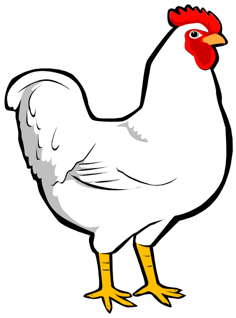
Animal & Plant Health Agency



SRUC

Great Britain avian quarterly report: disease surveillance and emerging threats

Volume 27: Quarter 2 – April to June 2022

Highlights

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Introduction and overview

This quarterly report reviews disease trends and disease threats for the second quarter of 2022, April to June. It contains analyses carried out on disease data gathered from the Animal and Plant Health Agency (APHA), Scotland's Rural College (SRUC) Veterinary Services and partner post-mortem providers, and intelligence gathered through the Avian Expert Group.

In addition, links to other sources of information including reports from other parts of the APHA and Defra agencies are included. A full explanation of how data is analysed is provided in the Annex available on GOV.UK.

Issues and trends

Industry trends – chick and poult placings

Broilers

The UK broiler chick placements were 4% lower, at 92.5 million chicks, in June 2022 compared to June 2021. On average, 22.8 million chicks were placed each week in the quarter (Figure 1).

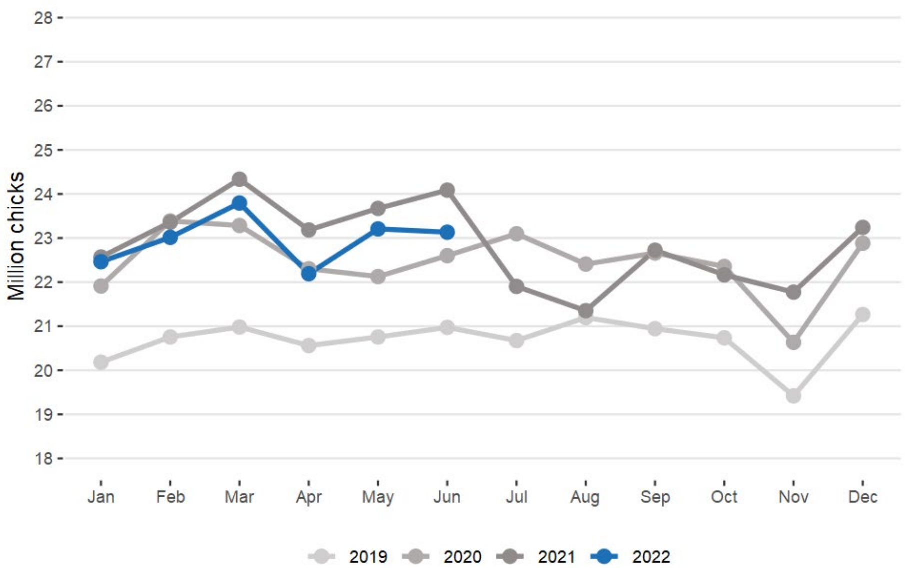

Figure 1: average number of broiler chicks placed per week in the UK by UK hatcheries

Turkeys

There was a decrease of 8.8% in turkey chick placements in June 2022 from June 2021, with 1.2 million poults placed in June 2022. On average, 0.2 million poults were placed each week in the quarter (Figure 2).

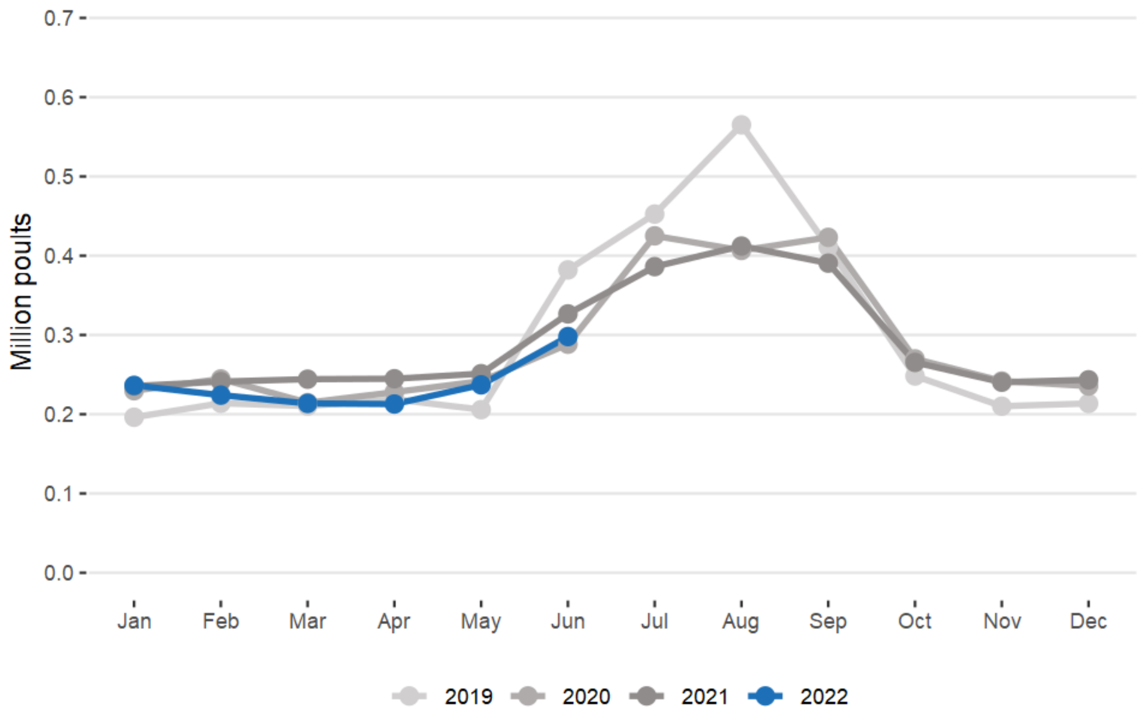

Figure 2: average number of turkey poults placed per week in the UK by UK hatcheries

Layers

Commercial layer chick placements were 20% lower in June 2022 compared to June 2021. On average, 0.6 million chicks were placed each week in the quarter (Figure 3).

During this quarter 222 million dozens were packed in UK egg packing stations. This was 6.5% lower than Quarter 2 of 2021, and 3% lower than the previous quarter. This quarter 58% of eggs were free range, 29% were from hens in enriched colony systems, and 9% were barn eggs. The number of barn eggs was 5 times higher in this quarter than the same quarter in the previous year. This is likely to reflect the fact that all eggs from free range and organic flocks were re-labelled as barn eggs from 21 March due to the avian influenza housing order.

The average UK farm-gate egg price this quarter was 94.8 pence per dozen. This is 6.9% higher than Quarter 2 of 2021 and a 6.1% higher than the previous quarter.

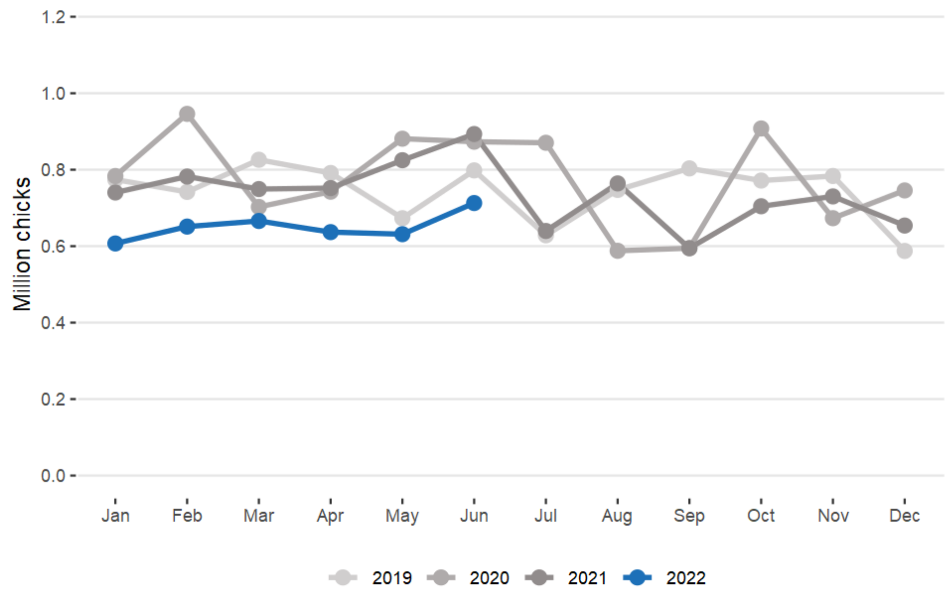

Figure 3: average number of layer chicks placed per week in the UK by UK hatcheries

Poultry industry statistics

The poultry industry statistics and the egg statistics are available on GOV.UK.

New and re-emerging diseases and threats

Refer to the annex on GOV.UK for more information on the data and analysis.

Highly Pathogenic Avian influenza (HPAI) in the UK and Europe

Numerous outbreaks of highly pathogenic avian influenza (HPAI) were confirmed in poultry, captive and wild birds in the UK and elsewhere in Europe during Quarter 2 of 2022.

UK situation update to 18 July 2022

Up to the 18 July 2022, 119 infected premises with HPAI H5N1 in poultry and captive birds across Great Britain were declared since October 2021. Of these, 103 have occurred in England, 11 in Scotland and 5 in Wales. Additionally, there have been 6 outbreaks in Northern Ireland. The outbreaks in poultry have included commercial laying hens, turkeys and ducks, breeder flocks, smallholding and backyard poultry and also gamebirds.

The outbreaks are summarised in the updated outbreak assessment dated 18 July 2022.

Up to 18 July, HPAI has been detected in wild birds in 342 locations in GB and the Scottish isles. These have involved 61 different species. The total number of positive findings is 1422. The majority of these have been identified as HPAI H5N1 or, in some cases, the neuraminidase (N) genotype has yet to be identified (H5Nx) due to low viral load.

In the first 2 weeks of July 2022, the majority of wild bird findings were focused around the Scottish coastline and the southern coast of England. Most of the birds were seabird species and some involved mass mortality events. The increased number of seabird cases may in part be due to breeding patterns; with auk species such as guillemot now at coastal breeding sies where birds are in high density breeding sites facilitating spread of virus between birds.

The outbreaks of HPAI in poultry, captive birds, and wild birds in Europe up to 18 July and the relation to wild bird migration flyways are shown in Figure 4.

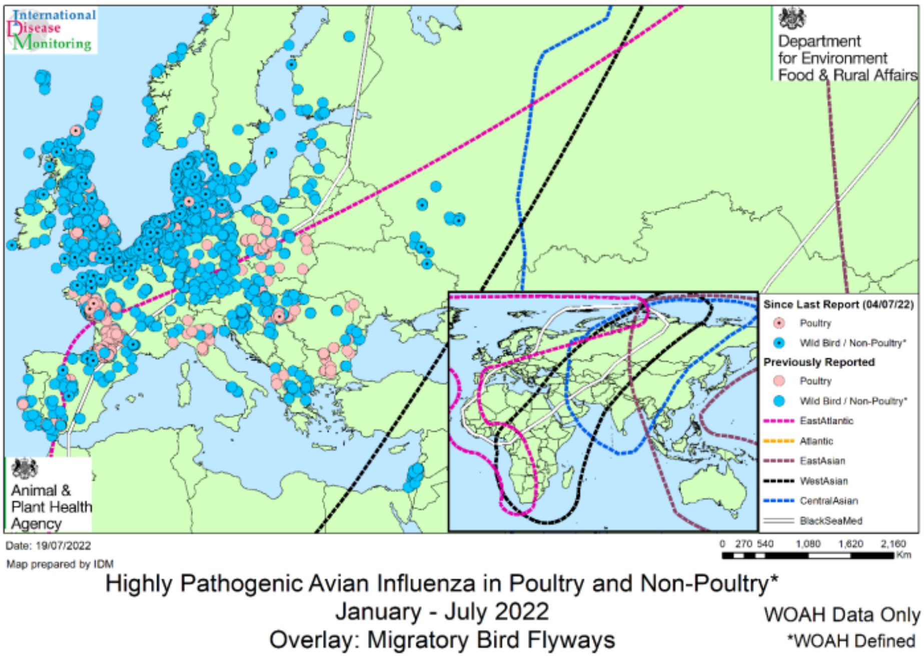

Figure 4: outbreaks of highly pathogenic avian influenza (from OIE data) in poultry, captive and wild birds across Europe, January to July 2022. Symbols with a central dot are those reported since 19 April 2022 and show the recent emergence of a small number of new outbreaks. The migration flyways are shown as dotted lines, with the UK being in the East Atlantic flyway.

European poultry and wildlife update and UK wildlife update 18 July 2022

The latest updated outbreak assessment dated 18 July, referred to above, reports that outbreaks of HPAI have been reported in poultry and/or captive and/or wild birds in 34 European countries (including the UK), according to World Organisation for Animal Health (WOAH) data. The number of outbreaks of HPAI H5 in poultry reported by WOAH each month are at their lowest since November 2021. However, the number of cases in non-poultry including wild birds has increased (Figure 5). This increase is mainly due to the widespread findings in seabirds across the continent of Europe.

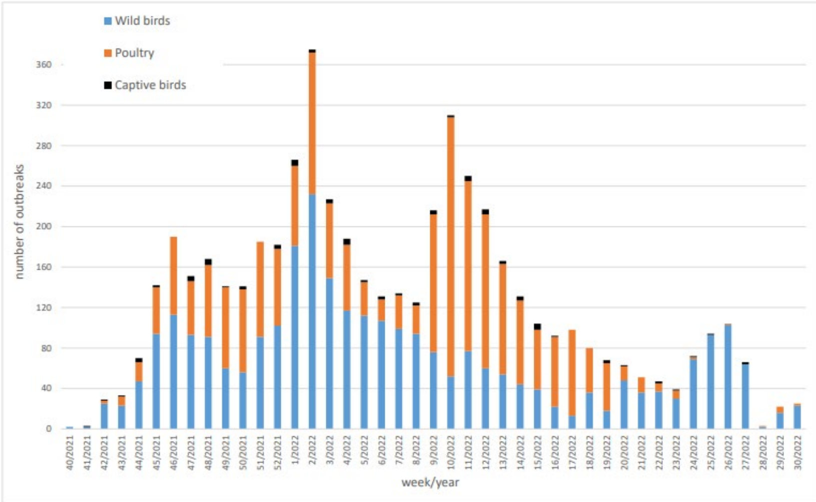

Figure 5: Number of HPAI positive events reported in poultry, captive and wild birds each week in Europe from October 2021 to 28 July 2022 (Istituto Zooprofilattico Sperimentale delie Venezie (IZSVe) 2022)

European Food Safety Authority (EFSA) report

Information in the most recent European Food Safety Authority (EFSA) report dated 30 June 2022 indicates that between 16 March and 10 June 2022 in Europe (including the UK) there were 750 HPAI detections in poultry, with the majority of poultry detections being in France (509); 410 in wild birds, the largest numbers being in Germany (158); and 22 in captive birds, with the majority in France (15).

Iceland has reported the first detection of HPAI in the territory. This was a white-tailed eagle, and the virus identified was closely related to those detected in North America since December 2021.

There have been no reports of HPAI in mammalian species in Europe between 16 March and 10 June 2022. However, HPAI has been detected in red foxes and skunks in North America, and in a common racoon dog in Japan.

All the HPAI (H5Nx) viruses characterised since October 2021 in Europe belong to clade 2.3.4.4b. The EFSA report states that whole genome sequencing indicates the persistent circulation of the A(H5N2), A(H5N8) and A(H5N5) virus subtypes in Northern Europe. These have been circulating in Europe since October 2020. Multiple novel reassortment HPAI A(H5N1) and A(H5N2) genotypes were introduced into Europe through the autumn migration of wild birds or from local reassortment events.

Between 16 March and 10 June 2022 HPAI was detected in at least 45 wild bird species; 11 waterfowl species, 9 raptor species, and 25 other wild bird species. Most reports between the end of April and June were in raptors and other wild bird species. So far, the current epidemic seems to be more extensive geographically than previous epidemics, with the northern limit from Iceland to Northern Norway and the southern limit in Portugal and Spain.

The numbers of wild birds reported are likely to underestimate the numbers of wild birds dying from HPAI, for example HPAI was considered the cause of death of over 4,000 barnacle geese in the Solway Firth, on the west coast of Scotland.

The outbreaks in poultry, captive and wild birds have almost entirely been due to HPAI H5N1. There have been a few detections of H5N5 and H5N8. H5N8 was the predominant subtype in the 2020 to 2021 avian influenza season. H5N5 was reported in wild birds in north Norway.

The weekly numbers of detections of HPAI across all avian species (poultry, captive birds, and wild birds) in successive years, with the number of countries affected each year, are shown in Figure 6 below, taken from the EFSA report.

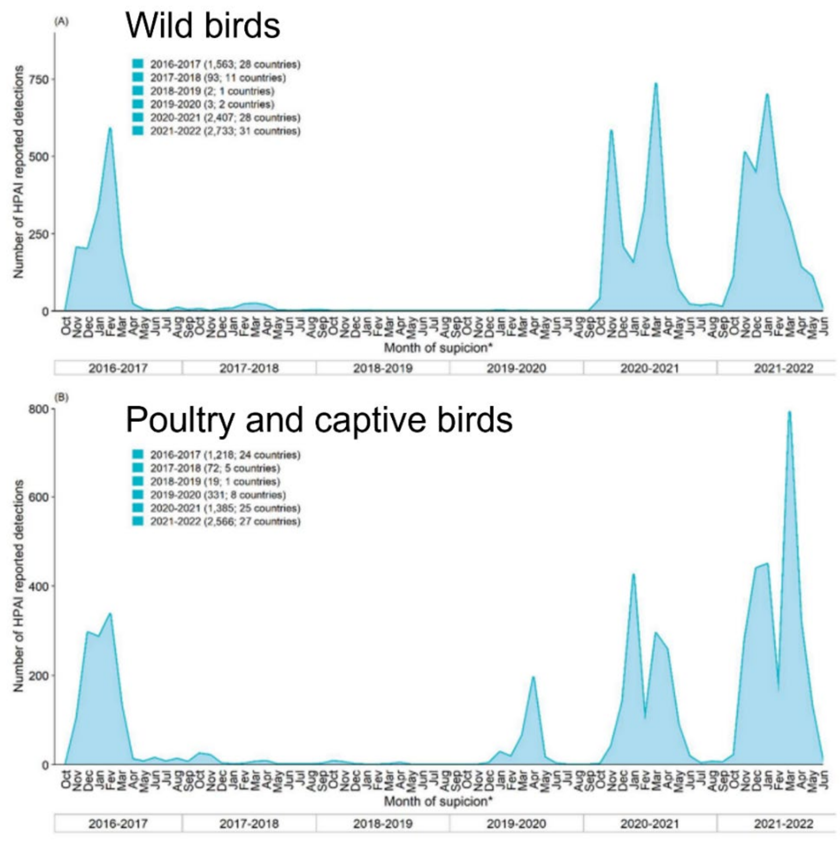

Figure 6: Distribution of total number of HPAI virus detections reported in Europe in the seasons 2016–2017, 2017–2018, 2018–2019, 2019–2020, 2020–2021 and beginning of 2021–2022 by month of suspicion in (upper figure) wild birds and (lower figure) domestic birds (poultry and captive birds) from 9 December 2021 to 10 June 2022

The EFSA report states that “the risk of infection for the general population in the EU/EEA is assessed as low, and for occupationally exposed people low to medium with high uncertainty due to the high diversity of circulating avian influenza viruses in bird populations.”

“The latest transmission events of A(H5) clade 2.3.4.4b viruses to humans in United Kingdom and USA together with the increasing number of transmission events of A(H5) viruses to wild mammals reported from different European countries underline the continuous risk of avian influenza viruses to transmit to humans also in Europe and that these viruses may adapt further to mammals.”

Transmission events to different mammal species have been increasingly reported. Foxes have been majorly found to be affected with avian influenza clade 2.3.4.4b and displayed neurological signs leading to death or were found dead.

The report warns that “the long duration of the AI risk period could represent a challenge for the sustainability of reinforced biosecurity measures. The persistent presence of HPAI A(H5) viruses in wild birds and the environment, and the possible reduction of biosecurity compliance might increase the risk of avian influenza incursions with the potential further spread between establishments, primarily in areas with high poultry densities.”

Conclusion

The EFSA report referred to above details that in previous years the risk of HPAI falls over the summer months. However, the number of detections in wild birds, and wild bird infection pressure, are not decreasing. The mass die-offs seen this summer, alongside the sustained transmission in wild breeding birds in GB and Europe is unprecedented. There are still immunologically naïve, susceptible, resident wild birds in the UK which could become infected. This number will increase as juvenile birds, fledge, and disperse. Higher environmental temperatures, together with increasing sunlight intensities must be greatly reducing environmental levels of HPAI H5N1 currently and may be contributing to the reduced number of poultry outbreaks.

At the time of the 18 July 2022, European poultry and wildlife update and UK wildlife update, the risk of HPAI H5 infection in wild birds in GB was medium.

The update detailed that “The risk of exposure of poultry across the whole of Great Britain is low (with low uncertainty) where good biosecurity is applied, and at medium (with low uncertainty) where biosecurity is suboptimal. This assessment takes into consideration the Avian Influenza Protection Zone (AIPZ) and assumes that bird keepers are taking the additional biosecurity measures required.”

Low Pathogenicity Avian Influenza

There were no outbreaks of notifiable low pathogenicity avian influenza (LPAI) this quarter.

There are no records of notifiable LPAI in the EFSA report. The non-notifiable subtype H9N2 remains endemic in Asia, the Middle East and Africa. Two human cases of H9N2 have been reported during the period of the EFSA report, in China.

Avian notifiable disease exclusion testing scheme (‘Testing To Exclude’, TTE, Testing For Exclusion) in Great Britain

The scheme started in May 2014 (Gibbens and others, 2014) and is ongoing.

No exclusion testing investigations were undertaken during Quarter 2 of 2022.

The scheme is very valuable in enabling possible LPAI to be investigated in situations where it is considered to be a differential diagnosis for the clinical signs seen in birds in a flock. The scheme currently only applies to chickens and turkeys.

The first 6 years of the scheme were reviewed by Reid and others (2021).

Differential diagnosis of negated notifiable disease report (DDNRC) cases in Great Britain

This scheme was introduced in autumn 2018 to offer differential diagnostic testing through the avian scanning surveillance project at APHA and its partners in cases where suspicion of notifiable avian disease (NAD) has been reported and subsequently negated on either clinical grounds or by laboratory testing.

Differential diagnostic testing is also available for TTE cases if NAD has been ruled out by laboratory testing. The scheme is described in more detail by Welchman and others (2019).

The scheme is important because it gives a better insight into disease outbreaks in both poultry and gamebirds which may present with clinical signs suspicious of NAD. When sudden mortality and other clinical signs of NAD affect commercial and small and backyard flock birds, there may be significant welfare implications as well as a marked economic impact, warranting further investigation.

No differential diagnostic investigations were undertaken during Quarter 2 of 2022.

Colleagues in private veterinary practice are encouraged to make use of this scheme for investigation of disease outbreaks which have been negated for NAD by TTE or as suspect NAD report cases.

Pigeon paramyxovirus investigations

There were two submissions of material from pigeons tested for Pigeon Paramyxovirus-1 (pAAvV-1, formerly PPMV-1) as report cases at APHA Weybridge during Quarter 2 of 2022. The samples were submitted in April. PAAvV-1 was confirmed in one of the cases by virus isolation and PCR. PAAvV-1 was not detected in the other case.

Unusual diagnoses

Gizzard perforation in layer chickens

Severe perforating gizzard lesions were reported by a private practitioner in 46-week-old layer chickens on a site with two houses, each of 16,000 birds. The birds were usually free range but were housed under the avian influenza housing measures. One house was affected, with increased mortality of seven to ten birds per day over a week. The farm had changed the feed ration a few weeks earlier by adding more maize meal to the diet. No loss in production was reported. The practitioner reported having seen similar lesions in layers aged 20–50 weeks.

Three birds were received for post-mortem examination, in 2 of which there was a perforating lesion approximately 1 cm in diameter at the junction of the proventriculus and gizzard (Figure 7). In both birds there was a large volume of brown fluid in the coelomic cavity, in one case containing feed particles.

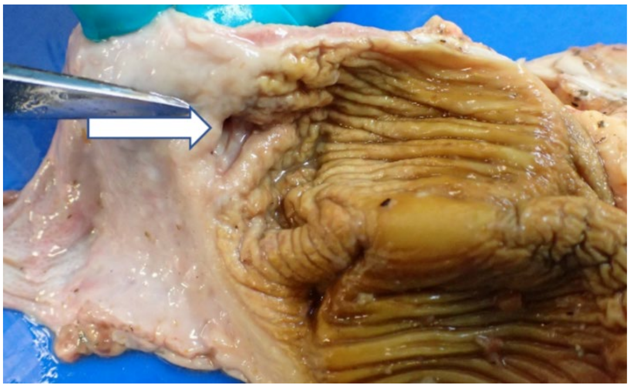

Figure 7: Perforation (arrow) at the junction of the proventriculus and gizzard in a layer chicken

Feed was still present in the crop and gizzard of both birds and dark-coloured material was present in the small intestine. The air sacs were opaque and in one bird there were fibrinous adhesions over the surface of the liver suggesting a secondary peritonitis associated with the escape of feed material into the coelomic cavity.

Histopathology showed basophilic intranuclear inclusion bodies in the glandular epithelium cells of the gizzard mucosa adjacent to the perforating lesion.

These findings were consistent with adenovirus gizzard erosion (AGE) and it was therefore possible that pathology due to adenovirus infection was the predisposing factor for these lesions although perforation was an unexpected outcome.

The causative adenovirus (Fowl Aviadenovirus serotype 1) has been previously reported in both pullet and layer flocks in Great Britain (Grafl and others, 2018), although these reports were in younger birds; AGE appears to be less commonly recorded in older flocks but the outbreak described here may have related to persistence of the virus in the environment of the house.

This case was described in the APHA March 2022 surveillance report in the Veterinary Record (APHA, 2022b).

Severe parasitism in a chicken

A chicken in a flock of 12 birds which had lost condition was examined at the APHA Shrewsbury Veterinary Investigation Centre (VIC). The bird was reported to have been wormed twice with fenbendazole within the previous three weeks.

Post-mortem examination confirmed an emaciated body condition and the bird weighed only 470 g, although it had reportedly been feeding. An egg count on the caecal contents revealed 184,000 coccidial oocysts per gram and 9050 *Capillaria* species worm eggs per gram.

Histopathological examination of the intestine showed numerous small cestodes suggestive of *Davainea proglottina* within the lumen and between the villi of the mid small intestine (Figure 8) accompanied by an inflammatory response in the lamina propria. Numerous coccidia at different stages of development were present in the ileum and caeca within the remaining epithelial cells and in the lamina propria accompanied by inflammatory cell infiltration. The size and location of the coccidia were consistent with *Eimeria tenella.* An embryonated *Capillaria* species egg was also seen.

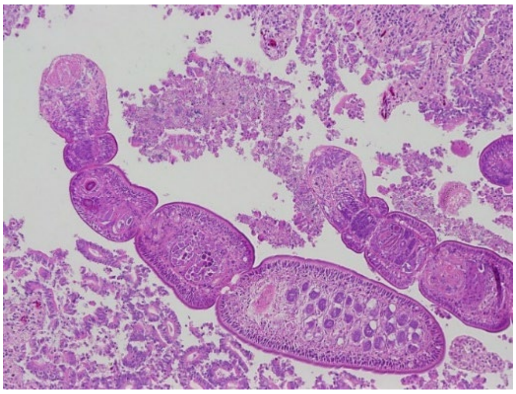

Figure 8: Histological image of *Davainea* sp. cestode in the intestine of a chicken

D. proglottina is considered one of the more pathogenic cestode species in chickens. The larval stages are found in slugs and snails, and they can survive in these intermediate hosts for several months. *Capillaria* species worms are also pathogenic and some species have earthworm intermediate hosts.

The emaciated condition of the bird was attributable to the combined effect of these intestinal helminth parasites as well as the coccidial burden and illustrated the severe parasitism that can sometimes occur in outdoor chickens. The control of *Davainea* relies on preventing access to the intermediate hosts.

This case was described in the APHA monthly surveillance report, May 2022, in the Veterinary Record (APHA, 2022c).

Erysipelas and amyloidosis in ducks

Following the description of erysipelas in layer chickens in the last quarterly report, the disease has been identified in commercial ducks during Quarter 2 of 2022. Ducks are known to be susceptible to erysipelas, but the disease is not as well recognised in ducks as in chickens and turkeys.

A low but ongoing level of mortality was reported in the duck flock. *Erysipelothrix rhusiopathiae* was isolated from an affected carcase. Histopathology showed a septicaemia with intravascular rod-shaped bacteria suggestive of *E. rhusiopathiae* in the liver, spleen, and heart. Amyloid formation was also evident in all three tissues, which may well have exacerbated the effect of erysipelas and contributed to the mortality.

Waterfowl are susceptible to amyloidosis which can be associated both with underlying infectious or inflammatory conditions (particularly of bacterial origin) and with stress and management-related factors.

The control of amyloidosis requires focusing on potential contributory factors within the flock (Landman and others, 1998). In this case, this would include the erysipelas.

This case was described in the APHA monthly surveillance report, May 2022, in the Veterinary Record (APHA, 2022c).

Changes in disease patterns and risk factors

Investigation into abnormal eggs and decreased egg production in layer chickens

Pale and soft-shelled eggs were reported in a flock of 27-week-old layer chickens with approximately 2-3% of eggs affected. Egg production was at 93.5%, which was an increase of 1.2% from the previous week, although the production peak was not as high as expected. There were no other reported clinical signs, nor were there changes in feed or water intake. The flock had been vaccinated for infectious bronchitis (IB) in rear. PCR testing, performed prior to submission, on choanal samples was negative for avian rhinotracheitis, *Ornithobacterium rhinotracheale*, *Mycoplasma gallisepticum* and *Mycoplasma synoviae*. The IB PCR result supported a diagnosis of IB with a Ct value of 38, which could indicate low viral load; however, the significance of this as an aetiological agent in the clinical signs is uncertain.

Four birds were submitted for post-mortem examination with a comprehensive clinical history for each bird. Bird A was culled and had been seen laying a white pale egg. Bird B was culled due to signs of sour or impacted crop, the crop was emptied by the submitting vet after death. Bird C was culled and suspected of having laid a white egg. Bird D had died of unknown causes.

Birds A and B were found to have colisepticaemia, with heavy pure growths of *Escherichia coli* from the spleens; Bird B had ovarian atrophy, poor body condition and was PCR-positive for IB; Bird C had an active ovary and a light brown egg in the shell gland; and Bird D had colisepticaemia, with heavy pure growths of *E. coli* from spleen, and a pale thin-shelled egg in the shell gland.

Histopathological examination identified a mild non-specific chronic salpingitis in three of the birds. Egg drop syndrome (EDS'76) was considered as a possible cause. Serology for EDS'76 virus using haemagglutination antibody inhibition test (HAIT) gave an inconclusive result, the interpretation of this is challenging as the birds were vaccinated. As a definitive diagnosis could not be reached on available testing, next generation sequencing is being carried out on samples from this case to try to identify possible causative agents.

EDS'76 can cause significant losses, however the disease is well controlled in many countries by either vaccination or eradication programmes (Smyth, 2020). In the UK, layer flocks are commonly vaccinated. APHA has not recorded any cases in the last 10 years.

Coronavirus nephritis in adult pheasants

At the beginning of May 2022, APHA Lasswade received fixed kidneys and swabs from fresh kidneys from a flock of pheasants. Seventy deaths had been reported in a flock of 500 breeding birds. The birds had not been vaccinated against coronaviruses.

At gross examination, visceral gout with pale and enlarged kidneys was observed. Histopathology revealed a marked subacute multifocal tubular interstitial nephritis in two of the samples (Figures 9 and 10). Non-specific nephropathy was observed in the other 2 kidney samples received.

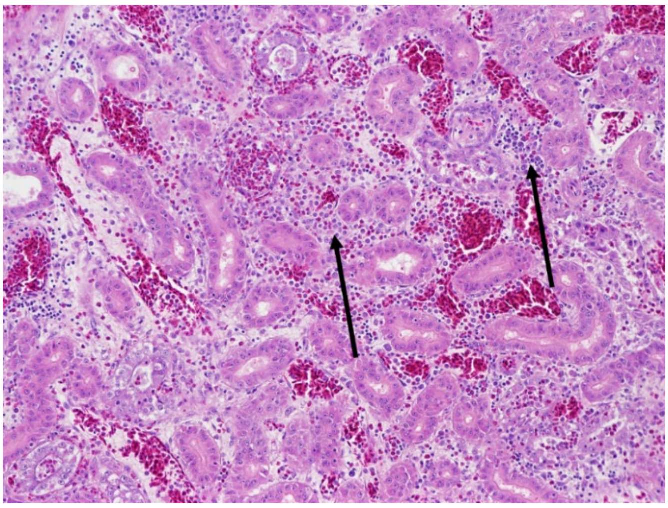

Figure 9: Kidney; tubulointerstitial nephritis with a multifocal mononuclear and granulocytic infiltration of the cortical interstitium (arrows).

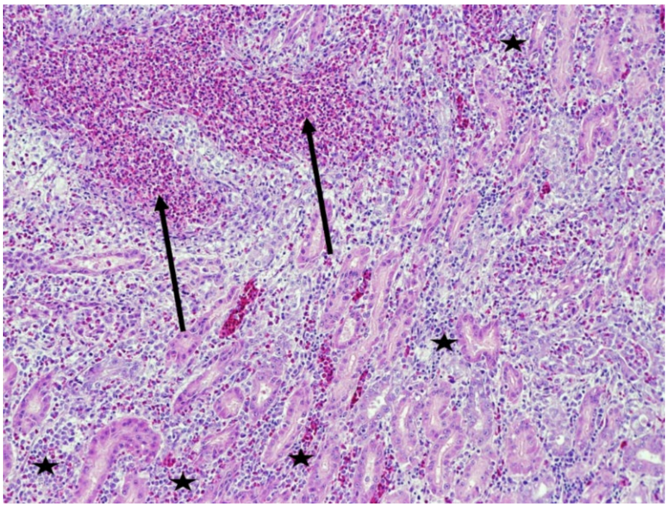

Figure 10: Kidney; tubular interstitial nephritis with dense granulocytic infiltrations into distended tubules in the medulla (arrows), which are associated with disruption of the epithelium. There is mononuclear and granulocytic infiltration the adjacent cortical interstitium (stars).

PCR for infectious bronchitis virus (IBV) and IBV-like γ coronaviruses was positive, but the genotype could not be determined.

A similar submission received from another part of the country showed a subacute to chronic tubular interstitial nephritis in all three samples received and PCR testing for IBV and IBV-like γ coronaviruses was weakly positive. In both cases, the epidemiology, gross and microscopic findings, and the molecular analysis were consistent with coronavirus nephritis of pheasants. These cases highlight the importance of combining histopathology with molecular tests to diagnose disease.

Coronavirus nephritis of pheasants has been described since the 1980s in Great Britain (Pennycott, 2000, Lister, 1989, Gough and others, 1996). Initial molecular analysis of the British pheasant coronaviruses showed a similarity to coronaviruses derived from poultry, though differences could be identified (Cavanagh and others, 2002). A recent publication from China has looked more closely at the molecular characteristics of pheasant-derived coronaviruses, concluding that the pheasant coronavirus in China and IBV detected in poultry have the same ancestor (Han and others, 2020). There are no recent data on the strains currently circulating in British pheasants.

Pheasant coronavirus nephritis is mainly a disease of breeding pheasants. Because of the various pressures on the game bird industry over the last 2 years, there may be an increase of breeding pheasants in the UK. As a result, the pattern and character of the disease may change and therefore the APHA is interested in collecting material to investigate this further. Any suspect cases can be discussed with APHA Lasswade.

This case was described in the APHA monthly surveillance report, June 2022, in the Veterinary Record (APHA, 2022a).

Horizon scanning

Report of fowl cyst mite in England

Laminosioptes cisticola is known colloquially as the fowl cyst mite. The life cycle is poorly understood but the mite is usually found in the subcutaneous tissues, although it has been reported in a range of other tissues. The mite affects poultry and gamebirds, as well as psittacines and passerines. When the mites die, they become encysted in collagen and small, flat to oval nodules may be seen in the subcutaneous tissues. The mite can therefore affect meat quality. (Tavakkoli and others, 2018). The mite has been reported in free-range chickens in Brazil (Martins and others, 2010) as well as other European countries. *L. cisticola* was last reported in Britain in 1977 (Amure and Stuart, 1977).

Fowl cyst mite has been reported in a smallholder flock in Southern England by Grist and others (2022). The paper details the gross and histopathological changes that were identified in 5 chickens from one flock over 6 years. The birds were 3- to 9-years-old and were laying hens that had died. Causes of death included egg peritonitis and traumatic injury. Multifocal, subcutaneous and fascial, randomly scattered, small (1-5mm diameter) nodular lesions were described in the hens. Histologically there were 2 types of lesions; mineralised lesions attached to fascial planes or expanding into the dermis, were seen in all birds; granulomatous lesions compatible with the presence of mites were detected in two of the birds.

The gross and histological findings were consistent with subcutaneous acariasis due to *L. cisticola*. However, the presence of this mite was not confirmed on DNA testing. The paper hypothesises that these cases may not be picked up on routine carcass inspection, although lesions could render meat unfit for consumption. The prevalence of this mite in the UK is unknown. This report originated in part through diagnostic material submitted through the APHA surveillance network and demonstrates the value of a multidisciplinary and collaborative approach involving gross and microscopic pathology in conjunction with molecular techniques.

New orthoreovirus species in ducks identified in Europe and Asia

A paper was published by Varga-Kugler and others (2022), detailing the discovery of an orthoreovirus, and calling for a new orthoreovirus species to be established. The paper details that the virus, Reo/HUN/DuckDV/2019, was found in 31-week-old ducks with reduced egg production, interstitial pneumonia, and lymphocytic inflammation of the oviduct. These clinical signs and pathology findings are non-specific and can also be detected in cases of influenza virus, adenovirus, flavivirus and pneumovirus infections; however, testing for these was negative. The virus identified was an orthoreovirus.

The orthoreovirus detected in this study, was similar to 2 others that have been identified in Pekin ducks in Germany and China. The clinical signs described in the Chinese and German birds included intestinal haemorrhage, airsacculitis and lymphocyte depletion of the bursa. Orthoreoviruses of waterfowl typically affect young birds and cause lethargy, diarrhoea, lameness, and stunting. Therefore, the clinical signs described in the paper were not thought to be typical of other waterfowl-origin reoviruses; in addition phylogenetic trees show that the three viruses detailed belong to a different clade. Varga-Kugler and others (2022) suggest that these three viruses are part of a new orthoreovirus species, and propose naming this species avian orthoreovirus B.

To date, this virus has not been recognised in Great Britain. However, APHA is monitoring submissions from ducks and encourages all vets and owners to submit commercial duck and geese for investigation under the DDNRC scheme when suspicion of notifiable avian disease (NAD) has been reported and subsequently negated on either clinical grounds or by laboratory testing.

References

AMURE, J. & STUART, J. C. 1977. A case of *Laminosioptes cysticola* infection. *Vet Rec,* 101**,** 387.

APHA 2022a. Disease surveillance in England and Wales, June 2022. *Veterinary Record,* 191**,** 20-24.

APHA 2022b. Disease surveillance in England and Wales, March 2022. *Veterinary Record,* 190**,** 276-280.

APHA 2022c. Disease surveillance in England and Wales, May 2022. *Veterinary Record,* 190**,** 451-455.

CAVANAGH, D., MAWDITT, K., WELCHMAN, D. D. B., BRITTON, P. & GOUGH, R. E. 2002. Coronaviruses from pheasants (Phasianus colchicus) are genetically closely related to coronaviruses of domestic fowl (infectious bronchitis virus) and turkeys. *Avian Pathology,* 31**,** 81-93.

GIBBENS, N., BROWN, I. H. & IRVINE, R. 2014. Testing for exclusion of notifiable avian disease. *The Veterinary record,* 174**,** 534-5.

GOUGH, R. E., COX, W. J., WINKLER, C. E., SHARP, M. W. & SPACKMAN, D. 1996. Isolation and identification of infectious bronchitis virus from pheasants. *Vet Rec,* 138**,** 208-9.

GRAFL, B., GARCIA-RUEDA, C., CARGILL, P., WOOD, A., SCHOCK, A., LIEBHART, D., SCHACHNER, A. & HESS, M. 2018. Fowl aviadenovirus serotype 1 confirmed as the aetiological agent of gizzard erosions in replacement pullets and layer flocks in Great Britain by laboratory and in vivo studies. *Avian Pathol,* 47**,** 63-72.

GRIST, A., PARSONS, D. G., BIANCO, C., CAFISO, A. & FOSTER, A. P. 2022. Suspected *Laminosioptes cysticola* (fowl cyst mite) lesions in backyard chickens in southern England. *Veterinary Record Case Reports,* n/a**,** e460.

HAN, Z., LIWEN, X., REN, M., SHENG, J., MA, T., SUN, J., ZHAO, Y. & LIU, S. 2020. Genetic, antigenic and pathogenic characterization of avian coronaviruses isolated from pheasants (Phasianus colchicus) in China. *Veterinary Microbiology,* 240**,** 108513.

LANDMAN, W. J. M., GRUYS, E. & GIELKENS, A. L. J. 1998. Avian amyloidosis. *Avian Pathology,* 27**,** 437-449.

LISTER, S. A. 1989. Diseases of Game Birds. *In Practice,* 11**,** 170-174.

MARTINS, N. R. D., DE RESENDE, J. S., MARQUES, M. V. R., BARRIOS, P. R., FERNANDES, A. A., MONTRESOR, L. C. & CUNHA, L. M. 2010. *Laminosioptes cysticola* in free-range chickens in Minas Gerais, Brazil. *Ciencia Rural,* 40**,** 1460-1463.

PENNYCOTT, T. W. 2000. Causes of mortality and culling in adult pheasants. *Vet Rec,* 146**,** 273-8.

REID, S. M., BROOKES, S. M., HANSEN, R., BROWN, I. H., IRVINE, R. M. & WELCHMAN, D. 2021. Testing for exclusion of avian notifiable disease: six-year review. *Vet Rec,* 189**,** 193-195.

SMYTH, J. 2020. Atadenovirus (Egg Drop Syndrome of CHickens and Related Infections). *In:* SWAYNE, D. (ed.) *Diseases of Poultry.* 14 ed.: Wiley & Sons, Inc. .

TAVAKKOLI, H., MOEINI, E., KHEDRI, J. & KHOSHSIMA SHAHRAKI, M. 2018. Occurrence of Laminosioptes cysticola mite in broiler poultry and proposed solutions to prevent infestation. *J Parasit Dis,* 42**,** 455-457.

VARGA-KUGLER, R., MARTON, S., THUMA, Á., SZENTPÁLI-GAVALLÉR, K., BÁLINT, Á. & BÁNYAI, K. 2022. Candidate ‘Avian orthoreovirus B’: An emerging waterfowl pathogen in Europe and Asia? *Transboundary and Emerging Diseases,* n/a.

WELCHMAN, D., HANSEN, R. & SCHOCK, A. 2019. Differential diagnosis of negated avian notifiable disease cases in Great Britain. *Vet Rec,* 184**,** 276.

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