

**FOOD AND FARMING GROUP  
Veterinary Sciences Team  
FINAL EPIDEMIOLOGY REPORT**

**Highly Pathogenic Avian Influenza H5N1, Suffolk, November 2007**



**Prepared by the National Emergency Epidemiology Group (NEEG)**

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# **FINAL REPORT: AVIAN INFLUENZA OUTBREAK IN SUFFOLK, NOVEMBER 2007**

## **EXECUTIVE SUMMARY**

(i) This report completes reporting of all the epidemiological investigations carried out following a report of suspected avian notifiable disease in turkeys in Suffolk on 11 November 2007. Highly pathogenic (HP) H5N1 avian influenza (AI) infection was confirmed on 13 November.

(ii) The infected premises (IP) comprised 5,000 growing turkeys, kept in 5 groups of 1,000, 1,118 ducks and 410 geese maintained under a free range system. Samples collected at slaughter for laboratory examination revealed that two groups of turkeys had a significant prevalence of infection (>50%), a further group had a maximum prevalence of 5%. No evidence of infection was found in the geese, but infection was detected in the ducks for which the maximum prevalence was 2%. The findings suggest that there had been an initial focal introduction of virus into one of the groups of turkeys, rather than a widespread exposure of all poultry on the site.

(iii) Epidemiological investigations of the IP resulted in the identification of five dangerous contact (DC) premises as a result of them being tended by the same stockmen who employed poor biosecurity measures. Samples were taken for laboratory examination from the birds culled at the DC premises. Infection was detected in one group of turkeys on one of these premises, which became designated as IP2. Epidemiological findings were consistent with infection having been transmitted from IP1.

(iv) Genetic analyses of the virus isolates from the turkeys on the two IPs and the ducks on IP1 indicated that the birds were infected from a single source. The current isolate has the closest genetic identity to an isolate from wild birds in the Czech Republic detected in mid-2007. The current isolate is phylogenetically distinct from the previous isolate of H5N1 in 2007 obtained from the Holton outbreak.

(v) The poultry on the premises which supplied the birds to IP1 and IP2 were sampled and tested with negative results. All of the birds were hatched in Great Britain.

(vi) The surveillance of poultry in the PZ and SZ did not reveal any further infected flocks indicating that infection was confined to the two IPs.

(vii) The results of the epidemiological investigations provide no evidence that infection was introduced via imported poultry or poultry products or any activities associated with such importations.

(viii) IP1 was located in an area where wild birds were relatively common and was notably near to an ornamental lake which supports some 1000 waterfowl.

H5N1 infection was not detected in wild birds nor have any incidents of high mortality been observed in the area.

(ix) The hypotheses for the introduction of HP H5N1 virus into the commercial poultry unit, after all other routes were ruled out, were:

- Introduction via wild birds infected with HP H5N1 virus. This hypothesis is strongly supported by the presence of wild birds in the adjacent lake to IP1 and the phylogenetic evidence.
- Introduction via poultry or poultry products infected with HP H5N1 virus, and/or via associated vehicles and personnel, from countries which have undisclosed infection in their domestic turkey, geese and duck population.

(x) Final disinfection sufficient to permit restocking of the two infected premises was completed on 17 and 24 April 2008 respectively. A final report closing the outbreak was sent to the OIE on 12 May 2008: [http://www.oie.int/wahid-prod/reports/en\\_fup\\_0000007028\\_20080512\\_112233.pdf](http://www.oie.int/wahid-prod/reports/en_fup_0000007028_20080512_112233.pdf)

## **INTRODUCTION**

1. This report updates the initial epidemiological report, published on <http://www.defra.gov.uk/animalh/diseases/notifiable/disease/ai/pdf/ai-prelim-epireport071129.pdf>, and completes reporting of all the epidemiological investigations carried out, which seek to explain the outbreak of HPAI H5N1 infection in free-range managed turkeys on a premises in the north of the county of Suffolk. The characteristics and events on the premises itself described in the early report are, in general, not repeated here.

## **THE FIRST INFECTED PREMISES (IP1)**

2. Suspicion of an avian notifiable disease on this premises was reported to the local Animal Health Divisional Office, Bury St Edmunds on the afternoon of Sunday 11 November as a result of an increased mortality in the turkeys in "Hut 5" (of 5) comprising approximately 1,000 turkeys.

3. Six turkey carcasses, 20 sets of blood samples and oro-pharyngeal and cloacal swabs were taken from the turkeys in Hut 5 for serological and virological examination at the European Union Community Reference Laboratory at the Veterinary Laboratories Agency (VLA), Weybridge, in the early evening of 11 November.

4. On the following day, 12 November, the preliminary results of the laboratory examinations revealed that a H5 virus was present in the samples submitted from the turkeys. This resulted in the establishment of a 3km radius Protection Zone and a 10km radius Surveillance Zone, together with a Restricted Zone as advised by the Ornithological Expert Panel (OEP). Then, on 13 November, the laboratory results confirmed that the turkeys were infected with highly pathogenic (HP) H5N1 AI virus.

5. During the course of 13 November further molecular genetic analyses revealed that the virus isolated had a 99.8% identity to the isolates from wild birds in June and July 2007 in the Czech Republic. With respect to the isolates of HP H5N1 from incidents of infection in France and Germany in July and August 2007 there was a 99.3% identity with the current Suffolk isolate.

6. Culling commenced on this infected premises (IP) on 13 November. Culling was completed on the afternoon of 15 November. In the course of the culling an increased mortality rate was observed in turkeys in Hut 4. No evidence of clinical disease was observed in the turkeys in Huts 1, 2 and 3 or in the ducks and geese.

7. During culling a representative sample, comprising blood samples and oropharyngeal and cloacal swabs, was taken for laboratory testing. The serological tests, using the haemagglutination inhibition test, were negative in all groups. The results of virological testing, using the real time PCR, revealed i) a high prevalence of infection in Huts 4 and 5 that had shown clinical disease and ii) a low prevalence in Hut 1 and in the group of ducks (Table 1).

Epidemiological Group	Date sampled	RT-PCR result (No. +/ No. tested)	Prevalence (%)
Turkeys Hut 1	15 November	1/60	4.9
Turkeys Hut 2	14 November	0/60	-
Turkeys Hut 3	14 November	0/60	-
Turkeys Hut 4	15 November	25/60	53.8
Turkeys Hut 5	15 November	55/60	98.5
Ducks	15 November	1/151	1.9
Geese	15 November	0/152	-

Table 1: Results of virological examinations of the groups of poultry on IP1

8. Virological and serological results suggested a point source exposure to the virus that was first introduced into the turkeys in Hut 5. Given the clinical picture and assuming an incubation period of 3-21 days the virus was introduced during the period 16 October 2007 to 6 November 2007.

9. All the birds were hatched in Great Britain. Table 2 indicates the dates that the birds arrived on the IP and their ages. The premises had not been stocked since the Easter 2007 turkey production.

Species (Number of birds)	Date moved to the IP	Age when moved to the IP
Turkey (3990)	3 September 2007	18 weeks
Turkey (1008 – Hut 4)	7 September 2007	16 weeks
Geese	13. August 2007	4 weeks
Ducks	24 October 2007	4 weeks

Table 2: Dates of arrival of the poultry on IP1 and the ages.

10. Questioning of the stockmen indicated that they had no set routine as to whether they attended to the turkeys or the ducks/geese first. They did have a routine for tending the turkey huts which was in the order: hut 1, hut 2, hut 3, hut 4, and hut 5.

## **RESULTS OF EPIDEMIOLOGICAL INVESTIGATIONS**

### **Source of Infection Tracings**

11. The usual tracings of potential sources of infection were enacted following the identification of infection at the premises.

12. No evidence was found to suggest that infection was introduced by the delivery of bulk turkey feed or the delivery of straw.

13. The turkeys and geese were obtained from a brooder farm within the parent company's network of farms within the Surveillance Zone and on investigation only 3,000 turkeys were currently on the premises. Even though these turkeys, if infected, were likely to have shown clinical signs they were sampled as a precautionary measure. No evidence of infection was detected on these premises.

14. The ducks were also obtained from one of the company's farms situated just outside the 3km Protection Zone. This premises comprised some 47,000 ducks, 4,000 geese and 11,000 turkeys, all housed in environmentally controlled buildings. The turkeys were examined clinically and found to be normal with no evidence of infection. A random sample of the ducks and geese were selected for serological and virological examination sufficient to detect a 2% prevalence of infection in each epidemiological group. No evidence of infection was found.

### **“Spread” Tracings from the IP to identify premises likely to have become infected**

15. Initial investigations revealed that the stockmen for the poultry on IP1 were also responsible for the feeding and general management of a further four flocks of turkeys. One premises was within the PZ and three premises were in the SZ.

16. Our investigations revealed evidence, from the information supplied to our field epidemiologists, of poor biosecurity measures applied by these stockmen in terms of the disinfection procedures and other disease control measures employed by these staff. Simple measures to prevent the transmission of infection between premises were not followed.

17. The four premises were identified as likely to have been exposed to infection with the HP H5N1 virus. They were identified as Dangerous Contacts (DC1 to DC4).

18. It was also revealed that the stockmen had also contact with the birds on the company's premises which supplied the ducks on IP1. This premises was therefore designated a DC premises (DC5).

### **DC1**

19. This premises contained a free range organic turkey grower unit containing 4,000 birds. The birds were hatched in Great Britain and the growing poults were derived from the same brooder farm as for IP1.

20. On arrival at the premises the veterinary staff of Animal Health found an unusually large number of deaths. The designation of the premises was changed to Slaughter on Suspicion (SOS) of disease and carcasses were submitted for virological examination.

21. The culling of these birds was completed in the afternoon of 15 November. During culling, a representative sample was taken for virological and serological testing. No virus was detected and all serum and swab samples were negative.

22. On investigation, the increased mortality was associated with very cold weather.

### **DC3 and DC4**

23. These two premises contained 3,000 and 6,000 turkeys respectively. Representative samples were taken during the culling. On DC3 samples were taken on 16 November and those on DC4 on 17 November. All samples were negative on serological and virological examination.

### **DC5**

24. This premises was also identified as a potential source tracing. The premises comprises some 11,000 growing turkeys, approximately 4,000 growing geese and some 47,000 growing ducks.

25. During the culling, which started on 22 November, a representative sample from each epidemiological group within the premises was taken for serological and virological examination. No evidence of HP H5N1 infection was found.

## **DC2 (IP2)**

26. This premises comprised a free range organic turkey grower unit of 9,000 birds. All had been hatched in Great Britain and the birds were derived from the same brooder farm as IP1 and DC1/SOS1. Birds were kept in 9 epidemiological groups (houses) of equal size.

27. Representative samples from each of the nine houses were taken during and before the culling process on 15 and 16 November. All samples from houses 1, 2, 3, 4, 5, 6, 8 and 9 were serologically and virologically negative.

28. HP H5N1 was detected in 3 of the 60 oro-pharyngeal swabs taken from house 7. Full genome sequencing of the virus detected revealed a 100% identity to the viruses isolated from the turkeys and the duck on IP1. All other samples from the birds in this house were serologically and virologically negative. There was no evidence of clinical disease in this house or the other houses.

29. No further sampling or culling was required as a result of conducting the tracings investigation of this premises.

30. Preliminary and final cleaning and disinfection (C&D) were completed on the two IPs and the four DC. Details are shown in Table 3.

Outbreak reference	Date preliminary C&D	Date final C&D
IP1	17/11/2007	29/04/2008
SOS1	18/11/2007	06/05/2008
IP2	19/11/2007	17/04/2008
DC3	19/11/2007	10/07/2008
DC4	19/11/2007	14/05/2008
DC5	29/11/2007	25/04/2008

Table 3: Dates of preliminary and final C&D.

## **The parent company**

31. The parent company's main enterprise was the production of ducks for the table, but also had components producing turkeys and geese for seasonal consumption. Although infection appeared to have been confined to one relatively small "cell" of the company's production units, which produced organic/free range turkeys, geese and ducks, the epidemiological investigations extended to the whole company.

32. Day old ducklings were imported weekly from a hatchery in The Netherlands. There was no epidemiological association with these imports and the current outbreak. Day old ducklings were also imported from France into the multiplier and rearing units. There was no epidemiological association with these imports and the current outbreak.

33. The seasonal, Easter and Christmas, turkey production component of the company comprises 18 grower units and one brooder/rearer unit. The latter was supplied with day old turkey poults from a hatchery in south-east England and a hatchery in Northern Ireland. Eight of the grower units and the brooder/rearer unit were sampled as a result of our investigations, with negative results.

34. Day old goslings were placed from May to mid-August for seasonal goose production. Some 36% of the goslings are imported from Germany (9%) and Denmark (27%). All epidemiological groups of geese were sampled for serological and virological examination for HP H5N1 with negative results.

35. The company also runs a slaughterhouse operation with associated cutting plants. Investigations into the slaughtering operations revealed a high level of biosecurity. Animal-by-products produced by the slaughter process and cutting plants were handled safely.

### **Surveillance of domestic poultry**

#### *Within the Protection Zone*

36. As required by the EU Directive 2005/94/EC a census was conducted of all poultry holdings in the PZ. The surveillance included the visiting of all premises on which birds were kept to conduct a clinical examination and an inspection of the production records. In addition geese, ducks and other waterfowl were sampled for laboratory examination. The sampling regime was sufficient to detect a 5% prevalence with 95% confidence in each epidemiological group on each premises. A blood sample together with oro-pharyngeal and cloacal swabs were taken from each bird selected for serological and virological examination. All samples taken were negative for HP H5N1.

#### *Within the Surveillance Zone*

37. All commercial premises within the SZ, containing more than 50 poultry, were identified. All premises containing geese, ducks and other waterfowl were visited to inspect the birds and examine production records.

38. Sampling of domestic geese, ducks and other waterfowl was conducted on all premises except those where it was assessed that chickens and/or turkeys would have acted as sentinels for HP H5N1 infection because of their close contact with the waterfowl. The sampling regime was designed to detect a 5% prevalence of infection with a 95% confidence. An oro-pharyngeal and cloacal swab was taken from each bird for virological examination. All samples were negative for HP H5N1 infection.

39. An exception to this sampling strategy was applied to the unit comprising some 30,000 outdoor geese owned by the parent company. For this group of geese the strategy was to detect a 2% prevalence with a 95% confidence in each epidemiological group within the unit as a whole. No evidence of

infection in these geese was found. This more rigorous sampling was applied as a result of the initial assessment by the OEP (see below) which indicated that a proportion of the wild bird populations on IP1 were likely to visit the outdoor goose unit which was just over 3km away.

## **Surveillance of wild birds**

### **Background surveillance**

40. Since late October 2006 a targeted surveillance programme for the detection of avian influenza including H5N1 in wild birds is in place in Great Britain. This surveillance programme has a number of components and is targeted to those species of birds considered to be at most risk of harbouring the H5N1 strain of the virus as determined by the European Food Safety Authority (EFSA). See preliminary report for further details on this surveillance programme.

### **Specific ornithological investigations**

41. An initial Expert Ornithological Field Assessment (EOFA) recommended by the Ornithological Expert Panel (OEP) was carried out on 12 November. The objective was to advice on the extent of the EU required Restricted Zone (RZ). Based on the likely movements of gulls and corvids from the area around IP1 the RZ was established (see preliminary report for further details).

42. A second specific EOFA on 13 November was conducted to determine the direction and distance of roosts from the area around the IP. The conclusion from this field assessment was that there was no evidence of gulls moving from the PZ and SZ to roosts beyond the RZ.

43. Further observations centred on the large free range flock of geese in the same complex as DC5 referred to above. Some 600 corvids and 2,500 Starlings were observed among the geese together with at least 5 Lesser Black-backed Gulls, 40 Black-headed gulls and one Lapwing. It was concluded that the range of species and the number of birds were normal for this landscape and time of the year.

44. Further visits were made to IP1 and the area around the adjacent lake on 15 and 23 November:

- To obtain droppings from known species on IP1 and the lakeside for virological examination.
- To observe the wild birds in the area for any clinical signs of disease and collect any carcasses of wild birds for virological examination.
- To conduct counts of wild birds on the lake and surrounding fields, and on IP1.

45. There were no significant changes in the bird populations between these two visits. Furthermore, the results of the virological examination of faecal samples from wild birds on IP1 did not produce any evidence of HP H5N1

infection. No signs of clinical disease were observed in the wild birds in the area.

46. Also, on 15 November, expert ornithologists from the British Trust for Ornithology visited 18 water bodies in south Norfolk and north Suffolk within a 24 km radius of IP1. The objective of these visits was to look for dead or sick birds that could have potentially contracted the H5N1 virus. There was no evidence of widespread disease or multiple deaths at the locations. No carcasses were found which were suitable for laboratory testing.

47. Following the confirmation of infection on IP2 an EOFA was conducted on and around these premises. The conclusion from this assessment was that the area that these turkeys were maintained in presented a low risk of infection from or to wild birds.

48. Up to date information on the wild bird survey which is still continuing can be found on the Defra website at:

<http://www.defra.gov.uk/animalh/diseases/notifiable/disease/ai/wildbirds/survey-results.htm>

## **SUMMARY OF EPIDEMIOLOGICAL FINDINGS**

49. This outbreak was confined to the index case which is also the first case of infection and a secondary case as a result of fomite transmission by the stockmen. The first case was identified sufficiently early such that infection had not become widespread on the premises.

50. The results of the genetic analyses on the HA1 portion of the haemagglutinin gene of the virus indicated that the infected poultry on the two IPs were infected from a single source.

51. The hypotheses for the introduction of HP H5N1 virus into the commercial poultry unit, after all other routes were ruled out, were:

- Introduction via wild birds infected with HP H5N1 virus. This hypothesis is strongly supported by the presence of wild birds in the adjacent lake to IP1 and the phylogenetic evidence.
- Introduction via poultry or poultry products infected with HP H5N1 virus, and/or via associated vehicles and personnel, from countries which have undisclosed infection in their domestic turkey, geese and duck population.

52. There was no evidence for the introduction of infection as a result of the importation of day old turkeys (from Northern Ireland), day old goslings (from Germany and Denmark) and day old ducklings from France and The Netherlands. The infection of turkeys on IP1 was not associated with any of these imports. This represents an unlikely means of transmission.

53. A number of poultry products were imported into the company's slaughterhouse. These presented a negligible risk as the animal by-products

disposal system in place was sufficiently secure and there was no identifiable means of transmission of infection from the slaughterhouse and cutting plant to IP1.

54. The molecular genetic analysis of the isolate from the outbreak indicated that there was a very close identity (98.8%) with the isolate obtained from a Mute Swan in mid-2007 in the Czech Republic in June and July. There were nucleotide similarities between the current Suffolk isolate and isolates from Kuwait which range between 99.4 – 99.6% and isolates from Germany which range from 99.2 – 99.4% all of which were identified in mid-2007. The current isolate was phylogenetically distinct from the previous isolate of H5N1 in 2007 obtained from the Holton outbreak.

55. As there were no epidemiological links with domestic poultry in central Europe, the molecular genetic results suggested that wild birds may have introduced the virus into Suffolk from Europe.

56. The location of IP1 with respect to wild birds species potentially susceptible to infection with H5N1 was a significant finding. Infected wild birds as source of infection could not therefore be ruled out. However, there was no evidence of widespread infection or a high prevalence of H5N1 in the local wild bird population, or in Great Britain as a whole.

57. Two epidemiologically significant findings were evident from the investigations:

- The poor biosecurity measures employed by the stockmen, which in this case were also peripatetic and therefore cared for more than one unit of poultry which resulted in the spread of infection in the area.
- The siting of a free range poultry unit (IP1), which is likely to attract wild birds because of feed availability, in an area already unavoidably occupied by populations of wild bird species, notably migratory waterfowl, but also “bridge” species (such as gulls) which are capable of becoming infected by HP H5N1 AI virus and transmitting this virus from primarily infected wild birds to commercial poultry.

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## **NATIONAL EMERGENCY EPIDEMIOLOGY GROUP and INTERNATIONAL ANIMAL HEALTH.**

**Food and Farming Group**

**Defra**