Animal &
Plant Health
Agency

# Scientific Opinion on the effectiveness of a housing order and Risk Assessment for GB.

**23 November 2021**

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APHA is an Executive Agency of the Department for Environment, Food and Rural Affairs and also works on behalf of the Scottish Government, Welsh Government and Food Standards Agency to safeguard animal and plant health for the benefit of people, the environment and the economy.

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# Summary

A request was made to review the evidence for implementing housing orders for poultry and captive birds on the number of outbreaks of avian influenza across GB. In the past five years, a housing order has been put in place twice, triggered by a perceived increase in risk of incursions from contact with (infected) wild migratory birds. An EFSA opinion in 2017 used expert opinion to assess the effectiveness of various biosecurity measures in preventing outbreaks, as there is no experimental evidence base. The report concluded that housing alone is not able to prevent outbreaks, and other biosecurity measures are equally or more effective. This assessment therefore uses in Part 1 the number of outbreaks reported in the past against the possible protective of housing and in Part 2, an assessment for the current risk levels on the basis of biosecurity levels and the infection pressure for different areas of GB from wild bird abundance.

- On the basis of predictions from the number of captive bird/poultry outbreaks reported last year (2020/21 season), it is concluded that implementation of the housing order on 14 Dec prevented 12 outbreaks across GB. This estimated saving could have been increased to 14.5 outbreaks by starting the housing order at the very beginning of the epizootic (03 Nov) and continuing it for 16 weeks (ending 23 Feb). Outbreaks were still occurring after 16 weeks (23 Feb), and the maximum effectiveness of the housing order could only have been fully achieved by extending the housing order for 21 weeks, and saving 16.5 outbreaks in total, thus decreasing the number of outbreaks by the full two-fold. However, extending the housing order to 21 weeks does represent law of diminishing returns, saving only an additional two outbreaks.
- Of the 12 outbreaks saved across GB by the 14 Dec housing order, two would have been in Scotland, one in Wales and nine in England.
- On the basis of the distribution of outbreaks last year, the housing order would have had a greater return in England than in Scotland and Wales.

This report also considered an update of a rapid risk assessment undertaken on 10 November 2021 in response to findings of HPAI H5N1 in poultry (on 11 November 2021) and findings in wild birds (12 November 2021). Since then, there have been further findings of HPAI H5N1 in poultry, captive birds and wild birds in the UK.

1. There is a heightened risk of an incursion of avian influenza H5Nx to the UK. This was already evidenced by the wild bird cases occurring across GB, Northern, Eastern and Central Europe and outbreaks in poultry in Netherlands, Italy, Czech Republic, Finland and Germany. In early October 2021 the risk of wild bird incursion was increased to MEDIUM.
2. Following this, the report of HPAI H5N1 in a wild bird rescue centre in Worcestershire (AIV 2021/07) and a backyard chicken flock in Wrexham (AIV 2021/08) on 26 October and 1 November resp. and five other wild bird reports from areas of Southport, Preston, Fife, Edinburgh and Wrexham were the first confirmed events of HPAI H5N1 in GB since July 2021. **Therefore, the risk level was**

**increased to HIGH for wild birds on the 29 October 2021 with between low and medium for exposure to poultry, depending on biosecurity.**

3. Since then, HPAI H5N1 has been reported in wild birds and poultry across Europe and in the UK has been detected at a further seven premises in England (three in commercial turkey premises, one in commercial layers, a mixed species wildlife sanctuary, and a small hobby unit) and Scotland (one in backyard chickens). Additionally, there have been further reports of HPAI H5N1 in wild birds from 20 more locations across GB, in a wide range of species including migratory water birds, bridging species and raptors but the majority in resident endemic species (Annex 1, Table 5). The risk of HPAI H5N1 incursion through movements of migratory wild waterfowl was increased to **HIGH** on 10 November 2021. As a result of the increasing infection pressure in Europe, the risk of HPAI incursion through movements of wild birds into the region has now been increased to **VERY HIGH (**with low uncertainty) for England and **VERY HIGH** (with high uncertainty) for Scotland and Wales. Surveillance results need to be caveated by the sensitivity of the programme. The multiple findings in the Midlands of dead mute swans, which are not migratory, suggests infection has seeded in the resident bird population. That does not rule out a similar situation in other parts of the country. The findings in poultry in areas like North Yorkshire should also be taken into account.
4. There has been a pattern of spread consistent with previous disease epidemics in which wild bird transmission was a factor. There is overwhelming evidence that spread to the UK by migrating wild waterfowl has happened in the past.
5. Given the large poultry population, the proportion which are outdoor, and in the regions close to the high aggregations of wild waterfowl, we consider the risk of exposure of poultry across the whole GB to be **MEDIUM** (with low uncertainty) where good biosecurity is applied, **to HIGH** (with low uncertainty) where there are substantial biosecurity breaches and poor biosecurity. This is considering an AIPZ is in place, therefore personnel should be taking additional biosecurity measures. If, however, stringent biosecurity is in place the risk would be **LOW** for such premises.
6. There are a number of risk pathways for the introduction of disease to kept birds, and contact, whether direct or indirect, with infected wild birds is the most important one, especially with respect to a primary introduction to domestic birds. Secondary spread in the UK when disease control measures and keeper awareness is high, a rare event; only two proven events of secondary spread of HPAI in recent years have occurred, and that was in 2007 and 2017, where spread between two units of the same business occurred through shared workers.
7. Housing free range poultry could reduce the likelihood of infection incursion, from reducing the direct contact with wild waterfowl or with their contaminated environment. An EFSA analysis following the 2016/2017 epidemic concluded that housing birds gave a two-fold reduction in risk.
8. However, to be effective, housing must be accompanied by thorough biosecurity measures to prevent the disease from being introduced to the poultry by contaminated people or other things that are taken into or enter the housing. Housing must be secure with adequate facilities to apply basic hygiene practices. EFSA concluded that stringent biosecurity measures, which includes housing but also a multitude of other biosecurity measures, bring an overall 44-fold reduction in risk.
9. Under some circumstances, poultry will not be able to be housed, whether for practical or welfare reasons relating to their husbandry needs, and so housing will not be universally achieved.

10. Comparing the last two seasons when poultry cases were reported in the UK (2016/17 and 2020/21) a housing order was in place but only after 14 December 2020 before which there were seven commercial outbreaks in 2020/21 but none in 2016/17, when the housing requirement was put in place on 12 December 2016. However, the difference in the number of cases is probably related to the wider geographic area, infection pressure, earlier start and longer duration of the outbreak in 2020/21.
11. The geographical extent of any housing requirement can be determined on the basis of proximity to large aggregates of wild waterfowl over the coming weeks as well as on the basis of practicality/feasibility and sustainability. It is not possible to say at this stage whether the infection pressure will increase over the coming weeks (although previous experience suggest it will), whether the season will last for as long as it did in 2020/21 and what the geographic extent will be. Nevertheless, the early start and wild bird cases already detected, suggests there is already heavy environmental contamination, infection in resident birds and with slow virus decay, a larger outbreak is approaching.
12. Any legal requirement to house and take biosecurity measures should be kept under review and adapted as needed to reflect emerging evidence, including levels of compliance with housing and biosecurity measures and the disease picture across Europe.

# PART 1 – Impact of Housing

## Approach and Results

### HPAI introduction from wild migratory and residential birds:

The EFSA Opinion (2017) states that "*According to expert opinion, prevention of access of poultry to water bodies could result in an estimated three-fold reduction in HPAI entry probability. Combining this biosecurity measure with confining poultry to indoor housing was estimated to further reduce the HPAI entry probability two-fold and adding routine or high biosecurity would result in a further estimated reduction of 4- and 44-fold, respectively*."

Therefore, as expected, housing alone will not bring about complete mitigation of the risk from wild bird exposure. Particularly as the "stringent" biosecurity levels assessed by EFSA are difficult to implement on an ad hoc basis and therefore does not represent the majority of holdings. There are other actions which can also reduce some of the risk, and ideally poultry keepers implement the biosecurity toolbox to achieve the added benefit.

The evidence for housing providing a preventive effect against infection with avian influenza in poultry is not extensive and is not unequivocal. Indeed, it is difficult to define the impact of such an intervention in the absence of case control studies.

In 2014, in the USA there was a large epizootic of H5N2 HPAI in poultry which culminated in the culling or death of 7.5 million turkeys and 42.1 million chickens. However, broilers (which were housed) were rarely infected despite the proximity to other outbreaks (USDA, 2015[1]). Epidemiological analyses of the EU epizootic in 2016/2017 did not show any statistical relationship between infected commercial premises with or without outdoor access; 53% had no outdoor access and 47% reported access for part of the day, although there is a tendency for smaller commercial holdings to be outdoors, unlike the larger (>10.000 birds) holdings. However, of the non-commercial holdings, only 10% of the affected holdings kept birds indoors all day (EFSA, 2017). Experimental evidence suggested the low incidence in broilers was not a feature of the genetic background of the different breeds of chicken used, but was a feature of the housing and husbandry, where broilers, kept for only a few weeks, have a faster turnover, with fewer contacts with workers, equipment and supplies, and better biosecurity practices (Bertran et al. 2016). In the Netherlands, in 2003, during a large epizootic of HPAI H7N7, and based on the evidence of 255 outbreaks, no single control measure could be identified which was strongly associated with cessation of the outbreak, except for reducing the number of susceptible stock in the area and speed of culling infected flocks. Other measures, such as compartmentalisation, tracing and improving biosecurity only served to slow down the spread to new regions, as opposed to speed of culling and preventive culling (Stegeman et al. 2004).

The prevalence of HPAIV in wild birds is the parameter of fundamental importance to our estimated risk level, however it is variable and can only be inferred from incomplete surveillance data. If the prevalence is reduced, because there is no longer circulating virus and therefore there are fewer infectious birds, then the risk level to poultry within the UK would be expected to also be reduced. Higher temperature and longer daylight hours will reduce viral persistence and therefore environmental contamination which will in turn reduce the virus circulation in the wild birds, but if infected wild birds are present at the site all year-round and with a high enough effective population size of susceptible naïve birds, contamination can remain. Bird migration patterns vary by season and towards spring and summer, different migratory species will arrive in the UK for breeding. These species include more passerine species which are not typically associated with transmission of HPAIV.

A desk-based study carried out by APHA summarised in Table 1 has highlighted those species that are likely to be relatively low risk in Scotland. The assessment is based on two factors:

1) The geographical origin of the birds prior to their autumn migration. Thus species/populations moving into Scotland from populations summering in Greenland and/or Iceland, are unlikely to have come into contact with AIV or AIV-

[1] Epidemiologic-Analysis-July-15-2015.pdf (usda.gov)

infected birds. This compares to bird populations wintering further south in England that migrate from continental Europe/Eurasia); and

2) The general feeding behaviour/habitat preference of the species. Thus, some species, for example Common eider (*Somateria mollissima*) - spend all of their time out at sea where they feed exclusively on molluscs and although abundant around Scottish coasts are very unlikely to contact poultry let alone transmit AI viruses to them.

On this basis, each of the selected species was categorised qualitatively according to its relative risk in the GB context. A summary of the species and their risk categories for Scotland compared to England and Wales is given in Table 1. These risk levels take into account the level of migration, as well as estimated population sizes. However, over time there will be diffusion of infection as local movements within UK occur and virus may be seeded to previously non affected populations.

**Table 1 Relative risk assigned to species for incursion of HPAI into Scotland and England or Wales, along with estimated population size.**

| Species | HPAI priority for Scotland | HPAI priority for England | HPAI priority for Wales | Est. population size[2] |
|---|---|---|---|---|
| Bewick's Swan | Very low | Low | Low | 4,350 |
| Dark-bellied brent Goose (bernicla) | Very low | Medium | Medium | 98,500 |
| Eurasian white-fronted goose (albifrons) | Very low | Very low | Very low | 2,100 |
| Goldeneye | Very low | Low | Low | 21,000 |
| Greylag Goose[3] | Very low | Very low | Very low | 140,000 |
| Greenland white-fronted goose (flavirostris) | Very low | Negligible | Negligible | 11,500 |
| Greater white-fronted goose | Very low | Medium | Very low | 2,100 |

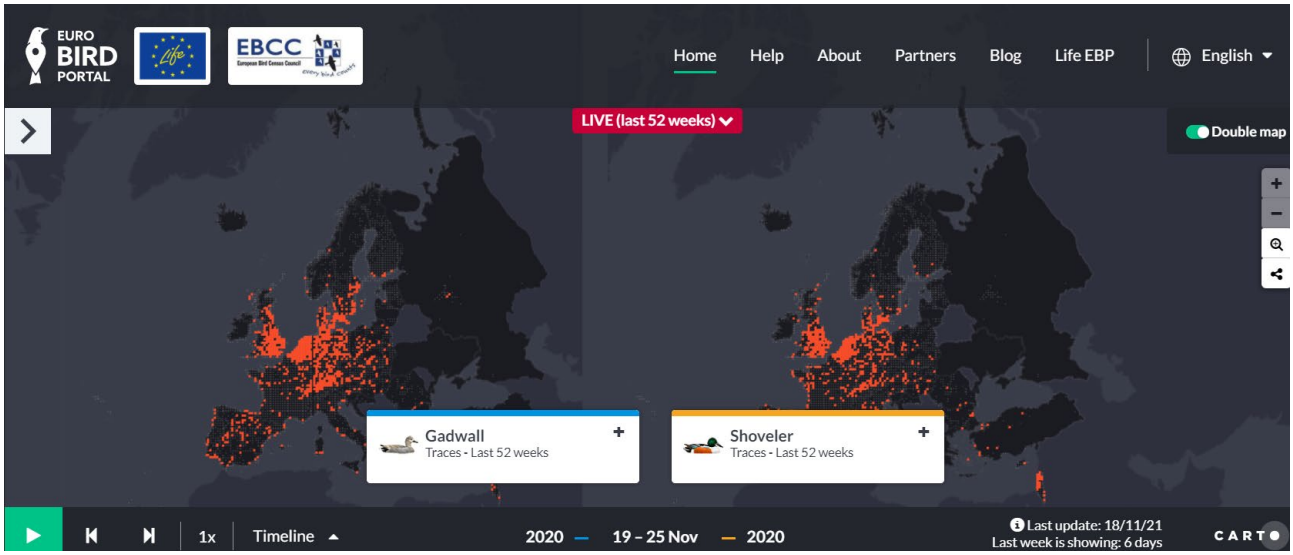
[2] Estimated population sizes according to the BTO Publication on "The State of UK's Birds" state-of-uk-birds-2020-report.pdf (bto.org)
[3] Some of these birds are frequently found positive, but as there is a substantial resident population, it is not possible to differentiate whether they have become infected from a migratory bird contact.

| | | | | |
|---|---|---|---|---|
| Mute swan | Very low | Very low | Very low | 52,500 |
| Pink-footed goose | Very low | Low | Very low | 510,000 |
| Whooper swan | Medium | Medium | Very low | 19,500 |
| Barnacle goose (from Svaalbard) | Low | Very low | Very low | 56,000 |
| Common eider | Low | Very low | Negligible | 81,000 |
| Greater scaup | Very low | Very low | Very low | 6,400 |
| Pochard | Very low | Medium | Low | 29,000 |
| Tufted Duck[4] | Medium | Medium | Medium | 140,000 |
| Common Teal | Medium | High | High | 435,000 |
| Eurasian Wigeon | Medium | High | High | 450,000 |
| Mallard | Medium | Medium | Medium | 675,000 |
| Shelduck | Low | Medium | Medium | 51,000 |
| Pintail | Very low | Low | Low | 20,000 |
| Shoveler | Negligible | Medium | Medium | 19,500 |
| Gadwall | Negligible | Medium | Medium | 31,000 |

The comparison between some of the species in the table above have been checked against the Eurobirdportal numbers (visualised below in figure 1, for gadwall and shoveler). (EuroBirdPortal - Home)

[4] Some birds are poorly surveilled therefore there is uncertainty around the risk associated with the birds.

**Figure 1 Visualisation of Gadwall and Shoveler numbers in Europe, from Euro Bird Portal**




However, when population numbers are considered, EFSA (2017) modelled the impact of wild bird density on the likelihood of a poultry premises becoming infected using EU wide data.

Upon introduction of HPAIV into a wild bird population of sufficient size within the EU, amplification and further wild bird-associated geographical spread of the virus may take place. An association was identified between the HPAIV occurrence in wild birds and the likelihood of infection of poultry holdings, which is supported by the association between detections in wild birds and poultry in the field. A model for the EU population size of wild birds showed the risk was only significant when the total population was 10,000 or 100,000. Using a population size of 10, 100 or 1,000 meant the infection did not become established. Entry of infected waterbirds into Europe only leads to an epidemic when the number of susceptible wild waterbirds is above a critical number. Reducing the number of susceptible birds (because the wintering populations are leaving or because of herd immunity from past exposure) means a new epidemic may not take off and therefore infection pressure to poultry farms is reduced. We should note though, that herd immunity with closely related viruses such as H5N8 and H5N1, is poorly understood and will vary by bird species and age.

## Impact of housing as an additional biosecurity measure during outbreaks in Great Britain

This section is only considering the housing order as a biosecurity measure when applied in addition to the recommendations for additional measures in our general Prevention Zone provisions. For more information on effectiveness of biosecurity in general, the EFSA Opinion (2017) has a greater breadth of work for twenty different biosecurity measures, which gives a rank of importance in effectiveness at preventing an incursion into poultry holdings. These measures included preventing access to wild birds, rodents and pests, transport C&D, biosecurity training of staff, air filtration, preventing feed, bedding and

water from wild bird contamination, separating poultry species and keeping records. These are not being assessed here.

To date, a housing order has been put in place in the Netherlands, where there has been a single report of HPAI H5N1 in commercial poultry in October and in Denmark on 1 November, following detection of HPAI H5N1 in wild birds and a commercial turkey premises and in France on 5 November as a pre-emptive measure, despite having no outbreaks in poultry. Belgium have announced a housing order to come into force on 22 November, following the detection of HPAI H5N1 in a single barnacle goose on 12 November. In the epizootics of 2016/2017 and 2020/2021, many EU MSs put in place a housing order, some used “higher risk areas” where wild bird numbers were greatest, and others in areas of particularly high poultry density. The orders may cover just certain sectors of commercial poultry and certain high-risk areas.

In total, 21 outbreaks were reported in poultry and captive birds in Great Britain between 3 November 2020 and 31 March 2021 (see Annex 1). These include H5N8 and H5N1. These are plotted as the blue line in 2. A housing order (HO) was put in place on 14 December. Assuming the HO reduced the number of outbreaks by a factor of two-fold (EFSA data), then the effect of not having the housing order for 16 weeks from the 14 December can be calculated by assuming each outbreak reported after the 14 December would have been two outbreaks. This is shown as the orange line in **Error! Reference source not found.**2. In the absence of the HO, the total number of outbreaks in GB would be been 33, which is 12 more than the 21 observed (**Error! Reference source not found.**2). Thus it is concluded that the HO applied on the 14 Dec 2020 for 16 weeks saved 12 outbreaks across GB. This assumes the AIPZ already in place contains the other biosecurity measures (separating feed, bedding and water from wild birds, having disinfectant foot baths at points of entry, cleaning equipment, rodent control and preventing wild bird access to ranges etc) and that all outbreaks were in establishments of the same biosecurity status and therefore the same level of exposure to virus.

Putting a 16-week HO in place just before the first outbreak on 3 November had only a slightly greater protective effect compared to that from starting it on 14 December with 18.5 outbreaks compared to 21 (Table 2). 16 weeks is 112 days, and the HO thus runs from 3 November to 23 Feb after which two more outbreaks were reported (representing four more as predicted with no housing order). Thus assuming each predicted outbreak with no HO (orange line in Figure 2) only gave 0.5 of an outbreak over the 16 week period of the HO from 3 November to 23 February, then the total number of outbreaks was 18.5 (grey line in Figure 2). The overall protective effect of the 16-week HO is therefore only 1.8 fold because of the four outbreaks expected after the 23 Feb. Extending the HO to 21 weeks (to 31 Mar) would have saved two of those four outbreaks after 23 Feb giving a total of 16.5 outbreaks and representing the full 2-fold reduction in outbreaks as expected from the HO (Table 2).

Thus, on the basis of the simulations here, early implementation of the 16-week HO only achieved a 1.8-fold reduction in the number of outbreaks. To achieve the full two-fold

effect would require the HO to run for the whole outbreak (and not ending on 23 Feb after 16 weeks).

The model outputs are listed in Annex 2.

**Figure 2 Predicted effects of the housing order (HO) using data for poultry/captive bird outbreaks of HPAI H5 reported in Great Britain in 2020/21 season. (NI excluded).**

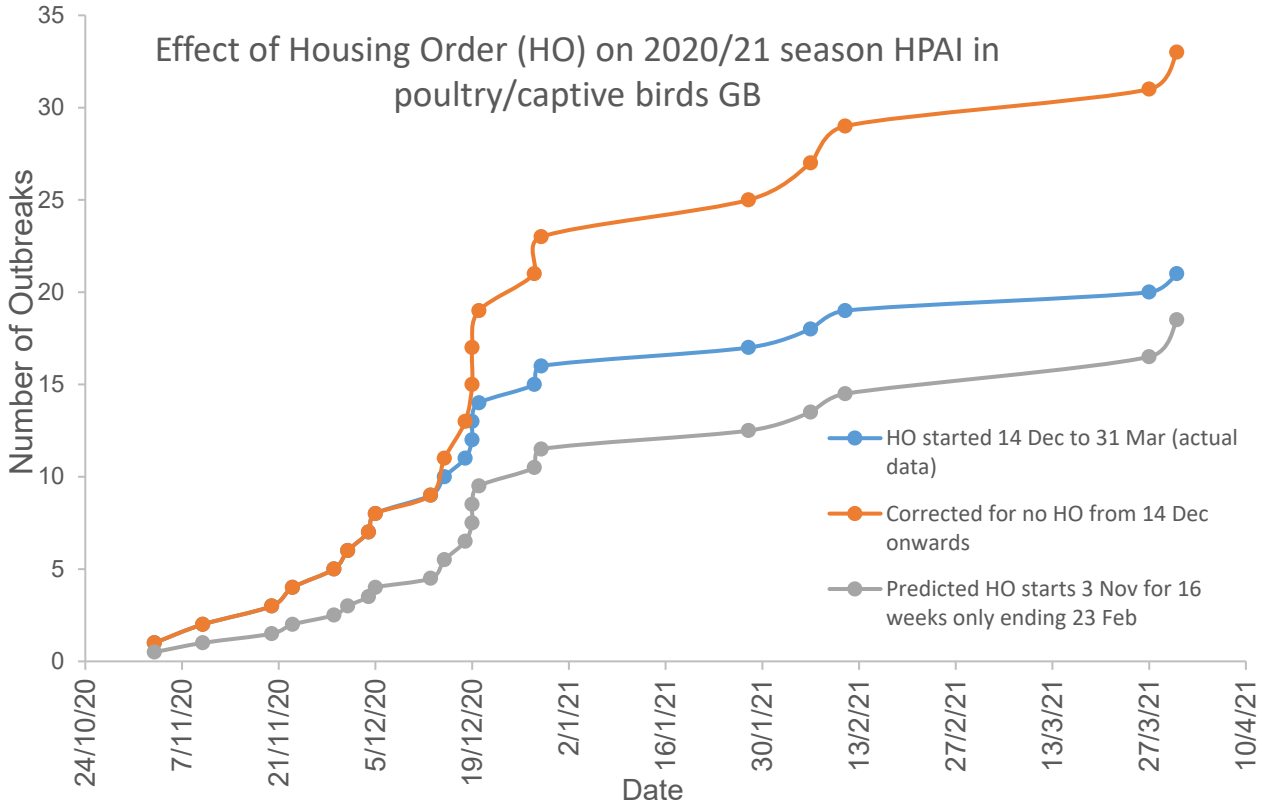



**Table 2 Predicted impact of housing order on number of poultry/captive bird outbreaks at the level of England, Wales and Scotland.**

| Country | Housing order at 14 Dec for 16 weeks ending 31 March – as observed | No housing order | Housing order for 16 weeks from 3 November to 23 February |
|---|---|---|---|
| England | 18 | 27 | 15.5 |
| Scotland | 2 | 4 | 2 |
| Wales | 1 | 2 | 1 |
| Total GB | 21 | 33 | 18.5 |

When a similar approach is applied to the data available for 2016/2017 (HPAI H5N8 outbreaks), the model accounts for different lengths of housing orders, because the order was extended beyond the 12 weeks period to 22 weeks. The housing period has now been extended to 16 weeks therefore the effectiveness of housing was modelled for four scenarios (Table 3) and the results are given in Figure 3 and Table 4.

**Table 3 Housing order lengths for 2016/17 outbreak, and scenarios modelled**

| Start | End | Weeks |
|---|---|---|
| 12 Dec 2016 | 15 May 2017 | 22 weeks |
| 12 Dec 2016 | 6 March 2017 | 12 weeks |
| 12 Dec 2016 | 3 April 2017 | 16 weeks |
| 12 Dec 2016 | 3 June 2017 | 25 weeks |

Outbreaks at the country level:

Of the 21 outbreaks reported in 2020/2021 most were in England. Of the two in Scotland which occurred after the HO, the HO is predicted to have saved a further two (Table 4) with four being predicted in the absence of the HO.

Wales only reported one outbreak again after the HO, and the HO would have saved a further one, with two being predicted in the absence of the HO (Table 4).

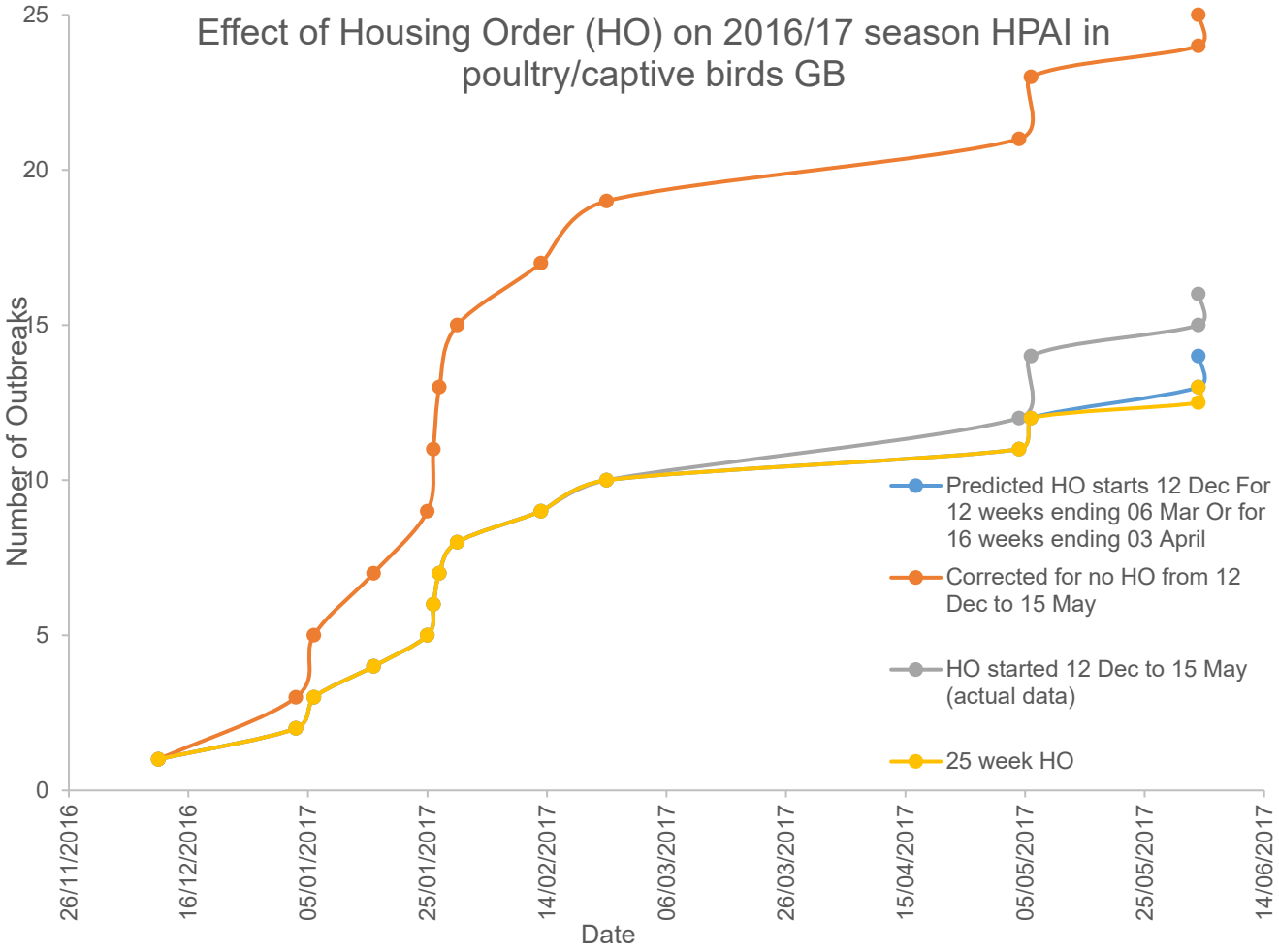
The HO had the greatest effect on England potentially saving nine outbreaks such that only 18 were reported.

**Table 4 Predicted impact of housing order on number of poultry/captive bird outbreaks for Great Britain as a whole. Data for 2016/17.**

| Scenario | Number of outbreaks | Reduction | Total outbreaks potentially saved |
|---|---|---|---|
| No housing order | 25 | No reduction | None |
| 12 week or 16 week housing order | 16 | 1.56-fold | 9 |

| Scenario | Number of outbreaks | Reduction | Total outbreaks potentially saved |
|---|---|---|---|
| Housing order at 12 Dec ending 15 May – as observed | 14 | 1.78-fold | 11 |
| Full housing order over 25 weeks | 13 | 1.92-fold | 12 |

**Figure 3 Predicted effects of the housing order (HO) using data for poultry/captive bird outbreaks of HPAI H5 reported in Great Britain in 2016/17 season. 12 week/16 week and 25-week housing orders are also shown.**




In 2016/17 the housing order was for 22 weeks and may have prevented 11 outbreaks according to the model (Table 4), achieving a 1.78-fold reduction. This is because there were two outbreaks after the lifting of the housing order in June in addition to the one on

11 December prior to the Order. One of those June outbreaks could have been avoided if the housing order were maintained into June, according to the model here. Because of the long tail in the 2016/17 outbreak extending to June, the 12 week and 16-week housing orders would have had less impact, only reducing the risk by 1.6-fold compared to no housing order by allowing an extra two outbreaks compared to the actual number.

Nevertheless, what cannot be determined is the type of holding which could have avoided an outbreak, because many other biosecurity measures are equally or more important in preventing an incursion from wild birds. Many pathways responsible for secondary spread, which is seen in other countries with different poultry production systems, would not be prevented by housing alone.

# Part 2: Risk Assessment

## Hazard Assessment

The hazard identified is the avian influenza virus, HPAI H5Nx subtype. Although the HPAI H5N1 virus has been isolated from the UK during the current season it is possible other strains will be detected in the coming months. HPAI H5N8 has been detected in Estonia, Finland, France, the Netherlands and Sweden in the last few weeks. The OIE/WHO RL (Weybridge) has undertaken some preliminary sequence analysis of the GB virus. The virus maps across the whole genome with the H5N8 viruses (reported by the lab as part of an international collaboration) found in the Netherlands, Iraq, Russian Federation and Kazakhstan during the last 4 months (and therefore distinct from the strain that caused widespread outbreaks in the EU in the first part of this year).

- The National Reference Laboratory (Weybridge) analysed the available full genome sequence data of a H5N1 HPAIV obtained from a UK avian influenza disease investigation (A/chicken/England/053052/2021 and A/mute swan/England/053070/2021). Our observational epidemiology and laboratory data to date would consider these current H5N1 viruses to be of equivalent pathogenicity, infectivity and transmissibility as last season's viruses

- Comparing them with the CDC (Atlanta) H5N1 genetic changes inventory and Suttie et al. 2019 to identify genetic mutations that determine viral phenotypic characteristics of importance that may increase virulence, signal adaptation to mammalian species or alter susceptibility to existing antivirals concluded that whilst there are notable differences to contemporary H5Nx viruses, the UK H5N1 virus demonstrates no strong correlates for specific increased affinity for humans.

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## Risk Question

*What is the risk of incursion of HPAI H5NX into housed and non-housed birds (domestic poultry and captive birds) in England, Scotland and Wales in the next three months from contact with migratory wild birds from Europe during the 2020/2021 winter season?*

*This can be split into several sub-questions:*

- *The likelihood of at least one new wild bird case being detected in the next three months*

- *The likelihood of at least one new poultry outbreak being detected in the next three months?*

## Terminology related to the assessed level of risk

For the purpose of the risk assessment, the following terminology will apply (OIE, 2004):

• **Negligible**: So rare that it does not merit to be considered

• **Very low**: Very rare but cannot be excluded

• **Low**: Rare but does occur

• **Medium**: Occurs regularly

## Entry Assessment

Given the daily increase in wild bird reports from NW Europe and Scandinavia that we have seen over the past four weeks, increasing numbers of wild birds being found dead in Europe and the total populations involved, it is likely that there are birds which are not showing clinical signs and are able to migrate, in which case, some of those birds are likely to already be present in the UK and may still be viraemic or have passed the viraemic period but have been the source of virus circulation in other birds at the aggregation sites.

There is a system for wild bird surveillance in the UK, whereby found dead birds from target species are reported either by wardens at reserves and wetland sites, or by the public for testing at the NRL. To date there have been positive reports of HPAI H5N1 in >140 wild birds at >35 locations in 15 species across GB. The majority of these have been in England with four in each Scotland and Wales. The levels of submissions reflect similar numbers we see year upon year. There is still considerable uncertainty around the transmission of AI from migratory species to endemic species. However, of the cases found so far in GB, most are in endemic species (pheasants, a curlew, a mallard duck, two peregrine falcons, and >50 mute swans), two in migratory species (Whooper swan and greylag goose[5]) and two in gulls (one herring gull, one unspecified species) which have long daily flight patterns. However, it also important to note that the sensitivity of the system is not high, as it is dependent on not only the birds being found, but also the triage system for pooled testing of samples and as once a site has positive birds, more findings will not be tested.

An estimate of the qualitative likelihood of migrating birds arriving in GB from various areas of Europe and Africa are shown below, by species (from the Flutest project). Those in red are the ones which have tested positive for HPAI H5N1 either in the UK or in Europe this season.

[5] Noting many are resident

The Barnacle geese in the Netherlands are different populations from the UK ones, and probably come through the Baltic from Norway/western Siberia, while the ones that winter in Scotland either come from Greenland via Iceland or from Svalbard via north Norway. Around this time of year, Greylag geese are mainly moving south from Scandinavia, or may form resident bird populations. Eurasian wigeon are migratory birds returning from breeding areas in northern Russia and Eastern Europe.

Between September and November, across Europe, other wild bird species testing positive for either HPAI H5N1 or HPAI H5N8 were: barnacle goose, Canada goose, pink footed goose, Eurasian Teal, common shelduck, wigeon, several swan species, grey heron, herring gull, several different raptors and multiple pheasants.

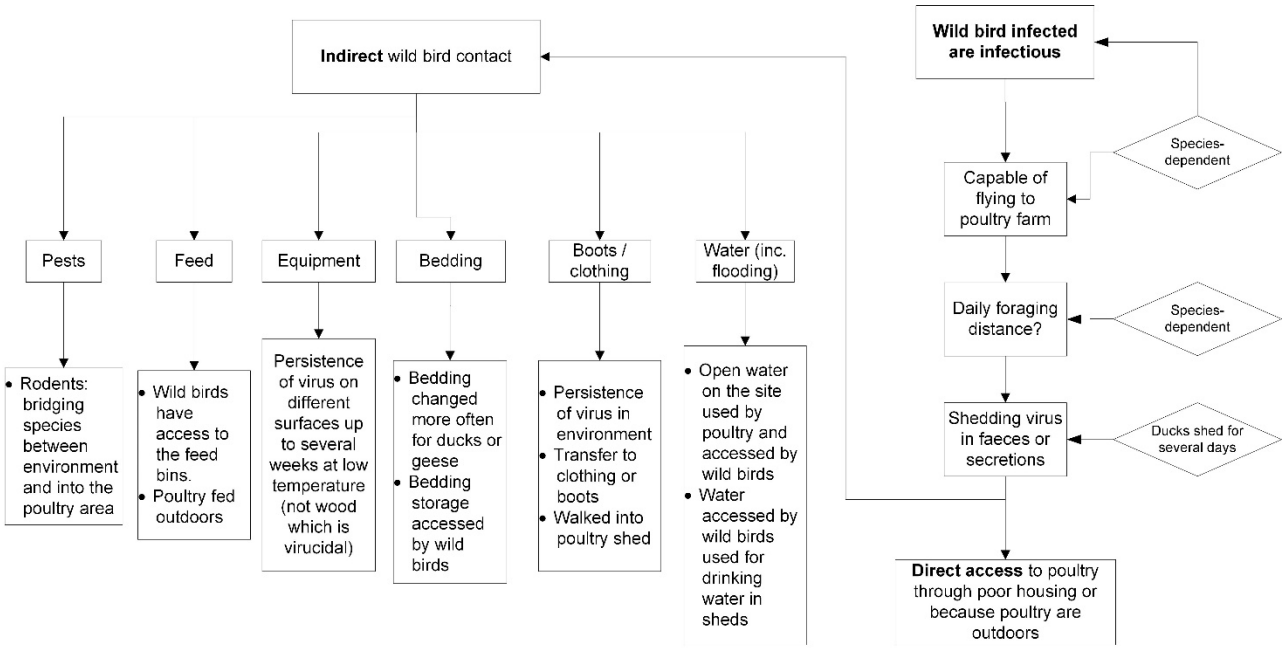
As of 18 November 2021, outbreaks of HPAI H5N1 in poultry have been reported in Denmark, Italy, Germany, Netherlands, Poland, Norway, Hungary, Estonia and the UK (total = 98 outbreaks). Cases of HPAI H5N1 in wild birds have been reported in Belgium, Bosnia and Herzegovina, Czech Republic, Denmark, France Germany, Hungary, Ireland, Italy, Netherlands, Poland, Romania, Serbia, Sweden and the UK.

Bridging species, such as gulls and corvids, have tested positive for HPAI H5N1 on the Continent. As bridging species, gulls are known to have long daily flight patterns between feeding sites, such as open farmland or rubbish tips, and their night roosts such as reservoirs and gravel pits. They are likely to have a role in fomite transmission from areas where there is environmental contamination. Fomite transmission via multiple pathways is particularly important in the current situation, considering the environment is high risk across the country.

We therefore consider the likelihood of there being infected wild waterfowl present in the UK is **VERY HIGH** as a country-wide assessment and that more cases will be detected in the next three months (low uncertainty). However, there will be regional variation, based on the proximity to aggregation sites for non-breeding wild waterfowl both migratory and residential such that the risk levels could be lower for Scotland and Wales, but because of the poor sensitivity of wild bird surveillance in all GB, the uncertainty is increased rather than the risk level decreased (**VERY HIGH**, with high uncertainty).

## Exposure Assessment

**Figure 4 Exposure pathways for poultry from contact with wild birds**




There are multiple pathways for the exposure of poultry to notifiable avian diseases via aerosol, direct or indirect contact.

These include:

- Contact with infected poultry such as live birds, hatching eggs and day-old chicks of poultry
- Contact with live infected wild birds, particularly waterfowl
- Contact with poultry products and by-products of infected poultry,
- Contact with contaminated feed, water, bedding, equipment, vermin or clothing / footwear of people in contact with infected birds or contaminated environment.
- Contact with flood water

For the purpose of this risk assessment, the pathways associated with trade in live poultry or poultry products (including domestic moves) will not be considered. There have not been any records of the legal trade in poultry or poultry products giving rise to an outbreak of HPAI in GB.

Biosecurity advice which poultry keepers should practice at all times of the year are focussed on these pathways as there is a constant low risk of incursion from any notifiable avian disease being introduced into poultry because LPAI viruses circulate constantly in wild birds. The EFSA report from 2017 used a combination of systematic review of all

poultry outbreaks and expert knowledge elicitation from members of the poultry sectors. The opinion also concluded that the relative risk reduction for entry is **three-fold** by preventing access to water bodies, that housing gives a further **two-fold** reduction, and by applying routine biosecurity there is a further **four-fold** reduction in risk while high biosecurity (which is difficult to implement and does not reflect the majority of the industry) is a **44-fold** reduction in risk.

**Contact with live infected wild birds, particularly waterfowl:**

Housing birds will reduce the direct contact with wild waterfowl. It will not prevent any of the other pathways through which disease may enter a poultry premises. Other biosecurity measures will be more important. The likelihood of contact with wild waterfowl will be dependent on the number of such species in the near environment and how attractive the site is to such birds. The presence within the poultry premises of a pond or open feed bins are two well-known factors which make the direct contact with wild waterfowl more likely for poultry with access to the outside environment.

Expert opinion is that the virus will retain infectivity in the environment at low temperatures, for up to 55 days at 4$^{o}$C (Ian Brown, EURL, Pers. Comm.). This means the environment could remain contaminated for several weeks at least.

**Incursion through imported live animals or products:**

For the other pathways, contact with other live birds (ie trade in poultry, hatching eggs, day old chicks) will be dependent on the business itself and the commercial activities. The contact with products or by-products from infected birds will be dependent on the activities of people entering the premises and bringing such products with them and it should be noted that swill feeding is not legal. These will not be addressed in detail for this assessment. However, housing birds will not impact on this risk.

**Contact with contaminated feed, water, bedding, equipment, vermin or clothing / footwear of people in contact with infected birds or contaminated environment including flood water:**

Contamination of feed, bedding and water by wild birds can be prevented by sourcing such products from safe sources (ie where contamination from wild birds was not possible) and keeping such items in containers which no wild birds can access. The site can be made less attractive to wild waterfowl by removing or covering any ponds on site and making sure feeding areas are protected. Contact with contaminated equipment, footwear and clothing can be prevented by making sure all personnel in contact with the birds use disinfectants appropriately. This will be particularly important where birds are housed, as contact with the birds is more frequent, as feed, bedding and water must be brought into the houses and birds must be checked for welfare issues or eggs collected from inside the houses. Visitors to the farm should also be recorded for security. Other biosecurity practices to ensure wild birds are separated from flocks such as feeding birds indoors or under cover, discouraging wild birds from landing, removing wild bird contamination,

netting ponds and draining watercourses, removing feeders and water stations from the range, ensuring good building maintenance and regular inspections for signs of wild bird/rodent access. It is not always possible to prevent flooding at a site, and ingress of flood water has been an important risk factor in past outbreaks, but housing should be wherever possible, securely built to prevent regular ingress.

Above all, what was recommended by the EFSA opinion, was to make sure all personnel are trained in and practice good biosecurity. Regardless of whether birds are housed or not, as housing cannot reduce these pathways as a standalone measure.

## Domestic poultry

The GB poultry sector is complex and seasonally variable. There is a requirement for all poultry keepers in England, Scotland and Wales with more than 50 birds to be registered with the British Poultry Register. Therefore, any data available will not include all the backyard or smallholder community. In terms of the proportion of the sector which is raised outdoors, for the egg sector, there are circa 25-26 million free range hens, and 1.5 million organic hens accounting for approx. 58% of UK production. For broilers, the proportion is a lot lower, at 3-5%. For ducks around 30% are outdoor and for geese, the majority are raised outdoors.

The poultry sector can be designated in the following way with the various populations according to the 2018 poultry register:

**Table 4 Poultry sector designations and populations according to the 2018 poultry register**

| Poultry Type | Number of Birds | As proportion of total population | Number of holdings | As proportion of total poultry holdings |
|---|---|---|---|---|
| Total Chickens | 270986618 | 85.45% | 10125 | 51.98% |
| Outdoor Chickens | 33500062 | 10.56% | 5879 | 30.18% |
| Layers | 47186064 | 14.88% | 5454 | 28.00% |
| Broilers | 166134899 | 52.39% | 1663 | 8.54% |
| Total Turkeys | 8462070 | 2.67% | 1069 | 5.49% |

| Poultry Type | Number of Birds | As proportion of total population | Number of holdings | As proportion of total poultry holdings |
|---|---|---|---|---|
| Outdoor turkeys | 1642191 | 0.52% | 443 | 2.27% |
| Total ducks | 4108083 | 1.30% | 1364 | 7.00% |
| Outdoor ducks | 981325 | 0.31% | 878 | 4.51% |
| Total geese | 146332 | 0.05% | 187 | 0.96% |
| Outdoor geese | 116826 | 0.04% | 125 | 0.64% |
| **Total CDGT** | **283703103** | **89.46%** | **12745** | **65.43%** |
| Total Pheasant | 23918729 | 7.54% | 4733 | 24.30% |
| Total Partridge | 9512172 | 3.00% | 2001 | 10.27% |
| **Total Poultry** | **317134004** | | **19479** | |

Note: the “outdoor” label is only an estimate and the NCP Salmonella survey estimates the free-range population to be 55% of the layer birds and 18% of turkeys.

## Captive birds

Captive birds, such as those held in collections, zoos or approved bodies are already semi-housed and should be kept separate from wild waterfowl. For some, this will be difficult to prevent access to their water environment (penguins, pelicans, flamingos etc) but it is unlikely it will be possible to house indoors, so every effort should be made to prevent wild waterfowl access. There were outbreaks in captive birds in Europe (in zoos) in 2016/2017 and 2020/2120 and a derogation exists in GB domestic legislation which means birds may not have to be destroyed, unless they are in contact with the infected collection.

## Ratites

Ratites, such as ostriches, cannot be housed on a long-term basis, but the susceptibility of such birds to this virus is not known at present. Ratites are often refractory to HPAI infection from other viruses. However, there has been a case in Germany of an emu showing clinical signs in a zoo and therefore these birds should also be considered susceptible.

## Game birds

The majority of game birds have already been released for the shooting season and therefore are considered wild birds and outside the scope of a prevention order around housing. Some will still be kept in pens and could not be housed due to welfare issues, therefore the pens themselves would need to be netted as the birds will often be able to fly out of the pens and forage locally.

Captive birds used as decoys would be at risk of increased contact with wild waterfowl. If they remain at one place for the duration of the fowling season, then they will not come into contact with domestic poultry. However, if the birds are moved around to other sites or spend any time at a premises where domestic poultry are kept, this is an increased risk for the poultry. It is illegal to release by hand captive birds for the purpose of being shot immediately after their liberation, under Part 1, Section 8 of the Wildlife and Countryside Act, 1981. Therefore, if gamebirds are released and then test positive when they have been shot, they are unlikely to have been infected at the premises of origin and more likely from contact with wild birds.

There have been reports of HPAI H5N1 in wild birds at 25 locations across GB, representing more than 100 individual positive birds, which is without doubt an under-ascertainment due to the poor sensitivity of a passive surveillance programme. Again, there will be regional variations and a difference in the biosecurity arrangements at the establishment level. It is important to emphasise both the role of wild ducks and geese visiting poultry premises, and the bridging species flying over or visiting sites. An AIPZ is in place, and personnel should be taking additional biosecurity measures. However, the pathways which lead to disease incursion are not prevented by housing *per se*, but housing birds is a risk reduction measure.

Given the large poultry population (around 20,000 establishments) and the proportion which are outdoor (up to 55% of layers and up to 20% of turkeys) and in the regions close to the high aggregations of wild waterfowl (estimated at around 10% based on previous work done in 2016), we consider the likelihood of *at least one outbreak* being detected in the next three months in GB to be high where biosecurity is less than stringent, that for poultry premises with some biosecurity measures, the likelihood is reduced to medium and for those few poultry establishments which have year round stringent biosecurity, the likelihood is low.

# Consequence Assessment

As this report is considering the scientific evidence around the implementation of a housing order, the modelling approach described in Part 1 of this report suggests that we should expect more outbreaks in the coming months, but this can be reduced by a housing order on top of the existing prevention zone measures. However, this will be more effective in the regions where more outbreaks are predicted, based on wild bird aggregations, effective population sizes of highly susceptible wild birds and the stringency of biosecurity.

# Conclusions

The assessment presented here suggests there is a VERY HIGH likelihood of HPAI H5N1 being present in wild birds in GB. While there may be regional difference, the presence in endemic or resident birds means infection has become seeded in the environment and will not reduce in the coming environmental conditions.

The incursion into poultry premises depends on the level of biosecurity present. There are multiple pathways which can bring infection into poultry and these are not necessarily prevented by only housing birds.

Direct evidence of the impact of housing is not available, nevertheless there are studies and expert opinion assessment which confirms that housing is only part of the biosecurity continuum. If stringent biosecurity is applied, the risk is substantially reduced, but may still not mitigate the risk. For premises with almost no biosecurity, the risk is HIGH for further cases to be detected in the following three months. For poultry premises with good biosecurity (but not stringent) the risk level is MEDIUM and for those with stringent biosecurity the risk is LOW. The level of uncertainty however varies by region.

A simple model of applying a two-fold reduction on the epidemic curve of previous outbreaks in GB shows that while some outbreaks may have been mitigated by housing, the housing order of 16 weeks will not entirely cover the risk period and it confirms that housing is not the only measure which needs to be taken to prevent outbreaks taking place.

Experts were asked to answer the following questions during the peer review of this document and provide their confidence in the answer. The questions are as follows:

**1.How certain are you that wild bird cases will continue to be reported in the next three months in England, Scotland or Wales?**

England: 90-99% Very likely / Extremely likely (albeit with lower numbers for Scotland and Wales)

Scotland: 90 – 99% Very likely/extremely likely

Wales: 90-99% Very likely, the sensitivity of wild bird surveillance in Wales is low considering people's engagement but also density of the population. Birds could be dying in places not so frequently visited by members of the public. With a cold snap and more turbulent weather at the cost migratory birds will move more in land and from north to south. It is extremely likely we will see more positive birds then. Highlighting also the fact that there are already positive birds in Wales – from east, west and south of the Country- positive sedentary birds indicating that the infections has been spreading here for a while already.

**2. How certain are you that there is a different risk level for poultry or captive bird premises with low, medium and stringent biosecurity in place?**

England: 95-99% Extremely likely. It is sensible to consider these three biosecurity levels as being a different risk. Not only around measures used but also compliance in applying.

Scotland: 33-66% (as likely as not) and 66-90% (likely)

Wales: 90-99% very likely – biosecurity measures can bring significant difference in risk management

**3. How certain are you that an outbreak will occur in the next three months in one of the following premises: Any poultry or captive bird establishment with low, medium or stringent biosecurity in England, Scotland or Wales?**

| Biosecurity level | England | Scotland | Wales |
|---|---|---|---|
| Low | 95-99% Extremely likely | 33 – 90% As likely as not/Likely | 90-95% very certain |
| Medium | 66-99% | 10 – 66% Unlikely/as likely as not | 33-90% certain |
| Stringent | 5-33% very unlikely[6] | 5-10% Very unlikely | 5-10% Not certain |

[6] But some uncertainty as even minor non-compliance can be critical during high risk period

# Annex 1- Data used

**Table 1: Summary of confirmed outbreaks of HPAI H5N8 in poultry and captive birds in the UK to 16 April 2021**

| Date HPAI H5N8 confirmed | Location, County | Description |
|---|---|---|
| 3/11/20 | Near Frodsham, Cheshire | Broiler breeder rearer chickens |
| 10/11/20 | Near Leominster, Herefordshire | Broiler breeder chickens |
| 23/11/20 | Near Melton Mowbray, Leicestershire | Poultry and captive birds |
| 29/11/20 | Near Northallerton, Hambleton, North Yorkshire | Rearing turkeys |
| 0112/20 | Near Northallerton, Hambleton, North Yorkshire | Rearing turkeys |
| 04/12/20 | Near Attleborough, Breckland, Norfolk | Rearing turkeys |
| 05/12/20 | Near King's Lynn, Norfolk | Rearing turkeys |
| 15/12/20 | Near Willington, Derbyshire | Captive birds and poultry |
| 19/12/20 | Island of Sanday, Orkney Islands | Small commercial free range laying flock |
| 19/12/20 | Near Gillingham, North Dorset | Backyard poultry |
| 20/12/20 | Near Attleborough, Breckland, Norfolk | Commercial duck premises |
| 28/12/20 | Near Great Ellingham, Norfolk | Backyard poultry |
| 28/12/20 | Near Ickburgh, Norfolk | Commercial duck rearing premises |
| 29/12/20 | Near Aylesbeare, Devon | Backyard poultry |
| 06/01/21 | Ballymena, County Antrim | Commercial layer rearer premises |

| | | |
|---|---|---|
| 12/01/21 | Lisburn, County Antrim | Commercial layer |
| 28/01/21 | Near Amlwch, Isle of Anglesey, Wales | Game bird rearing premises |
| 06/01/21 | Near Redcar, Redcar and Cleveland | Commercial layer |
| 27/01/21 | Near Uttoxeter, East Staffordshire | Commercial broiler chickens |
| 20/11/20 | Near Stroud, Gloucestershire | Captive birds |
| 13/12/20 | Near Droitwich Spa, Worcestershire | Captive birds |
| 31/01/21 | Near Skelmersdale, West Lancashire | Captive birds |

**Table 2: Summary of confirmed outbreaks of HPAI H5N1 in poultry and captive birds in the UK to 16 April 2021.**

| Date HPAI H5N1 confirmed | Location, County | Description |
|---|---|---|
| 18/12/20 | Near Hawes, Richmondshire, North Yorkshire | Backyard chickens |
| 11/02/21 | Near Glenrothes, Scotland | Game bird rearing and breeding premises |

# Annex 2 Model

| Country | Actual report | Predicted no HO | Predicted 16 week HO 03 Nov | Location | Date | Cumulative actual report | Cumulative predicted no HO | Cumulative predicted 16 week HO 03 Nov |
|---|---|---|---|---|---|---|---|---|
| England | 1 | 1 | 0.5 | Frodsham | 03/11/2020 | 1 | 1 | 0.5 |
| England | 1 | 1 | 0.5 | Leominster | 10/11/2020 | 2 | 2 | 1 |
| England | 1 | 1 | 0.5 | Stroud | 20/11/2020 | 3 | 3 | 1.5 |
| England | 1 | 1 | 0.5 | Melton | 23/11/2020 | 4 | 4 | 2 |
| England | 1 | 1 | 0.5 | Northallerton | 29/11/2020 | 5 | 5 | 2.5 |
| England | 1 | 1 | 0.5 | Northallerton | 01/12/2020 | 6 | 6 | 3 |
| England | 1 | 1 | 0.5 | Attleborough | 04/12/2020 | 7 | 7 | 3.5 |
| England | 1 | 1 | 0.5 | King Lynn | 05/12/2020 | 8 | 8 | 4 |
| England | 1 | 1 | 0.5 | Droitwich | 13/12/2020 | 9 | 9 | 4.5 |
| England | 1 | 2 | 1 | Willington | 15/12/2020 | 10 | 11 | 5.5 |
| England | 1 | 2 | 1 | Hawes | 18/12/2020 | 11 | 13 | 6.5 |
| Scotland | 1 | 2 | 1 | Orkney | 19/12/2020 | 12 | 15 | 7.5 |
| England | 1 | 2 | 1 | Gillingham | 19/12/2020 | 13 | 17 | 8.5 |
| England | 1 | 2 | 1 | Attleborough | 20/12/2020 | 14 | 19 | 9.5 |
| England | 1 | 2 | 1 | Gt Ellingham | 28/12/2020 | 15 | 21 | 10.5 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| England | 1 | 2 | 1 | Aylesbeare | 29/12/2020 | 16 | 23 | 11.5 |
| Wales | 1 | 2 | 1 | Anglesey | 28/01/2021 | 17 | 25 | 12.5 |
| England | 1 | 2 | 1 | Redcar | 06/02/2021 | 18 | 27 | 13.5 |
| Scotland | 1 | 2 | 1 | Glenrothes | 11/02/2021 | 19 | 29 | 14.5 |
| England | 1 | 2 | 2 | Utoxeter | 27/03/2021 | 20 | 31 | 16.5 |
| England | 1 | 2 | 2 | Skelmersdale | 31/03/2021 | 21 | 33 | 18.5 |

# Annex 3 HPAI H5N1 positive wild birds in GB

Table 3 showing wild bird species testing positive for HPAI H5N1 from October to November 2021

| Wild bird species positive for HPAI H5N1 October November 2021 | Number detected |
|---|---|
| Barnacle Goose | 4 |
| Canada Goose | 11 |
| Common Buzzard | 2 |
| Common gull | 1 |
| Curlew | 2 |
| Unspecified duck | 1 |
| Great-crested Grebe | 1 |
| Greylag goose | 3 |
| Unspecified Gull | 1 |

| | |
|---|---|
| Mallard Duck | 2 |
| Mute Swan | 63 |
| Peregrine Falcon | 2 |
| Pheasant | 10 |
| Pink Footed goose | 7 |
| Whooper Swan | 12 |