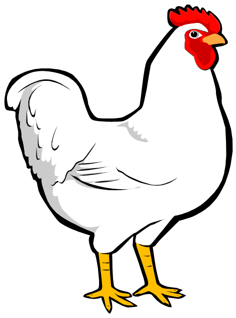

Great Britain avian quarterly report: disease surveillance and emerging threats

Volume 25: Quarter 4 of 2021 (October to December)

Highlights

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Introduction and overview

This quarterly report reviews disease trends and disease threats for the fourth quarter of 2021, October to December. It contains analyses carried out on disease data gathered from 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

There was no change in placings of broiler chicks from UK hatcheries during December 2021 compared with December 2020 (see Figure 1), at 91.5 million chicks, representing an average of 22.2 million chicks per week for the quarter.

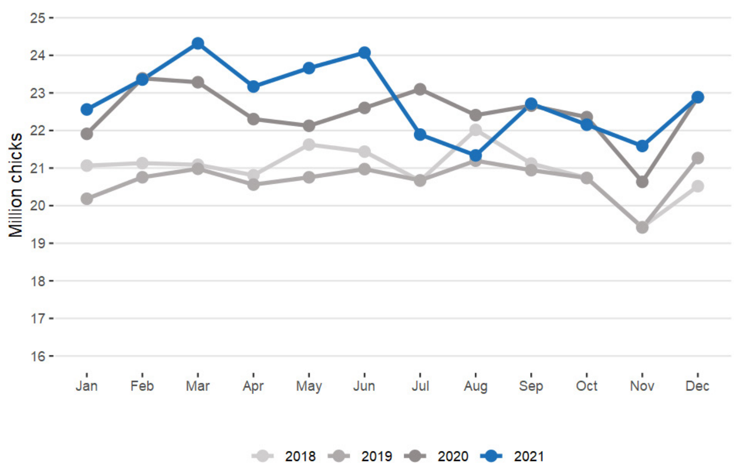

Figure 1: average number of broiler chicks placed per week in the UK by UK hatcheries

Turkeys

There was 3.3% increase in the number of turkey poults placed during December 2021 compared with December 2020 (see Figure 2), at 1.0 million, representing an average of 0.29 million poults placed per week for the quarter.

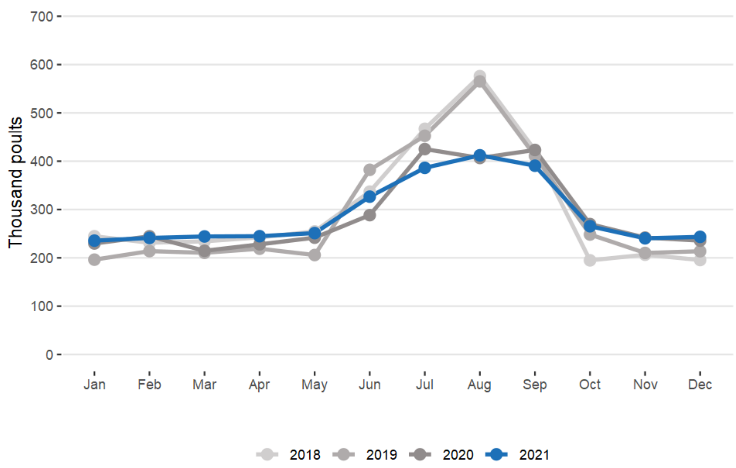

Figure 2: average number of turkey poults placed per week in the UK by UK hatcheries

Layers

There was a decrease of 12% in the number of layer chicks placed during December 2021 compared with December 2020, at 2.6 million chicks (see Figure 3). UK packing station egg throughput in quarter 4 of 2021, at 7.7 million cases, was 3.2% lower than in quarter 4 of 2020 and 1.5% lower than quarter 3 of 2021. Free range eggs accounted for 60.7% of eggs packed in quarter 4 of 2021, compared with 55.6% in quarter 4 of 2020.

Free range egg output during quarter 4 of 2021 exceeded enriched colony system output by 83.5%, a smaller difference compared to the previous quarter.

Barn and organic production remained at low levels although both showed a slight increase compared to the previous quarter. Average UK farm gate prices for eggs in quarter 4 of 2021 were 2.7% lower than the preceding quarter, but 7.4% higher than quarter 4 of 2020.

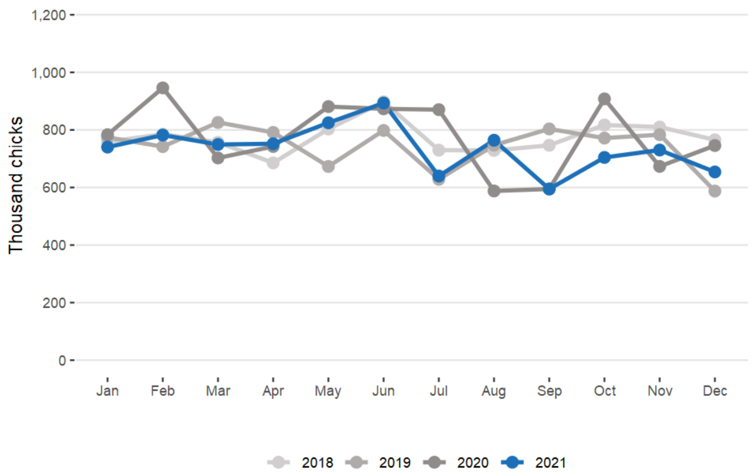

Figure 3: average number of layer chicks placed per week in the UK by UK hatcheries

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 4 of 2021.

UK situation update upto 21 February 2022

Up to 21 February, there have been 90 outbreaks of HPAI in poultry and/or captive birds in the UK since the start of October 2021, all of which involved H5N1. Following five detections in captive birds and small or backyard chicken or mixed species flocks, the first case in a commercial flock (turkeys) was detected on 12 November.

Further outbreaks confirmed in commercial birds have been in commercial and breeder turkeys and broiler, broiler breeder and free-range layer chickens, and in gamebird breeders.

The outbreaks are summarised in the updated outbreak assessment dated 21 February 2022.

Up to 21 February there have also been 685 wild birds of 35 species in which HPAI has been detected, from 201 locations in 66 counties in England, Wales and Scotland. All of these have either been identified as HPAI H5N1 or, in 15 cases, the neuraminidase (N) genotype has yet to be identified (H5Nx). The largest number of cases has been 204 in mute swans (*Cygnus olor*), followed by 102 in Canada geese (*Branta canadensis*) and 41 in barnacle geese (*Branta leucopsis*).

Cases have been identified in different species of raptor; more since December than in October and November with the largest number being 71 cases in the common buzzard (*Buteo buteo*). Only eight cases have been identified in ducks, four in mallard (*Anas platyrhynchos*), one in a wigeon (*Anas* or *Mareca penelope*) and three in unidentified ducks.

The outbreaks of HPAI in poultry, captive birds and wild birds in Europe up to 21 February and the relation to wild bird migration flyways are shown in Figure 4.

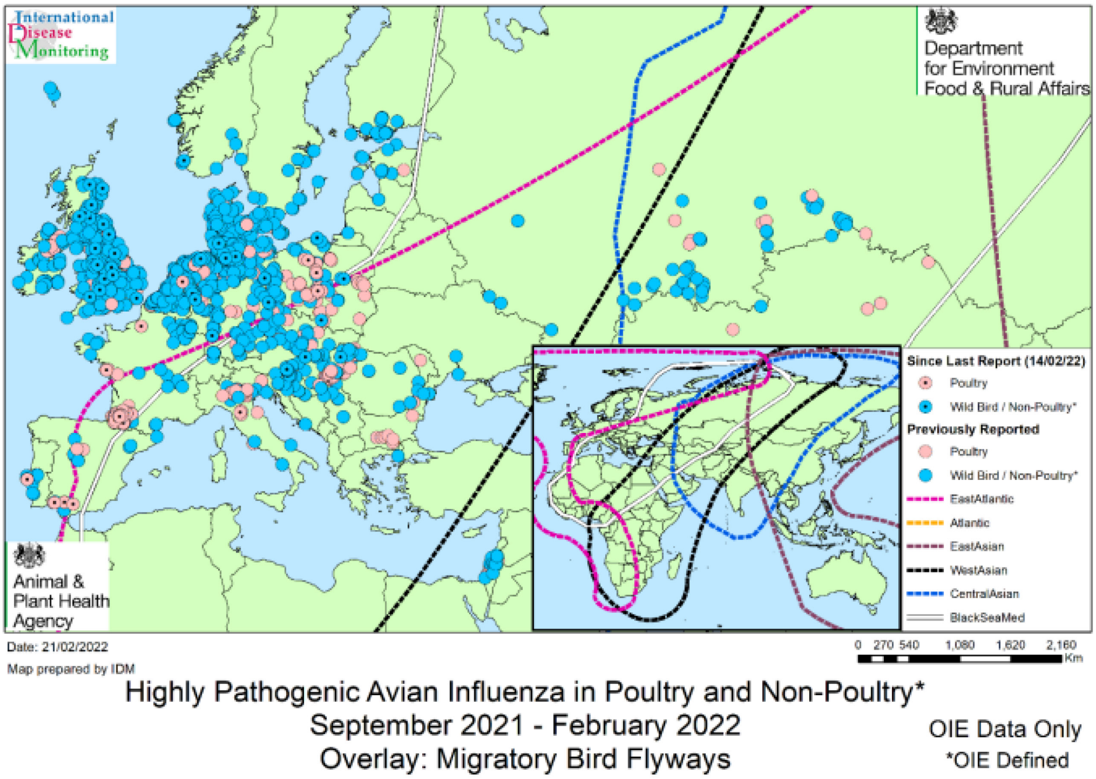

Figure 4: outbreaks of highly pathogenic avian influenza (from OIE data) in poultry, captive and wild birds across Europe, September to 21 February 2022. Symbols with a central dot are those reported since 14 February 2022 and show the recent emergence of new outbreaks. The migration flyways are shown as dotted lines, with the UK being in the East Atlantic flyway

European poultry and wildlife update and UK wildlife update 21 February 2022

The latest updated outbreak assessment dated 21 February, referred to above, reports that 2,368 outbreaks of HPAI have been reported in poultry ,captive or wild birds in 31 European countries (excluding UK), according to World Organisation for Animal Health (OIE) data, although the situation continues to change rapidly.

The strains have been identified principally as H5N1 with only 14 cases of H5N8 in poultry and wild birds and 2 cases of H5N2 and one of H5N3 in wild birds. The number of HPAI events in Europe each week from October to 22 November is shown in Figure 5.

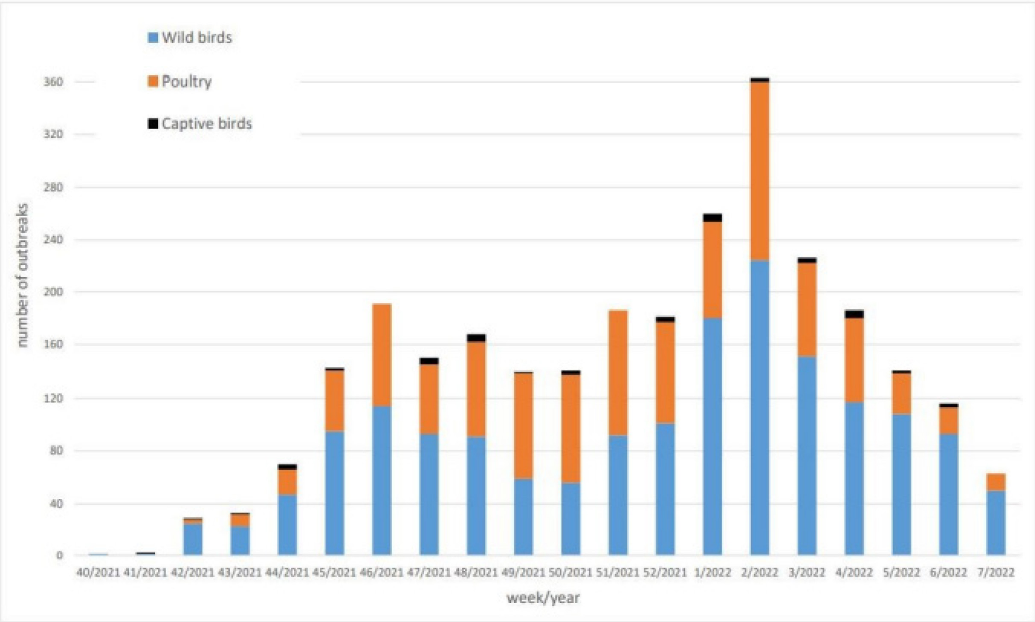

Figure 5: Number of HPAI positive events reported in poultry, captive and wild birds each week in Europe from October 2021 to 21 February 2022 (Istituto Zooprofilattico Sperimentale delie Venezie (IZSVe) 2022)

EFSA report

Information in the most recent European Food Safety Authority (EFSA) report dated 20 December 2021 indicates that between 16 September and 8 December 2021 in Europe (including the UK) there were 316 HPAI detections in poultry (the majority of poultry detections being in Italy, Hungary and Poland), 523 in wild birds (the majority being in Germany, Netherlands and UK) and 28 in captive birds.

HPAI H5N1 was also detected in 2 wild mammal species during the quarter, red fox (Vulpes vulpes) and Eurasian otter (Lutra lutra), in Sweden, Estonia and Finland.

All the HPAI H5N1 viruses characterised during this reporting period (September-December 2021) belong to clade 2.3.4.4b. Whole genome sequencing indicates the occurrence of new H5N1 virus introductions in North, Central, South and East Europe starting from October 2021, as well as the persistent circulation in northern Europe of the H5N1 genotype which has been circulating in Europe since October 2020.

Between 16 September and 8 December, the principal wild bird species in which HPAI was detected (more than 30 detections) were greylag goose (*Anser anser*) (91), barnacle geese (60), mute swan (58), wigeon (37) and mallard (31).The overall geographical pattern shows a concentration of reported cases in a band from the Baltic Sea coast of Germany in the east, across Denmark, the Netherlands and Belgium to the Channel coast of France in the west.

The outbreaks in poultry, captive and wild birds have principally comprised HPAI H5N1, with very few outbreaks of HPAI H5N8 which was the predominant subtype in the 2020 to 2021 avian influenza season.

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.

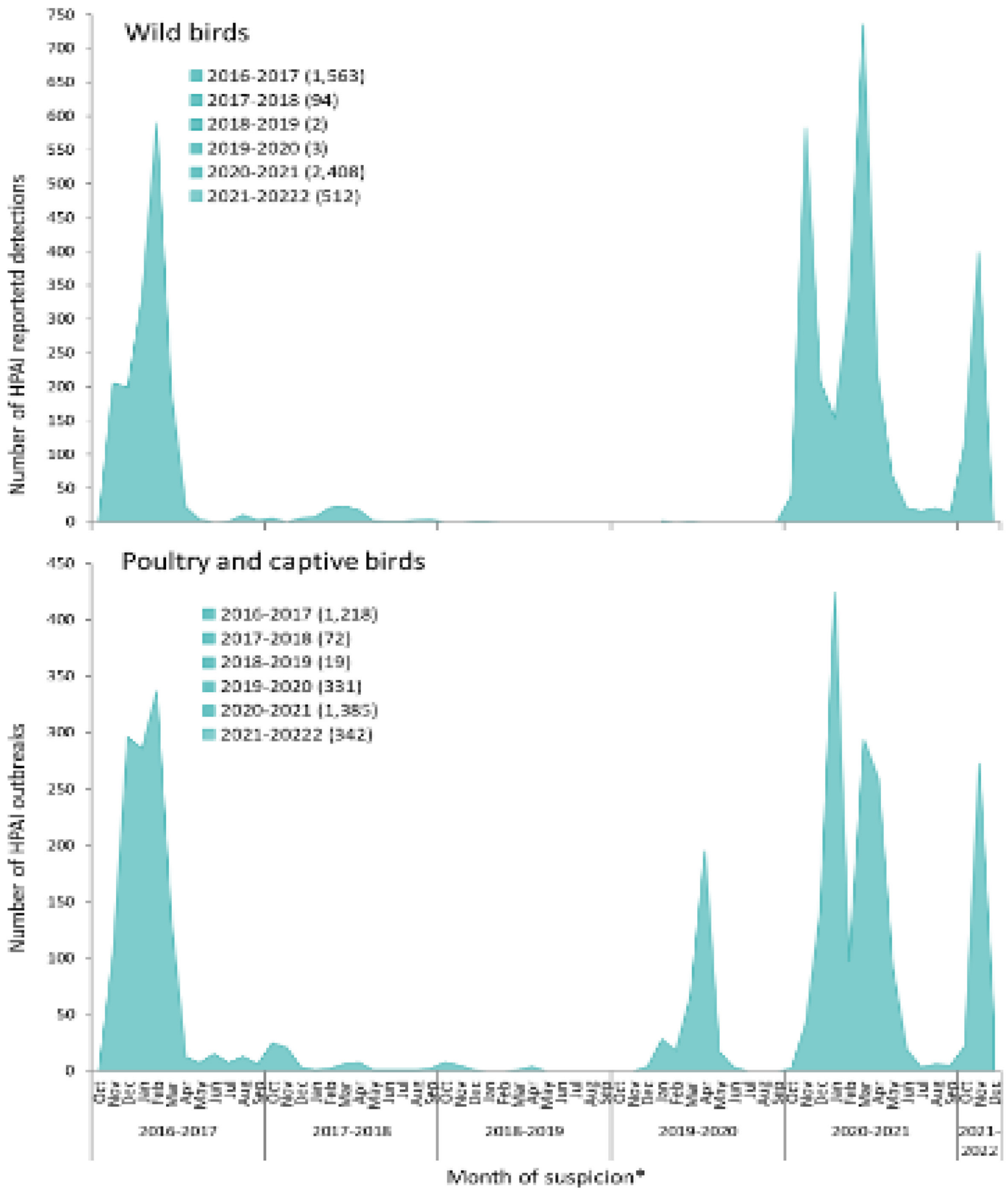

Figure 6: Distribution and total number of HPAI virus detections reported in Europe in the seasons 2016 to 2017, 2017 to 2018, 2018 to 2019, 2018 to 2020 2020 to 2021 and October to December 2021 by month of suspicion in wild birds (upper figure) and domestic birds (poultry and captive birds) (lower figure). The number of countries affected each time period is given in brackets.

The EFSA report notes that ‘No human infection with avian influenza viruses, as currently detected in wild birds and poultry in Europe, has been identified in the EU or EEA countries during the period covered by this report or has been previously reported’.

However, one case of [human infection in England has been reported] in January 2022, arising from very close, regular contact with a large number of infected birds, which were kept in and around the home over a prolonged period of time.

Conclusion

The updated outbreak assessment dated 21 February, referred to above, records that “HPAI H5 is continuing to circulate in both susceptible over-wintering migrant water birds and sedentary wild bird species within Great Britain, with a greater number of events likely to be observed around water bird wintering sites. The risk level of HPAI H5 in wild birds is therefore maintained at very high across Great Britain.” The report concludes that “The risk of exposure of poultry across the whole of Great Britain is maintained at medium (with low uncertainty) where good biosecurity is applied, and at high (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.”

“On 24 November, the Chief Veterinary Officers for England, Scotland, Wales, and Northern Ireland announced housing measures, which came into force on the 29 November 2021. It is now a legal requirement for all bird keepers to keep their birds indoors, to exclude contact with wild birds, and to follow strict biosecurity measures in order to limit the spread of and eradicate the disease.

These housing measures build on the strengthened biosecurity requirements that were introduced as part of the AIPZ in Great Britain on 3 November 2021, and in Northern Ireland on 17 November 2021.”

“It is particularly important that stringent adherence to good biosecurity practices is now not only maintained but is constantly being reviewed for further improvement. Strict attention should be made to ensure compliance with reviewed contingency plans, with regular maintenance checks and repairs being carried out promptly on roofs and fabric of buildings – especially following damage caused by winter storms.

Reinforcement of good biosecurity awareness behaviours and practices should be constantly instilled into personnel to prevent disease being introduced to poultry and captive birds. Special consideration should be made when bringing in equipment and materials, especially bedding and outer packages which may have become contaminated following environmental exposure whilst stored outside.”

If you keep poultry (including game birds or as pets), you should follow our [biosecurity best practice advice] on GOV.UK.

Remain vigilant for any signs of disease in your flock and report any suspicious clinical signs of avian influenza to the Animal and Plant Health Agency.

- In England contact 03000 200 301
- In Wales, contact 0300 303 8268
- In Scotland, contact your local field services office

Further guidance about Avian Influenza including updated biosecurity advice for poultry keepers, in:

- England is available on GOV.UK
- Wales, is available on the Welsh Government's website
- Scotland, is available on the Scottish Government's website
- North Ireland is available on DAERA's website

The declaration in England of an Avian Influenza Protection Zone (AIPZ) on 3 November, requiring all keepers of poultry and captive birds to comply with minimum biosecurity measures is set out in AIPZ declaration. This document includes a link to an interactive map. An AIPZ also came into force across the rest of Great Britain on 3 November 2021, and in Northern Ireland on 17 November 2021.

In terms of public health risk, "The UK Health Security Agency (UKHSA) has said that avian influenza is primarily a disease of birds and the risk to the general public's health is very low. The regional UKHSA Health Protection Teams are working closely with Defra to monitor the situation and will be providing health advice to persons at the infected premises as a precaution."

"The Food Standards Agency has said that on the basis of the current scientific evidence, avian influenza poses a very low food safety risk for UK consumers. Properly cooked poultry and poultry products, including eggs, are safe to eat."

Low Pathogenicity Avian Influenza

No outbreaks of notifiable Low Pathogenicity Avian Influenza (LPAI) were identified in the UK in quarter 4 of 2021.

The EFSA report indicates that notifiable H5 LPAI was detected in northern Italy between August and November 2021. The non-notifiable subtype H9N2 remains endemic in Asia, the Middle East and Africa and 2 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 Avian notifiable disease exclusion testing scheme started in May 2014 (Gibbens and others 2014) and is ongoing.

Three exclusion testing investigations were undertaken during quarter 4 of 2021, as summarised in Table 1. 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 (2021a, b).

Table 1: Summary of findings from the Notifiable Avian Disease Exclusion Testing Scheme during quarter 4 of 2021

Species	Clinical details	Cloacal and oropharyngeal swabs taken	Result	Outcome
Chickens	Drop in production from 85% to 56% over previous 10 days with a sudden drop over the last 48 hours. No morbidity or mortality observed but feed intake had reduced to 90g per bird	Yes	Negative M-gene (AI virus) and L-gene (ND virus) PCR results	Avian notifiable disease excluded
Chickens	Chronic low productivity and some mortality in a housed multi-tier commercial laying flock	Yes	Negative M-gene (AI virus) PCR results	Avian notifiable disease excluded

Species	Clinical details	Cloacal and oropharyngeal swabs taken	Result	Outcome
Turkeys	The only clinical sign identified at the time was a 20% drop in egg production over the previous 2 to 3 days, with a small number of white eggs becoming visible	Yes	Negative M-gene (AI virus) PCR results	Avian notifiable disease excluded

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.

Differential diagnostic investigations were undertaken on three cases negated during quarter 4, one in broilers (negated following laboratory testing), one in a small backyard flock and one in turkeys (both negated following laboratory testing). The broiler case is still being investigated, the small flock case was diagnosed as infectious laryngotracheitis (ILT) and the turkey case as a bacterial infection of the respiratory tract.

Colleagues in private veterinary practice are encouraged to submit samples to this scheme.

Pigeon paramyxovirus investigations

There were two submissions of material tested for Pigeon Paramyxovirus-1 (pAAvV-1, formerly PPMV-1) as report cases at APHA Weybridge during quarter 4 of 2021, from pigeons submitted in October. PAAvV-1 was detected by culture from cloacal swabs in one case and by PCR and culture from tissue samples in the other case.

Unusual diagnoses

Oesophageal lesions associated with infectious laryngotracheitis

In a case investigated by the Royal Veterinary College Farm Animal and Diagnostic Services, 5 chicken pullets aged 3 to 5 months died over a weekend out of a flock of 25 birds. The birds had shown 'bubbly' eyes and increased respiratory noise prior to death. Some were homebred, others were bought in approximately 5 months earlier.

Post-mortem examination showed a large, thick yellow removable cast filling the choana and the mucosa of the larynx and trachea was covered by a thick layer of similar yellow, thick diphtheritic material that partially occluded the tracheal lumen (Figure 7). Necrotic foci were also visible in the upper oesophagus and adjacent oropharynx.

Histopathology confirmed that the lesions were typical of infectious laryngotracheitis (ILT). Although typically causing tracheal lesions, oesophageal and pharyngeal lesions have also occasionally been attributed to ILT (Sary and others 2017).

The birds also had heavy infestations of red mite (*Dermanyssus gallinae*), this and other stress factors are likely to trigger clinical ILT disease in birds already carrying the causative *Gallid herpesvirus type 1* and reinforces the importance of controlling parasitic and other diseases as part of good flock management.

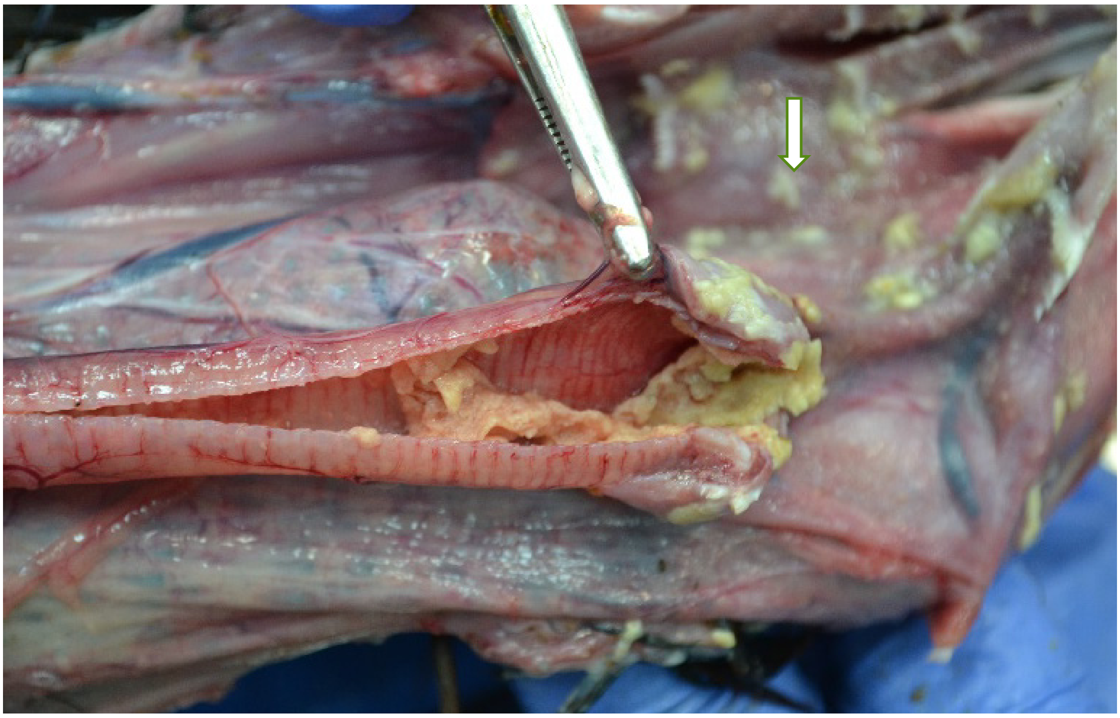

Figure 7: Diphtheritic material in the tracheal lumen of a pullet with infectious laryngotracheitis. Necrotic foci (shown by an arrow) are also visible on the adjacent oropharyngeal mucosa

This case was described in the APHA monthly surveillance report, September 2021, in the Veterinary Record (APHA 2021a).

Systemic yeast infection in ducklings

Approximately 15 of 25 6-week-old ducklings died following non-specific signs of dullness and lethargy over a 3-week period. Fifteen adult ducks and 20 geese were present on the pond. Three ducklings were submitted but there were no obvious gross lesions on post-mortem examination and bacteriology was unrewarding.

However, histopathology revealed severe diffuse interstitial pneumonia, splenitis and hepatitis with multiple yeast-like bodies within swollen endothelial cells in a range of tissues.

These findings were consistent with a disseminated yeast infection, with a yeast of the Order *Saccharomycetales,* as described by Ravi and others (2016), which has been reported in domestic waterfowl and other wild water bird species. It is postulated that disease in ducklings is a result of contamination of aquatic environments with yeast stages from adult and/or wild birds.

There is no known effective treatment for this condition. Keeping young domestic ducks away from bodies of water to which older ducks have access was suggested as a possible preventive measure.

There may also be a seasonal effect as both this case and the case reported by Ravi and others (2016) occurred in the warmer summer months which may favour yeast survival in water.

This case was described in the SRUC monthly surveillance report, August 2021, in the Veterinary Record (SRUC 2021).

Changes in disease patterns and risk factors

Outbreak of high mortality in broilers caused by avian pathogenic *E. coli* infection

Escherichia coli infections are a common cause of disease of poultry and result in significant economic losses worldwide. *E. coli* infections of poultry mainly cause hepatosplenomegaly and polyserositis (usually perihepatitis, pericarditis and arthritis), but all viscera and bones can also be affected.

It is commonly accepted that *E. coli* infections are triggered by various stresses including viral infections. Morbidity and mortality are highly variable, but the disease is usually well controlled by antimicrobial treatment.

Investigations were undertaken by APHA into cases identified by the differential diagnosis of negated report cases scheme described above. As part of the scheme, a number of outbreaks were identified which were characterised by very high mortality in broilers, mimicking that seen in an avian influenza outbreak. Various antimicrobial treatments had been attempted, but the response was inconsistent. After NAD was ruled out by laboratory testing, birds were submitted to APHA for further investigation.

Post-mortem examination, histopathology and bacteriology showed that the birds had died of peracute to acute colisepticaemia. Extensive investigation ruled out an underlying viral infection as a trigger for the disease outbreaks. All isolates from these outbreaks were flagellar antigen H21 positive, but the O type could not be determined although it was related to O91. Whole genome sequencing showed that all isolates except one were of the same sequence type (ST-1564).

Many of the virulence genes detected were those commonly observed in avian pathogenic *E. coli* (APEC). In addition, a number of antimicrobial resistance genes were detected, explaining the poor response to treatment. There is very little information on this strain in the public domain and these isolates warrant further study.

A description of one of these outbreaks was given by the private veterinarian at the British Veterinary Poultry Association winter meeting (18 to 19 November 2021) and the findings were discussed with interest by the attending poultry veterinarians. Work continues to further characterise the *E. coli* strains isolated from these outbreaks.

A recent publication (Mehat and others 2021) has confirmed that the APEC pathotype comprises multiple *E. coli* serotypes, most commonly O1, O2 and O78, and independent genotypes.

Marek's disease

Veterinary Investigation Diagnosis Analysis (VIDA) data show an increase in the number of annual diagnoses of Marek's disease since 2018 in chicken submissions to the GB scanning surveillance network (see Figure 8). The APHA small and non-commercial flock disease surveillance dashboard shows that Marek's disease remains the most common diagnosis in flocks of this type, and the annual number of diagnoses have increased each year since 2017 (see Figure 9).

This may be for a variety of reasons including that the disease may have become more common, the numbers of smallholding and non-commercial chickens may have increased, increased engagement with the Great Britain scanning surveillance network, or more virulent strains of Marek's disease virus (MDV) may be present in small chicken flocks, as discussed below.

Smaller flocks are particularly susceptible to the disease because of the lack of vaccination of chicks that is widely used in commercial flocks.

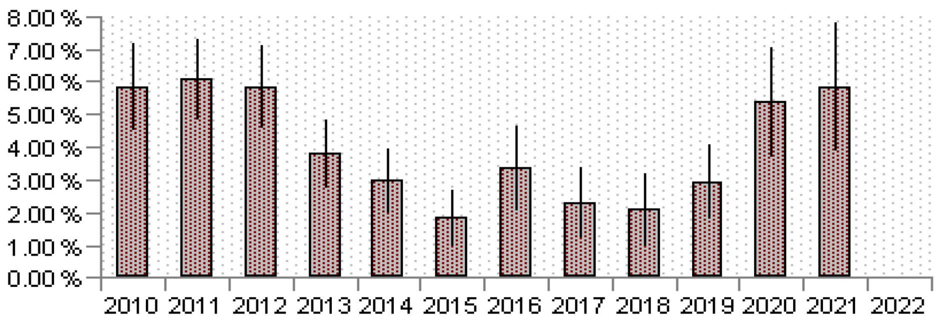

Figure 8: Incidents of Marek's disease in chickens as a percentage of diagnosable submissions to the Great Britain scanning surveillance network, from 2010 to 2022

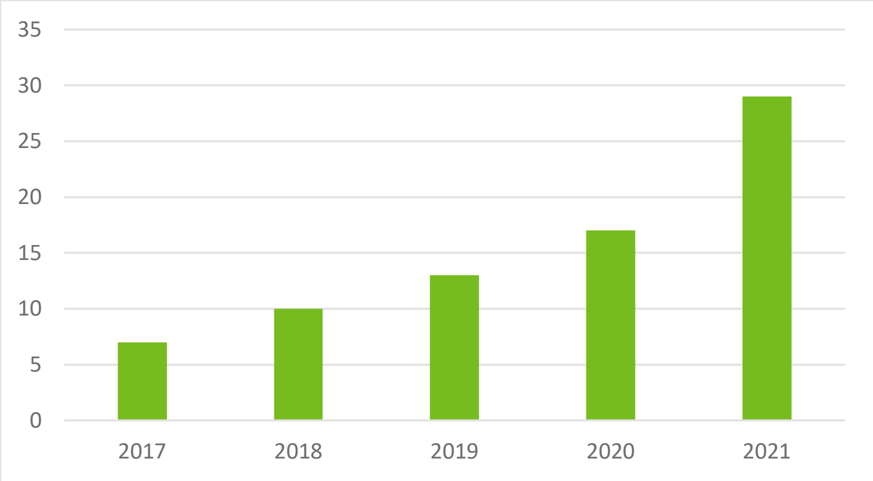

Figure 9: VIDA records of Marek's disease diagnoses in non-commercial and small chicken flocks from 2017 to 2021

Survey of Marek's disease viruses currently circulating in UK backyard chicken flocks

This contribution has kindly been provided by Susan Baigent, Venugopal Nair, and Aidin Molouki of the Marek's Disease Virus Reference Laboratory, The Pirbright Institute, Woking, GU24 0NF

Marek's disease (MD) is a common problem in backyard chickens, most of which are not vaccinated against this disease. However, little is known about the virulence of strains of Marek's disease virus (MDV) that are currently circulating in backyard chickens in the UK, and the level of risk which they pose to commercial poultry.

A collaborative project, between the APHA Avian Expert Group and the MDV Reference Laboratory at the Pirbright Institute, has investigated the genetic characteristics of MDV strains from UK backyard chickens.

Samples submitted from suspect MD cases to APHA, between 2018 and 2021, were subjected to histopathological analysis at APHA Lasswade, and the presence of MDV field strains was then confirmed by PCR testing at the MDV Reference Laboratory. The genetic characteristics of the MDV strains from 13 confirmed cases were studied further by determining the sequence of the *meq* gene of the virus.

Sequence changes in the *meq* gene of MDV isolates from backyard chickens are closely associated with differences in virulence of MDV strains and can also be used to group the viruses based on common genetic features to make comparisons with MDV strains circulating elsewhere in the world.

The results showed that UK backyard chicken flocks are a reservoir of MDV strains of diverse origins which vary widely in their predicted level of virulence, including representatives from each of the following: strains of relatively low virulence (mild, mMDV) which group with MDV strains usually found in Europe or MDV strains in the 'long meq cluster'; virulent strains (vMDV) which cluster with MDV strains usually found in Europe; and highly virulent strains (very virulent plus, vv+MDV) which cluster with MDV strains usually found in Eurasia. As some vv+MDV strains can break through the protection provided by vaccines, these vv+MDVs harboured by backyard chickens are potentially a threat to commercial chicken flocks.

The detailed findings of this investigation will be published in due course.

Avian intestinal spirochaetosis

Avian intestinal spirochaetosis (AIS) is a condition of adult layer, breeder and sometimes other chickens (Hampson 2020), caused by *Brachyspira* (formerly *Serpulina*) species spirochaetes. Several *Brachyspira* species have been reported in chickens, and four are considered to be pathogenic: *B. intermedia*, *B. pilosicoli*, *B. alvinipulli* and *B. hyodysenteriae*. These can cause a spectrum of clinical signs varying from mild (birds with diarrhoea and reduced egg production) to severe, in which there is a severe typhlocolitis leading to death.

The severe form is particularly recognised in rheas (*Rhea americana*). The identification of avian *Brachyspira* has been enhanced in recent years by the use of molecular-based techniques which provide more accurate confirmation of species than biochemical techniques as the phenotypic properties used for biochemical identification of *Brachyspira* can vary (Hampson 2020).

Sixty avian *Brachyspira* species cultured by APHA from chickens from 2006 to 2021 have been analysed by whole genome sequencing (WGS, Stubberfield, E. personal communication). Of these, 35% were identified as B. *intermedia*, 32% as *B. pilosicoli*, 15% as *B pulli* and the remainder as *B. hyodysenteriae*, *murdochii*, *alvinipulli* or *innocens*. The clinical history in these cases was often not known but the findings suggest that *B. intermedia* and *B. pilosicoli* are likely to be the predominant pathogenic species in British chickens.

Forty of these isolates were screened for genes and single nucleotide polymorphisms (SNP) associated with antimicrobial resistance (AMR) which have been characterised in *B. hyodysenteriae (*Stubberfield and others 2021*).* Minimum inhibitory concentrations (MIC) were determined by broth dilution to six antibiotics (tiamulin, valnemulin, tylosin, tylvalosin, lincomycin and doxycycline) for 25 of the isolates, comprising B. *pilosicoli*, *intermedia*, *pulli* and *murdochii*, selected on the basis on their AMR gene or SNP presence.

Previously reported genetic resistance determinants including *tva*(A) and *tva*(B) were identified in several isolates, some of which had MIC values above the epidemiological cut-off (ECOFF) values, which may be relevant for the treatment of AIS on-farm.

This emphasises the need to control AIS using methods other than antimicrobial treatment, including good biosecurity and hygiene, the use of probiotics, essential oils and other intervention strategies (Hampson 2020).

A retrospective case series of severe spirochaetosis in rheas was reported by McFadzean and others (2021), in which *B. hyodysenteriae*, *B. intermedia*, *B. alvinipulli*, *B. suanatina* and *B. hampsonii* were identified by WGS in affected birds and potentially associated with disease. It was speculated that these isolates may have been spread by migratory waterfowl that may have had direct or indirect contact with the rheas.

Horizon scanning

Differences in virulence in *Enterococcus cecorum* strains in experimentally infected meat-type chickens

In recent years pathogenic strains of *Enterocococcus cecorum* have emerged as causative agents of septicaemia and skeletal infections in broiler chickens, with a high economic impact worldwide, as escribed in the Avian quarterly report for quarter 2 (APHA 2021b). Although research has been conducted, many aspects of the pathogenesis of *E. cecorum*-associated disease remain unknown. A recent publication by Schreier and others (2021) describes an experimental infection model established in broiler chickens.

Two different *E. cecorum* strains, EC14 and EC15, were compared using two dose concentrations of each strain in oral infection of one-day old chicks. The clinical signs and gross lesions of *E. cecorum*-associated disease were monitored in the following seven weeks. Although both strains were originally isolated from clinical disease outbreaks and had a high embryonic lethality, only EC14 induced the typical course of disease with characteristic clinical signs and gross lesions.

In total, 23% of the birds in the 2 EC14 groups were *E. cecorum*-positive in extraintestinal organs on culture and no differences were found between the two infecting doses. EC14 was frequently detected by real-time PCR in the free thoracic vertebra (FTV) and femoral heads without any detectable gross lesions. In contrast, EC15 was not detected in any extraintestinal organs although birds in the EC15 groups were colonised by *E. cecorum* in the caeca after experimental infection.

This study demonstrated that virulence differs among *E. cecorum* strains in experimentally infected chickens and emphasises the need to characterise virulence factors and pathogenic mechanisms of the organism. This experimental model provides the basis for further research on the pathogenesis of *E. cecorum* and possible prevention and intervention strategies.

Infectious bronchitis virus types in Europe and the United States

The importance of infectious bronchitis virus (IBV) in causing disease in both commercial and small and backyard chicken flocks was highlighted in the Avian quarterly reports for quarter 2 (APHA 2021b) and quarter 3 (APHA 2021c). The IBV types affecting European countries were recently reviewed (de Wit and others 2021) and the authors concluded that “because of the highly infectious nature of the virus, its ability to evolve quickly, and the increasing trade both within and outside Europe, new IBV variants will continue to emerge. Some variants are anticipated to become widespread, show increased virulence, or disparate pathogenicity, which highlights the need for careful vaccination, sustained vigilance, and the need for continued development of novel approaches to control IBV".

Some IBV genotypes appear to have originated within Europe and others from outside Europe, such as the QX variant, which was first seen in China in 1998, followed by Russia in 2001 prior to being identified in Dutch broilers in 2003. The QX variant was first reported in the UK, in a backyard chicken, in 2008.

A recent review of IBV in the United States (Jackwood and Jordan 2021) concluded that "control is complicated even more because the type of IBV detected in commercial poultry is greatly influenced by live attenuated vaccine usage, with the predominant IBV type identified being the same type as the vaccine virus used in the birds".

This was exemplified by the shift away from use of one vaccine (ArkDPI) to another (GA08) that has resulted in a corresponding shift of IBV types from ArkDPI to the previously rare GA08 variant. A surveillance programme is required to detect and control emerging variants in commercial poultry.

The detection of new variants is more difficult in broilers with their short lifespan and the vaccines that are used than in layers and breeders in which the longer lifespan gives a longer time to clear vaccine viruses.

Nevertheless, vaccines are the most effective means of controlling IB. The major current IBV variant circulating in all sectors of US commercial poultry production is reported to be DMV/1639/11, which was initially detected in 2011, but only began causing significant disease in 2014 to 2015.

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