings Investigation Program and inshore fisheries colleagues.

Appendix 1 – Combined Wildlife Disease Data 2024

Appendix 1 incorporates data from APHA DoWS, SRUC and GWH (IoZ) wildlife submissions from 2024. This was achieved using the VIDA (Veterinary Investigation Diagnosis Analysis) coding system; listed diagnoses have set criteria that need to be fulfilled.

This data set only includes routine diagnostic submissions and does not include project work. Only a subset of the wild birds testing positive for avian influenza virus have been included in this summary (those received at the APHA Veterinary Investigation Centres). For the complete avian influenza in wild bird data set please refer to Avian influenza in wild birds: 2024 dataset found on Bird flu (avian influenza): cases in wild birds.

“Mixed bird” submissions are submissions where multiple species have been submitted together. Some species have been listed as “unspecified” or unknown. This is usually due to severe autolysis impeding definitive identification or because the carcase is incomplete, making full identification impossible. Please note that the count is by submission, and not by carcase, shown in the table A1 and figure A1 below. A single submission may often contain multiple carcases. Each submission may have several VIDA code diagnoses and therefore may be listed multiple times in each table. Tables A2 to A4 provide counts for diagnosis reached (including multiple VIDA codes from single submissions), but do not include submissions where a diagnosis was not reached. In some cases, carcases received from AIV surveillance (PCR negative for AI) were autolysed or unsuitable preventing post-mortem examination (PME). Notifiable diseases, such as tuberculosis and avian influenza in wild mammals, are not included in these tables, as reported information is available at Data on TB in Non-Bovine Species and Bird flu (avian influenza): findings in non-avian wildlife. Cases of poisoning from chemicals are also not included in the tables because they do not fall under the APHA DoWS (ED1600 contract), instead are dealt with by the Wildlife Incident Investigation Scheme – WIIS in England and Wales.

Table A1: the number of submissions by category of animal and country

Country	Animal Category	APHA	IOZ	SRUC	Total
England	Amphibian	0	20	0	20
	Bird	1,381	68	7	1,456
	Mammal	145	43	1	189
	Reptile	0	6	0	6
Total for England	**Total**	**1,526**	**137**	**8**	**1,671**
Scotland	Bird	10	4	299	313
	Mammal	0	1	19	20
	Reptile	1	1	0	2
Total for Scotland	**Total**	**11**	**6**	**318**	**335**
Wales	Amphibian	0	2	0	2
	Bird	96	4	1	101
	Mammal	5	2	0	7
Total for Wales	**Total**	**101**	**8**	**1**	**110**
Not supplied	Bird	4	0	1	5
	Mammal	0	0	2	2
Total for Not supplied	**Total**	**4**	**0**	**3**	**7**
Total for all countries	**Total**	**1,642**	**151**	**330**	**2,123**

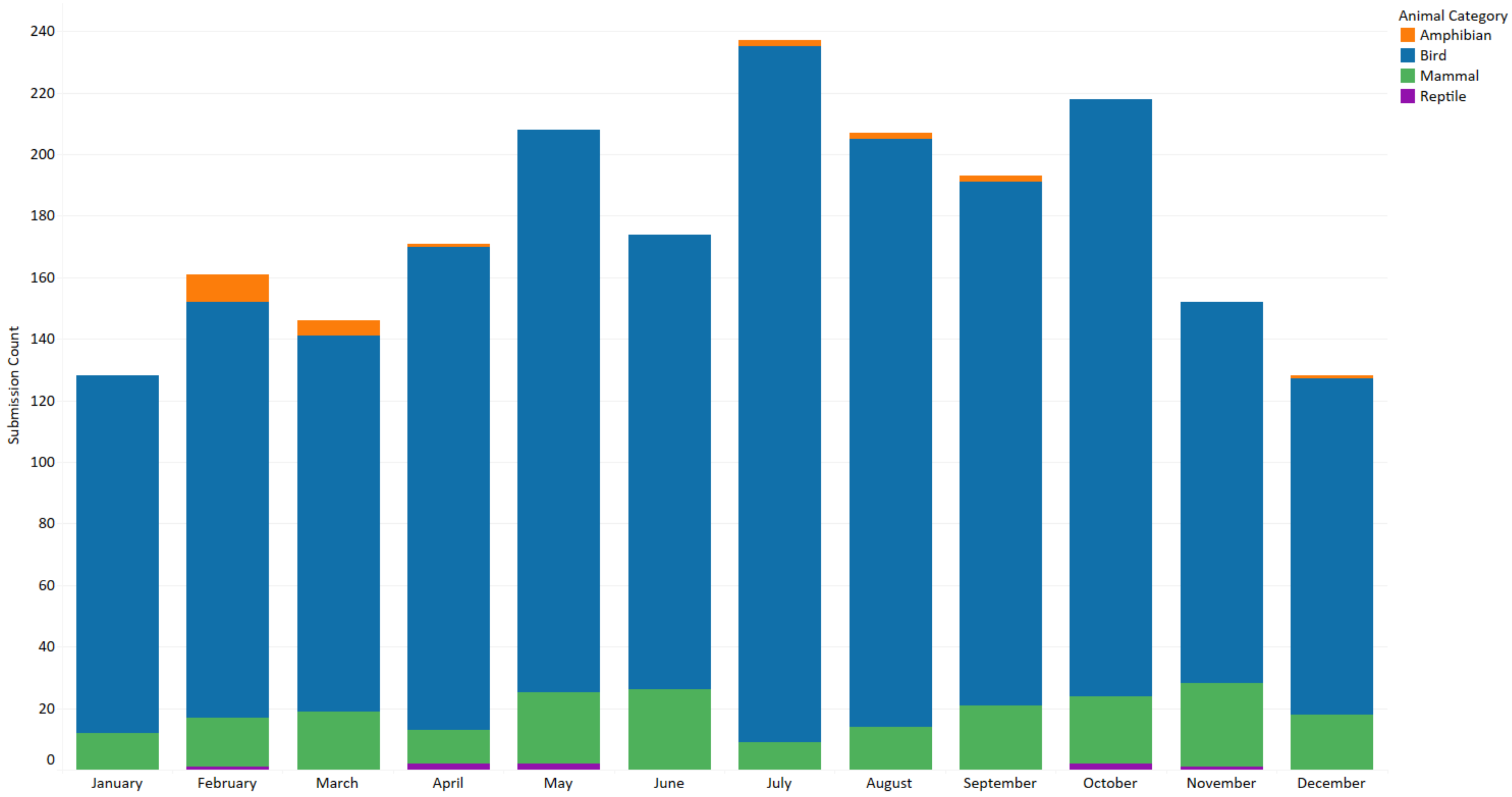

Figure A1: Bar chart to show the number of submissions (on the y axis) by animal category for each month from January to December 2024 (on the x axis), with amphibians shown as orange bars, birds shown as dark blue bars, mammals shown as green bars and reptiles as light blue bars. For this period, the majority of submissions are categorised as birds of different species. The greatest number of submissions (over 230 submissions) that were primarily wild birds, occurred in July.

Table A2: number of VIDA diagnoses in mammals by species

Animal Group	Common Name	Diagnosis Description	Diagnosis Count
Canid	Fox	Leptospirosis	6
		Diagnosis not listed - digestive disease	3
		Streptococcal infection	2
		Salmonellosis dt S. Typhimurium	2
		Trauma: Predation	1
		Staphylococcal infection	1
		Pneumonia (bacterial)	1
		Parasitic pneumonia	1
		Parasitic gastroenteritis	1
		Mastitis dt organism NOS	1
		Ectoparasitic disease	1
		Diagnosis not listed - urinary disease	1
		Diagnosis not listed	1
		Colisepticaemia	1
		Amyloidosis	1
Deer	Muntjac deer	Diagnosis not listed - systemic disease	1
	Roe deer	Parasitic gastroenteritis	6
		Tick-borne fever	1
		Parasitic gastroenteritis - Haemonchosis	1
		Diagnosis not listed - systemic disease	1
	Sika deer	Salmonellosis dt S. Typhimurium	1
	Deer unspecified	Parasitic pneumonia	1
		Diagnosis not listed - digestive disease	1
Hedgehog	European hedgehog	Parasitic pneumonia	24
		Trauma: Predation	10
		Trauma/fracture	7
		Salmonellosis dt S. Enteritidis	7
		Trauma: Road Traffic Accident	4
		Parasitic gastroenteritis	2
		Septicaemia	1
		Salmonellosis dt S. Typhimurium	1
		Malnutrition	1
		Listeriosis - systemic/enteric	1
		Diagnosis not listed - urinary disease	1
		Diagnosis not listed - systemic disease	1
		Diagnosis not listed - nervous disease	3
		Diagnosis not listed - digestive disease	1
		Adverse environment - drowning	1
Mustelid	Badger	Malnutrition	2
		Trauma/fracture	1
		Trauma: Road Traffic Accident	1
		Ectoparasitic disease	1
	Eurasian otter	Trauma: Predation	3

		Streptococcal infection	2
		Malnutrition	2
		Trauma: Road Traffic Accident	1
		Parasitic gastroenteritis	1
		Meningitis/encephalitis	1
		Mandibular and Dental Abnormalities	1
	Pine marten	Streptococcal infection	1
		Diagnosis not listed - respiratory disease	1
Rabbit and hare	Brown hare	Trauma/fracture	1
		Nephritis	1
		Neoplasm	1
		European Brown Hare Syndrome	1
		Diagnosis not listed - systemic disease	1
		Amyloidosis	1
	European rabbit	Myxomatosis	3
		Rabbit haemorrhagic disease (including RHD2)	2
		Visceral parasitism	1
		Trauma/fracture	1
		Coccidiosis	1
	Mountain hare	Parasitic gastroenteritis	1
		Coccidiosis	1
Rodent	Beaver	Trauma/fracture	1
		Trauma: Road Traffic Accident	1
		Pneumonia	1
		Interstitial pneumonia	1
		Diagnosis not listed - systemic disease	1
		Diagnosis not listed - digestive disease	1
	Grey squirrel	Trauma: Predation	1
		Diagnosis not listed - circulatory disease	1
	Red squirrel	Squirrel pox	11
		Trauma/fracture	1
		Trauma: Predation	1
		Septicaemia	1
		Listeriosis - systemic/enteric	1
		Diagnosis not listed - digestive disease	1
		Diagnosis not listed - circulatory disease	1
Seal	Common/harbour seal	Diagnosis not listed - respiratory disease	1
	Grey seal	Streptococcal infection	9
		Parasitic pneumonia	6
		Diagnosis not listed - systemic disease	4
		Colisepticaemia	4
		Septicaemia	3
		Malnutrition	3
		Diagnosis not listed - musculo-skeletal disease	3
		Diagnosis not listed - digestive disease	3
		Trauma/fracture	2

		Trauma - bycatch	2
		Arthritis	2
		Umbilical infection +/- joint infection	1
		Salmonellosis dt S. Typhimurium	1
		Pox and parapox virus infection	1
		Pneumonia	1
		Meningitis/encephalitis	1
		Mandibular and Dental Abnormalities	1
		Diagnosis not listed - nervous disease	1
		Diagnosis not listed	1
	Seal unspecified	Gastric ulceration	1
Total diagnosis count			**212**

Table A3: number of VIDA diagnoses in birds by species

Animal Group	Common Name	Diagnosis Description	Diagnosis Count
Buzzard	Common buzzard	Trauma/fracture	19
		Malnutrition	12
		Oral trichomonosis (avian) including oesophagitis in garden birds	6
		Trauma: Road Traffic Accident	5
		Avian Influenza	4
		Helminthosis	3
		Diagnosis not listed - digestive disease	2
		Trauma: Predation	1
		Pneumonia	1
		Neoplasm	1
		Mycotic pneumonia or airsacculitis	1
		Mycoplasmosis	1
		Infectious sinusitis	1
		Diagnosis not listed - musculo-skeletal disease	1
Eagle	Golden eagle	Avian Influenza	2
		Avian tuberculosis	1
		Trauma/fracture	1
		Trauma: Predation	1
		Diagnosis not listed - respiratory disease	1
	White-tailed eagle	Trauma/fracture	1
		Avian Influenza	1
Falcon	Hobby	Malnutrition	1
		Helminthosis	1
		Diagnosis not listed - skin disease	1
	Kestrel	Malnutrition	12
		Trauma/fracture	7
		Helminthosis	2
		Oral trichomonosis (avian) including oesophagitis in garden birds	1
		Diagnosis not listed - digestive disease	1
	Peregrine	Trauma/fracture	3
		Avian Influenza	3
Harrier	Hen harrier	Trauma/fracture	2
		Trauma: Predation	2
		Malnutrition	2
	Montagu’s harrier	Trauma: Predation	1

Hawk	Goshawk	Trauma/fracture	1
	Sparrowhawk	Trauma/fracture	24
		Malnutrition	18
		Oral trichomonosis (avian) including oesophagitis in garden birds	13
		Trauma: Road Traffic Accident	2
		Avian Influenza	2
		Trauma: Predation	1
		Helminthosis	1
		Diagnosis not listed - digestive disease	1
Kite	Red kite	Trauma/fracture	8
		Avian Influenza	2
		Oral trichomonosis (avian) including oesophagitis in garden birds	1
		Diagnosis not listed - systemic disease	1
Osprey	Western osprey	Malnutrition	2
		Neoplasm	1
		Diagnosis not listed - digestive disease	1
Owl	Barn owl	Trauma/fracture	7
		Malnutrition	7
		Trauma: Road Traffic Accident	3
		Impactions of crop/gizzard/duodenum	1
	Short-eared owl	Trauma/fracture	1
		Malnutrition	1
	Tawny owl	Trauma/fracture	15
		Malnutrition	4
		Avian tuberculosis	2
		Helminthosis	2
		Trauma: Road Traffic Accident	1
		Trauma: Predation	1
		Peritonitis	1
		Oral trichomonosis (avian) including oesophagitis in garden birds	1
		Ingestion of inappropriate materials	1
		Diagnosis not listed - digestive disease	1
Grouse	Red (willow) grouse	Trichostrongylosis	1
		Helminthosis	1
Pheasant	Common pheasant (feral)	Trauma/fracture	4
		Avian Influenza	2
		Trauma: Road Traffic Accident	1
		Trauma: Predation	1
Corvid	Carrion crow	Diagnosis not listed - systemic disease	1
	Jackdaw	Trauma: Road Traffic Accident	1
	Rook	Septicaemia	1
		Peritonitis	1
		Airsacculitis - cause not determined	1

Finch	Brambling	Oral trichomonosis (avian) including oesophagitis in garden birds	1
	Bullfinch	Trauma/fracture	1
		Oral trichomonosis (avian) including oesophagitis in garden birds	1
	Chaffinch	Oral trichomonosis (avian) including oesophagitis in garden birds	8
		Trauma/fracture	1
		Trauma: Predation	1
		Cnemidocoptosis	1
	Goldfinch	Oral trichomonosis (avian) including oesophagitis in garden birds	6
		Ectoparasitic disease	1
	Greenfinch	Oral trichomonosis (avian) including oesophagitis in garden birds	15
		Trauma/fracture	2
		Trauma: Predation	2
	Siskin	Oral trichomonosis (avian) including oesophagitis in garden birds	5
		Trauma/fracture	1
		Trauma: Predation	1
		Protozoal infection	1
Flycatcher	Robin	Malnutrition	1
Sparrow	House sparrow	Salmonellosis dt S. Typhimurium	1
		Mycotic pneumonia or airsacculitis	1
		Fungal Infection	1
		Avian pox	1
Starling	Common starling	Trauma/fracture	2
		Trauma: Predation	2
		Salmonellosis (excluding S. Enteritidis and S. Typhimurium)	1
Swallow	Barn swallow	Colisepticaemia	1
Thrush	Blackbird	Trauma/fracture	3
		Trauma: Predation	2
		Malnutrition	2
		Trauma: Road Traffic Accident	1
		Protozoal infection	1
		Peritonitis	1
		Pasteurellosis	1
		Helminthosis	1
		Diagnosis not listed - digestive disease	1
	Song thrush	Trauma/fracture	1
Tit	Blue tit	Trauma/fracture	1
	Great tit	Trauma/fracture	1
Tree-clinging	Wren	Trauma/fracture	1
Warbler	Goldcrest	Trauma: Predation	1
Waxwing	Waxwing	Malnutrition	1
		Diagnosis not listed - digestive disease	1

Woodpecker	Great spotted woodpecker	Trauma/fracture	2
Pigeons and doves	Feral pigeon / Rock dove	Trauma/fracture	7
		PMV of pigeons (PPMV-1)	4
		Oral trichomonosis (avian) including oesophagitis in garden birds	3
		Trauma: Predation	2
		Yersiniasis	1
		Helminthosis	1
		Coccidiosis	1
	Woodpigeon	Trauma/fracture	4
		Oral trichomonosis (avian) including oesophagitis in garden birds	3
	Dove unspecified	PMV of pigeons (PPMV-1)	3
		Septic arthritis or tenosynovitis dt bacterial infection	1
Auk	Guillemot	Malnutrition	6
		Avian Influenza	3
		Peritonitis	1
		Helminthosis	1
		Diagnosis not listed - digestive disease	1
	Puffin	Trauma/fracture	1
		Malnutrition	1
	Razorbill	Nephrosis / nephropathy	1
		Malnutrition	1
Diver	Great northern diver	Diagnosis not listed - urinary disease	1
Gannet, Cormorant and Shag	Cormorant	Malnutrition	2
		Trauma: Road Traffic Accident	1
		Trauma - Snaring or entanglement	1
		Ingestion of inappropriate materials	1
		Helminthosis	1
		Diagnosis not listed - digestive disease	1
		Avian Influenza	1
	Northern gannet	Peritonitis	2
		Malnutrition	2
		Helminthosis	1
	Shag	Visceral parasitism	1
		Trauma/fracture	1
		Malnutrition	1
		Helminthosis	1

Gull	Black-headed gull	Malnutrition	2
		Amyloidosis	2
		Trauma: Road Traffic Accident	1
		Salmonellosis dt S. Typhimurium	1
		Diagnosis not listed - systemic disease	1
		Diagnosis not listed - reproductive disease (other than foetopathy)	1
	Common gull	Avian Influenza	2
		Trauma/fracture	1
	Great black-backed gull	Trauma/fracture	3
		Avian Influenza	3
		Malnutrition	2
	Herring gull	Trauma/fracture	53
		Avian Influenza	26
		Trauma: Road Traffic Accident	9
		Malnutrition	8
		Trauma: Predation	5
		Mycotic pneumonia or airsacculitis	4
		Impactions of crop/gizzard/duodenum	3
		Salmonellosis dt S. Typhimurium	2
		Peritonitis	2
		Fungal Infection	2
		Trauma - Snaring or entanglement	1
		Septicaemia	1
		Egg peritonitis/salpingitis complex	1
		Diagnosis not listed - respiratory disease	1
		Diagnosis not listed - digestive disease	1
		Airsacculitis - cause not determined	1
	Kittiwake	Avian Influenza	4
		Malnutrition	3
		Trauma/fracture	1
		Peritonitis	1
	Lesser black-backed gull	Trauma/fracture	12
		Trauma: Road Traffic Accident	1
		Mycotic pneumonia or airsacculitis	1
	Yellow-legged gull	Malnutrition	1
	Gull unspecified	Trauma/fracture	1
		Malnutrition	1
		Impactions of crop/gizzard/duodenum	1
Petrel and shearwater	Fulmar	Avian Influenza	3
	Manx shearwater	Neoplasm	1
Tern	Arctic tern	Trauma: Predation	1
		Egg peritonitis/salpingitis complex	1
Grebe	Great crested grebe	Trauma: Predation	1

Heron	Grey heron	Trauma/fracture	1
		Trauma - Snaring or entanglement	1
		Malnutrition	1
	Heron unspecified	Trauma: Predation	1
Rail	Coot	Trauma - Snaring or entanglement	1
		Peritonitis	1
Wader	Curlew	Malnutrition	5
		Diagnosis not listed - skin disease	5
		Rickets/osteomalacia	3
		Diagnosis not listed - digestive disease	2
		Cellulitis (usually E.coli, scratching)	2
		Trauma/fracture	1
		Diagnosis not listed - musculo-skeletal disease	1
		Avian Influenza	1
	Lapwing	Avian tuberculosis	1
		Trauma/fracture	1
	Woodcock	Trauma/fracture	1
Duck	Domestic duck (feral)	Yersiniasis	1
		Trauma/fracture	1
		Helminthosis	1
	Mallard	Trauma/fracture	7
		Trauma: Predation	6
		Trauma: Road Traffic Accident	4
		Malnutrition	2
		Botulism	1
		Avian Influenza	1
	Shelduck	Airsacculitis - cause not determined	1
	Shoveler	Diagnosis not listed - reproductive disease (other than foetopathy)	1
	Duck unspecified	Ingestion of inappropriate materials	1

Goose	Barnacle goose	Avian tuberculosis	1
		Helminthosis	1
	Canada goose	Trauma/fracture	19
		Trauma: Predation	6
		Botulism	3
		Trauma: Road Traffic Accident	2
		Poisoning dt lead	2
		Pneumonia	1
		Peritonitis	1
		Neoplasm	1
		Mycotic pneumonia or airsacculitis	1
		Fungal Infection	1
		Egg peritonitis/salpingitis complex	1
		Diagnosis not listed - digestive disease	1
		Avian Influenza	1
	Egyptian goose	Trauma/fracture	1
	Greylag goose	Avian Influenza	6
		Trauma/fracture	3
		Trauma: Predation	1
		Poisoning dt lead	1
		Ingestion of inappropriate materials	1
		Impactions of crop/gizzard/duodenum	1
	Pink-footed goose	Trauma: Road Traffic Accident	1
	Goose unspecified	Trauma/fracture	4

Swan	Mute swan	Trauma/fracture	42
		Malnutrition	12
		Trauma: Road Traffic Accident	6
		Botulism	6
		Trauma: Predation	5
		Poisoning dt lead	4
		Helminthosis	3
		Diagnosis not listed - systemic disease	3
		Avian Influenza	3
		Peritonitis	2
		Colisepticaemia	2
		Amyloidosis	2
		Visceral parasitism	1
		Urolithiasis	1
		Avian tuberculosis	1
		Septicaemia	1
		Pneumonia	1
		Pericarditis	1
		Necrotic enteritis dt Clostridium perfringens	1
		Mycotic pneumonia or airsacculitis	1
		Ingestion of inappropriate materials	1
		Impactions of crop/gizzard/duodenum	1
		Fungal Infection	1
		Egg peritonitis/salpingitis complex	1
		Diagnosis not listed - urinary disease	1
		Diagnosis not listed - musculo-skeletal disease	1
		Diagnosis not listed - digestive disease	1
		Diagnosis not listed - circulatory disease	1
		Airsacculitis - cause not determined	1
	Whooper swan	Malnutrition	2
		Helminthosis	2
		Avian Influenza	1
	Swan unspecified	Malnutrition	2
		Avian tuberculosis	1
		Trauma: Road Traffic Accident	1
		Trauma: Predation	1
		Egg peritonitis/salpingitis complex	1
		Botulism	1
Total diagnosis count			**802**

Table A4: number of VIDA diagnoses in amphibians and reptiles by species

Animal Category	Animal Group	Common Name	Diagnosis Description	Diagnosis Count
Amphibian	Frog	Common frog	Trauma/fracture	1
			Trauma: Predation	1
			Ranavirus-associated disease of amphibians	1
			Diagnosis not listed - skin disease	1
			Diagnosis not listed - reproductive disease (other than foetopathy)	1
	Newt	Great crested newt	Trauma: Predation	2
		Smooth newt	Diagnosis not listed	1
	Toad	Common toad	Trauma/fracture	3
			Trauma: Road Traffic Accident	1
			Bufonid herpesvirus skin disease	1
Reptile	Lizard	Slow worm	Diagnosis not listed - reproductive disease (other than fetopathy)	1
	Snake	Adder	Trauma: Predation	3
			Trauma/fracture	1
		Grass snake	Trauma: Predation	1
Total diagnosis count				**19**

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