OUTBREAK OF HIGHLY PATHOGENIC H5N1 AVIAN INFLUENZA IN SUFFOLK IN JANUARY 2007

A REPORT OF THE EPIDEMIOLOGICAL FINDINGS BY THE NATIONAL EMERGENCY EPIDEMIOLOGY GROUP, Defra 5 APRIL 2007

EXECUTIVE SUMMARY

1. Suspicion of Highly Pathogenic Avian Influenza (HPAI) was reported on a turkey finishing site in Suffolk on 1 February 2007.

2. Following the service of restrictions, a veterinary enquiry was carried out and samples were submitted to the National (and Community) Reference Laboratory, Weybridge on 2 February 2007. Depopulation of the clinically affected birds was completed on the same day and the presence of highly pathogenic Avian Influenza (HPAI) H5N1 virus was confirmed on 3 February.

3. Depopulation of the remaining birds on the site was completed by 5 February and preliminary cleansing and disinfection by 8 February. The required movement control and surveillance zones were established in line with European Council Directive 2005/94/EC and epidemiological investigations were carried out into the possible source and spread of the disease.

4. The outbreak was confined to a single farm which was adjacent to a turkey factory comprising a slaughterhouse and two processing plants. Epidemiological investigations into five live poultry premises that had contact with the site during the infectious period through personnel and vehicles, and surveillance of poultry premises and wild birds within the restricted zones revealed no evidence of spread of infection.

Epidemiological Investigations

5. Extensive investigations have been carried out by the National Emergency Epidemiology Group (NEEG) comprising:

a. Close examination of the farm and factory premises

b. Detailed review of the records on the farm and at the factory

c. Interviews with staff at the farm and the factory

d. Expert ornithological analysis of wild bird activity in the area, and potential links with Hungary

e. Expert virological analysis of the HPAI virus recovered from the outbreak and comparison with viruses of the same strain identified from previous domestic and wild bird outbreaks

f. Examination of the data requested from and provided by both Bernard Matthews and the Hungarian authorities

g. Exchange visits between veterinary experts in Hungary and GB to share information and examine the data

h. Examination of records of all Hungarian imports of poultry products to Great Britain (GB) during 2006

i. Identification and investigation of all poultry farms potentially exposed to the infection at Holton farm by either contacts with the farm or proximity to it.

j. Enhanced wild bird surveillance in the area during February and March 2007

Outcome of Investigations

6. This farm was unusual in being sited immediately adjacent to a premises that comprised a turkey slaughterhouse and two large poultry processing plants, and was under the same ownership. However there was no direct contact between personnel of the two sites, which were managed separately.

7. General standards of biosecurity for personnel and vehicles on the farm were good, with staff dedicated to particular sheds, controlled access to individual houses, changes of footwear and disinfection on entry, and paved surfaces around the site.

8. Water is supplied to each house from a bore hole and stored in covered tanks preventing contamination by wild bird activity. Feed is supplied from the company's own feedmill with good vehicle biosecurity on entrance and exit from the site and on return to the mill. Storage of the feed and raw materials at both sites would have prevented contamination by wild bird or rodent activity, In addition, the production process would have killed any virus had it been present.

9. The disease was confined to a single turkey house (house 10) on the site (of the 22 sheds that contained turkeys), at the time of detection. This shed was unusual compared to others on the site in that it was in a poor state of maintenance. There were holes in the woodwork (probably rodent damage), the ventilation vents were not covered in mesh, side vents were close to the ground and the roof leaked. These features would allow access for either small wild birds, rats or mice that could mechanically carry virus into the house, or ingress of water contaminated by birds outside.

10. Infection was introduced into the affected house between 5 December 2006 and 25 January 2007. Although the birds were placed in the house on 8 December 2006, they were only allowed access to the part of the house where infection is believed to have entered on the 25 January 2007. The house was fumigated (which would destroy any virus present) on the 5 December 2006.

11. Rodent control was practised routinely on the turkey farm and was in evidence; however reports of visits from pest controllers show that despite the control efforts, rodents were an ongoing problem on the site and particularly in House 10.

12. The virus has been sequenced and shown to be notably similar (almost 100% homologous) to that recovered from the Hungarian outbreaks in geese in January 2007, and very similar (95% homologous) to certain wild bird isolates in Hungary and UK (Scotland) in 2006. This level of similarity suggests the virus was either transferred directly between the Hungarian geese and GB turkey outbreaks, or that they shared a common source. The similarity of the viruses recovered in Hungary and the GB suggests either direct transmission from the Hungarian affected premises, or a common source that was an as yet undisclosed locus of infection with the same virus as is associated with the three outbreaks in domestic poultry.

13. The Holton factory received only breast meat from Hungary. Such tissue can carry an infective dose of virus, if harvested from a viraemic bird.

14. Fresh poultry product received at the factory is either processed or held in freezers. During the period of risk of infection the meat was processed on arrival or frozen.

15. There is normally very little waste from the breast meat processing at the Holton factory as it arrives trimmed; however occasional waste is created when product is dropped on the floor. Such an event happened to the consignment that left Hungary on 12 January and was received and handled in GB on the 15 January, when approximately 60kg of breast meat was discarded into waste bins. This particular incident occurred when a box of chilled turkey breasts was dropped on the floor and was discarded.

16. Analysis of the timing of the Hungarian and GB outbreaks show that these occurred very close in time and infection could not have moved from these farms in Hungary to the GB through the normal trade routes to the Holton factory. The last potentially infected shipment left Hungary, from the slaughterhouse in Kecskemet,on 12 January (the slaughterhouse was closed for its annual maintenance from 13 – 20 January) and the first affected Hungarian premises was most likely infected after this, between 14 and 16 January.

17. The turkeys on the Suffolk farm became infected at the time of increasing clinical signs and mortality on the first Hungarian infected premises (IP), between 22 – 25 January.

18. There were no Hungarian workers on the farm or the factory site, and no Hungarian connection could be established beyond the regular shipments of turkey breasts from Hungary to the factory.

19. There was clear evidence that gulls loafed on the roofs of the turkey houses, and also flew regularly between the farm and the factory where they scavenged waste. There was also a clear route by which pests such as rats and mice can travel between the factory and the farm.

20. Hypotheses for the possible source of infection were:

a. Wild birds, primarily infected migratory species or resident species infected by migratory species introduced infection either by gaining access to the shed, or by contaminated feed or other material that then entered the shed (through normal procedures or carried in by vermin).

b. Introduction from a domestic poultry flock (with undisclosed infection) in GB by the movement of live birds, personnel movements or vehicles.

c. Introduction via personnel who have recently visited countries with outbreaks of H5N1.

d. Mutation of circulating low pathogenic Avian Influenza (LPAI) in the affected flock.

e. Introduction through other imports of Hungarian poultry products to other locations in GB and transfer of infected material from other processing sites

f. Transfer of infection from the January 2007 outbreaks in Hungary, for which infection from wild birds cannot be ruled out, via the Holton Factory

g. A common ultimate source with recent outbreaks in Hungary, possibly a wild bird, with infection being carried in turkey meat imported via the processing plant adjacent to the infected premises

h. The deliberate introduction of infected material from the January 2007 Hungarian outbreaks

21. Epidemiological investigations have provided evidence against each of the first six hypotheses above (a – f) that either refutes them, or shows them to be very unlikely or implausible.

22. Our joint investigations with our Hungarian counterparts have not identified a possible source, but we are left with the possibility that meat products from pre-clinically infected turkeys, infected from a common source with the Hungarian outbreaks in January 2007, might have been slaughtered and exported to the Holton site. This is the most plausible explanation of events.

23. The only alternative explanation, for which there is no evidence, is the deliberate introduction of material from the Hungarian infected premises into the affected shed in Suffolk.

Conclusions

24. Our conclusion is that infection was most likely introduced to GB via the importation of turkey meat from a sub-clinically infected turkey flock in Hungary which had been infected from a common source, possibly wild birds, which may also have infected the two goose farms in Hungary.

25. Disease surveillance and control measures were effective in detecting disease early, which limited the potential for spread and enabled the outbreak to be controlled rapidly.

26. The difficulty in identifying the precise source is probably in part due to the fact that this is a very unlikely occurrence and an isolated event that occurred probably in January. The occurrence of infection in turkeys in Suffolk must be the outcome of a series of normally low probability events during which, in this case, the probability of key events was increased. Most potential routes of infection are controlled through current procedures both in the industry and nationally/internationally; this was confirmed by the epidemiological investigations.

27. The incident highlights the importance of good personnel biosecurity between turkey houses on site, which limited the outbreak, prior to the confirmation of infection, to a single houses and also between separate premises which prevented spread of disease off the site). It also emphasises the importance of implementing effective animal by-product controls which could have further reduced the risk of infection.

28. This outbreak also highlights the risks associated with poor building maintenance, which can allow the introduction of infection despite effective biosecurity practices among personnel.

29. There remain uncertainties about the epidemiology of H5N1 infection.

30. The balance of the benefits of adjacent location of commercial poultry production and processing plants, in terms of protecting welfare and limiting environmental impact by reducing travelling time, need to be weighed against the increased risk of disease transmission, particularly where imported products are handled.

THE FULL REPORT

SUMMARY OF EVENTS

1. An outbreak of avian notifiable disease was suspected and reported on a turkey finishing unit in north Suffolk (see Figure 1) on the evening of 1 February 2007.

2. Twenty-two of the 24 controlled environment houses making up the unit had been stocked with some 159,000 day old poults, from the company's own hatchery, between 30 November and 14 December 2006. The eggs had been supplied by the company's own breeding flocks. The other two houses had been left empty.

3. On 27 January the birds in one house were seen to be "off colour" and the morbidity and mortality rates increased over the following 7 days (Table 1). This house (10) contained 7,119 turkeys which were 56 days old.

	27 Jan	28 Jan	29 Jan	30 Jan	31 Jan	1 Feb	2 Feb
No. Dead	6	7	8	13 (16)*	156 (30)	860	1580

* Figures in brackets are the additional number of birds that were culled as a result of disease

Table 1 Daily mortality in House 10

4. The clinical signs were lethargy, anorexia, birds going off their feet and death. There was no evidence of coughing, snicking, diarrhoea or swollen heads.

5 Cloacal swabs were taken for virological examination together with blood samples for serology and submitted to the Avian Virology Unit, VLA, Weybridge on 2 February when the remaining birds were culled. Initial results indicated the presence of Influenza A virus.

6. On 3 February the presence of highly pathogenic (HP) H5N1 AI virus of the Asian type was confirmed. Molecular genetic sequencing of the HA gene (one of the eight genes of the virus) of this isolate showed 100% homology to the recent H5N1 isolate from domestic geese in Hungary and 95% homology to the H5N1 isolate from the swan found at Cellardyke, Scotland, UK in 2006. The intravenous pathogenicity index (IVPI) of the isolate was 3.0, which is the highest value possible.

7. No serological response was observed in the birds sampled. This indicates early infection.

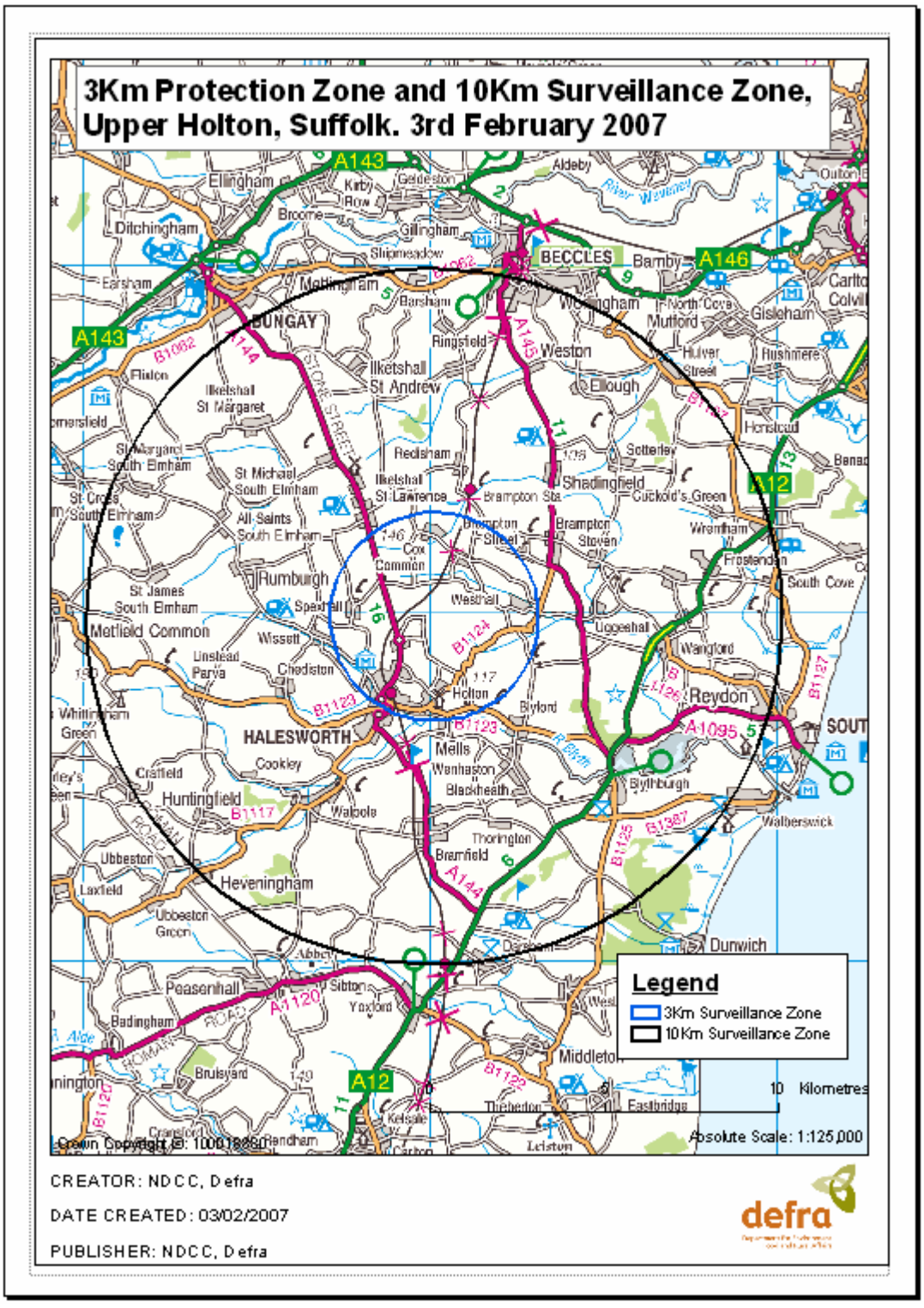


Figure 1: Location of the Infected Premises and the Protection and Surveillance Zones

8. The statutorily required Protection Zone (PZ), Surveillance Zone (SZ) and Restriction Zone (RZ) or Zone B were put in place on 3 February. The PZ had a 3 km radius and the SZ a 10 Km radius. All three zones are depicted in Figure 7.

9. The birds in the other houses remained clinically normal until culling of the rest of the flock on the premises began on the evening of Saturday 3 February. This was completed in the evening of 5 February. Cloacal and oro-pharyngeal swabs were taken for virological examination, together with serum samples, from a sample of 20 birds in each of the 21 houses.

10. HP H5N1 virus of the Asian lineage was identified in samples from 3 of these 21 houses (12, 15 & 22) (see Figure 2). The birds were sampled from two of these houses (12 & 15) two days after culling of the affected shed and from one house (22) three days after the confirmation of infection in the clinically affected house. All samples from all 21 houses were serologically negative.

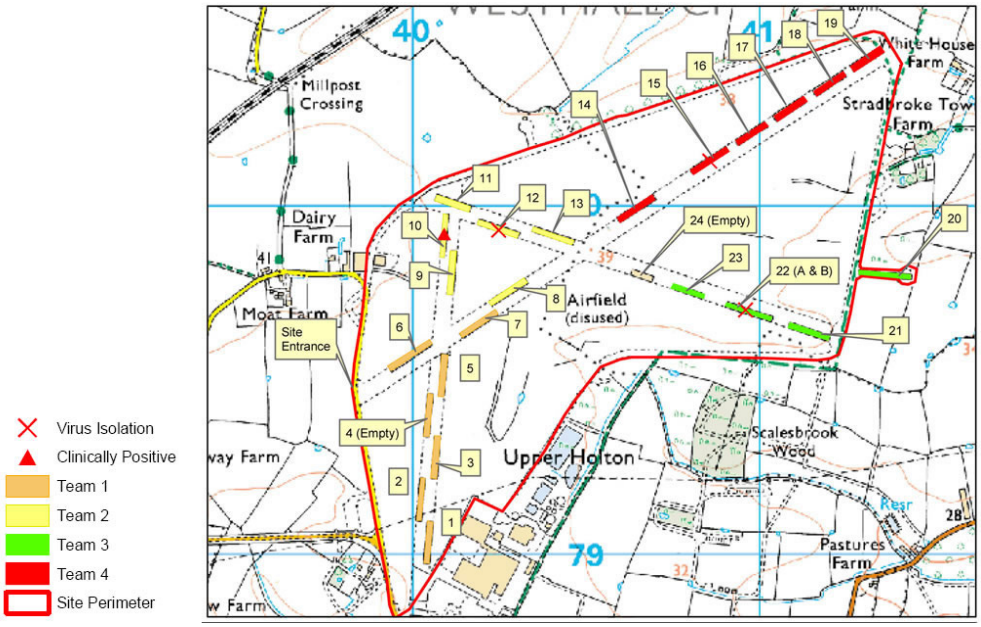


Figure 2: Map of site containing the turkey finishing units

11. Molecular genetic studies, involving the sequencing of all eight genes of the virus were completed on 13 February. The isolate from this outbreak was compared with the isolates obtained from the two outbreaks of H5N1 infection in domestic geese in Hungary in 2007. From our discussions with Hungarian colleagues a wild bird source could not be ruled out. The first of these commenced on 19 January in the county of Csongrád and the second, in the same county 9 km from the first was detected clinically on 25 January. This comparison of the sequencing results from the Suffolk isolate and the two Hungarian isolate revealed a 99.96% and a 99.97% homology (identity).

12. The results of the molecular genetic sequencing and the absence of any serological responses in the affected birds indicated that the HPAI infection had not arisen as a result of a mutation of a low pathogenic virus, during the passage amongst the turkeys, resulting in the HPAI strain.

13. The timelines for the dynamics of infection in the Suffolk flock and the two affected Hungarian goose flocks are depicted in Figure 3. The estimated infection and infectious periods are based on available data. More data and more precise data are available for the Suffolk outbreak. Therefore these two periods are not directly comparable between the two Hungarian IPs and the Suffolk outbreak.

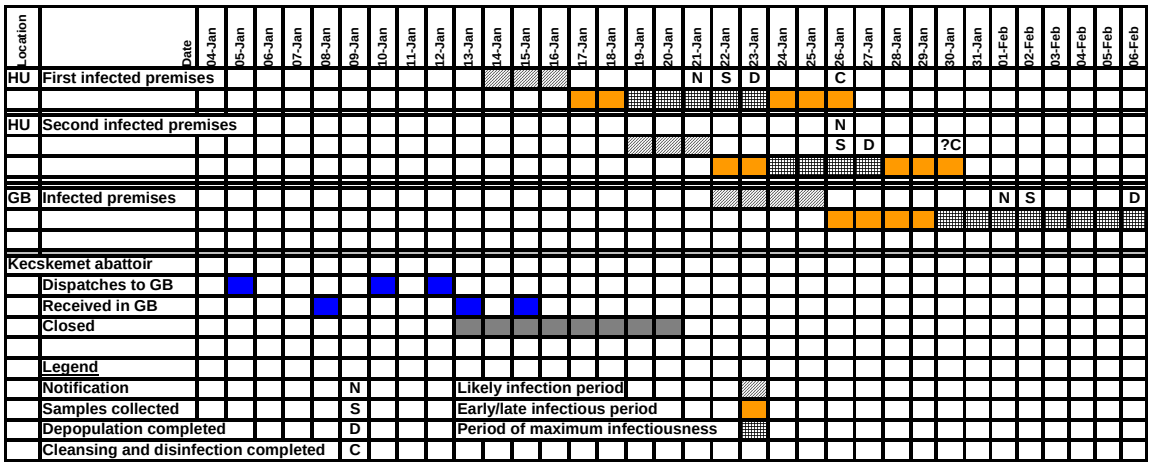


Figure 3. Sequence of events on the three infected premises in Hungary and GB

STANDARD EPIDEMIOLOGICAL INVESTIGATIONS

14. The epidemiological investigations commenced on Saturday 3 February.

The Affected Premises

15. The premises comprises a turkey finishing unit, and adjacent to it the company has a turkey slaughterhouse and two processing plants. The whole site occupies an area of approximately 0.9 square kilometres. The slaughterhouse and processing plants are physically separated from the finishing units by a fence and have separate entrances. These are situated at the southern point of the site to the east of House 1 (Figure 2). There is no interchange of staff between the factory units and the turkey finishing component (see below).

16. As far as we are aware this is a unique site in Great Britain in containing these three components in turkey production at one location and for which turkey meat is imported from Hungary.

17. The turkey finishing unit is managed using an all-in all-out system with the birds being slaughtered at 14 -21 weeks of age.

The Affected House

18. The affected house (and site) was investigated by field veterinary epidemiologists of the National Emergency Epidemiology Group (NEEG), members of the Ornithological Expert Panel of the NEEG, comprising colleagues from the British Trust for Ornithology, the Wildfowl & Wetlands Trust, the Royal society for the Protection of Birds, Joint Nature Conservation Committee, The Wildlife Trusts, Natural England, Scottish Natural Heritage and The Scottish Executive Environment and Rural Affairs Department, and a Natural England wildlife expert.

19. The house is of wood/wood board construction and one of the oldest on the site. The ventilation system is different to that of the other houses on the site in having side air inlets and roof extraction fans. (The other houses have continuous roof inlets with fan extractors on the side walls.)
20. The exterior side inlets are 40 cm from the ground and 20 cm wide with no mesh covering. All inlets open simultaneously and the roof fans are operated separately. There was evidence of rodent (rat) gnawing at the corners of the side vents. Rodent control bait boxes were placed at the corners of the house, but evidence from previous rodent control reports indicate that rodents (rats and mice) were a continuing problem on the site, notably House 10. The holes created by the rats were sufficiently large to allow the entry of small birds such as tits and sparrows.

21, There were places where birds up to the size of starlings could gain access but there was no evidence that they had been used.

22. The ceiling vents could be used as roosts when the fans are off and the droppings could land on the louvres. If the louvres blew open the droppings would fall onto the bedding.

23. Numerous potential perching places inside the shed were inspected and no droppings or other evidence was found. The staff responsible for the houses informed the team that wild birds were rarely found in the houses.

24. The roof of the house was leaking and the side wall on the west side was very damp. This could have allowed the physical transfer of infection from the roof.

25. One member of staff looking after the affected house commented that they thought that the turkeys in this house did not generally “do as well” as those in other sheds. An analysis was therefore conducted on the data relating to production during the last production cycle on the site. All houses were included and the data comprised mortality figures, the number of rejected birds at slaughter per 10,000 and the final weight. The results are summarised in Figure 4 and indicate that there was no evidence that either the mortality rate was greater, or that there was greater proportion of birds rejected at slaughter or the final weight of the birds was lower in House 10 compared with the other houses. Similarly a comparison of these data relating to health and production of the six houses, which included House 10, managed by the same two members of staff did not provide any evidence that the birds in the affected house experienced poorer health or production.

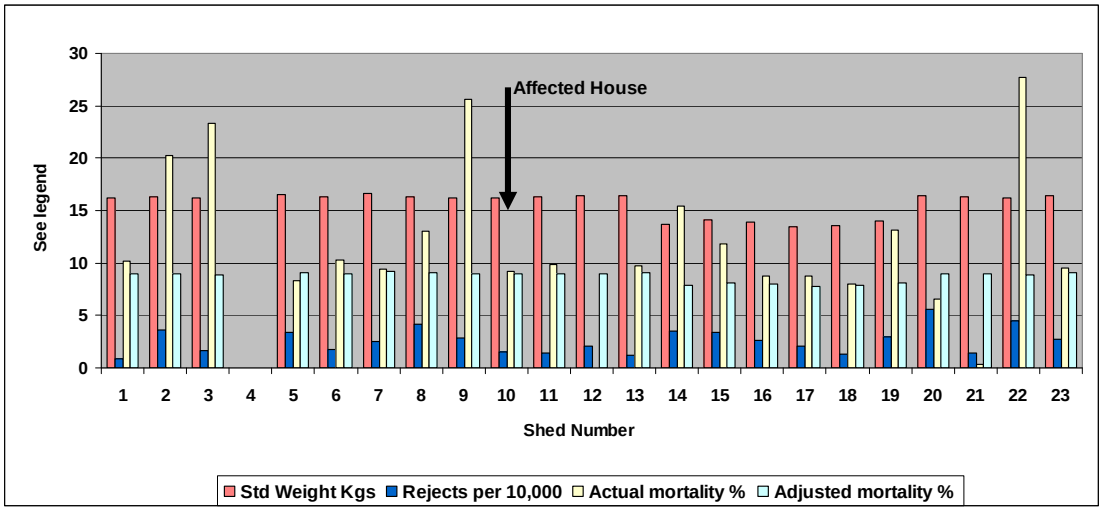


Figure 4: Production data for all houses occupied in the previous cycle

Site Management Aspects

26. **Water** is supplied from a bore hole and stored in covered containers at the end of each house.

27. **Feed** is supplied from the company's own feed mill in Kings Lynn. Before entering the site the wheel arches of the feed lorries are sprayed with disinfectant. The drivers are given a disposable boiler suit and plastic overshoes to wear whilst on site. There is no cleansing and disinfection when vehicles leave the site. Because of the size of the site feed lorries will be completely emptied and will return directly to the feed mill. On return to the mill vehicles are washed inside and out, dried and refilled and the vehicle re-sheeted. A final wash is given to the outside to remove dust.

28. The relevant feed deliveries to shed 10, in the most likely period of infection from 22 -25 January, were on the 22, 23 and 25 January. The distribution of feed to the various houses is shown in Table 2.

Date of Delivery	House number receiving delivery														
	1A*	9A	9B	10A	10B	11A	11B	12B	13A	13B	20A	20B	21A	21B	22A
22 Jan		√		√		√	√	√							
23 Jan					√					√	√	√	√	√	√
25 Jan	√	√	√		√										
25 Jan				√		√	√		√	√					

* Each house has a feed hopper at both ends

Feed Deliveries to the Site During the Most Likely Time Window of Infection

Table 2

29. The feed mill is approved under the Universal Feed Assurance Scheme (UFAS). An investigation of the premises found it to be maintained to a very high standard. The whole storage and manufacturing process is inaccessible for wild birds. The feedstuffs produced at the mill comprise only ingredients from UK sources. The main component of the feedstuff produced is pelleted feed in a computer controlled operation which includes a heating process to at least 80^{o} C. Whole wheat grains are added to the pellets making up to 30% of the final ration. Before inclusion the wheat goes through a spraying process with a proprietary solution (Anitox Monoprene F Liquid) containing ammonium salts of propionic and butyric acids, propionic acid and formaldehyde.

30. At the loading point of the bulk (25 tonnes) lorry trailers there is a minimal risk of contamination of the feed. The conclusion from this investigation indicates that any AI virus present in the ingredients will be killed during the production process and the risk of post-production contamination is unlikely.

31. **Dead birds** are placed in covered containers outside each house. These are likely to be accessible to rodents but not to wild birds. The containers are emptied twice a day and the contents stored in a metal lidded trailer. The container is picked up by a commercial company operating under the Fallen Stock Company. (See below under Tracings.) All carcases go for incineration.

32. There were 10 **personnel** working on the fattening unit. There are four teams, made up of 7 staff, responsible for the day-to-day management of the birds. Each looked after a specific group of houses (see Figure 2). The other staff comprised a farm manager, a farm supervisor and a tractor driver, who acted as a substitute for the farm workers.

33. None of the staff is allowed to keep poultry or other birds because of company policy. This was corroborated by questioning of the staff. Staff are not allowed to work on other poultry premises. There was one exception to this in that the farm manager and supervisor had visited another turkey fattening unit owned by the company and situated in Ellough, some 8 km to the north-east of the IP (see Spread Tracings section below).

34. All staff were British born except one Spanish member. None had travelled to Hungary and they did not have access to the abattoir or processing plants adjacent to the finishing unit.

35. On arrival at the site staff had access to shower facilities and changed into dedicated overalls and black rubber boots for site work. The presence of concrete around the houses enabled general cleanliness to be maintained. On entering the houses boots are dipped in disinfectant and then changed to the house dedicated green rubber boots and dipped in disinfectant in the ante-room before entering the house proper. Houses are locked when the

staff leave to work in another house. The houses therefore remain locked for the majority of the day.

36. Wood shavings are used as **bedding** for the turkeys. The supplier for the site is a sawmill in South Humberside. Rough planks of timber are imported from Russia, Sweden and Finland. These are cut and planed to provide timber products. The by products are wood/bark dust, sawdust and wood shavings. The wood shavings are collected by vacuum extraction systems and then compressed into bales and then tightly wrapped in polythene. The whole process is done under cover and no shavings are imported. The saw mill company has one other major customer for baled shavings to be used for poultry.

37. Shavings were delivered weekly on to the site. They were stored outside the houses on pallets. It is possible that the polythene covering could be contaminated with bird droppings which could then be carried into the house. Such contamination was observed. Such contamination was observed at one visit by wildlife experts after the flock had been culled.

Investigation of the events in the affected house since its previous depopulation and the placement of the poults

38. Following the previous depopulation, the drinkers and feeders were removed from the shed followed by cleansing and disinfection and a period of natural drying. New shavings, in large cling wrapped bales, were delivered on 30 November 2006. Twenty-six bales were delivered for House 10 and taken off the articulated delivery vehicle on pallets using a forklift truck and stored outside the building pending usage. They were left 48-72 hours before being placed in the house, again using a fork-lift truck.

39. On 3 and 4 December the 26 pallets/bales were evenly distributed throughout the shed and the feeders and drinkers replaced following cleansing and disinfection of this equipment. Shavings on one end of the shed (Section A, see Figure 5) were spread from the bales and pallets and the wrapping removed. Bales in the other end of the shed (Section B) were left on their pallets awaiting later usage.

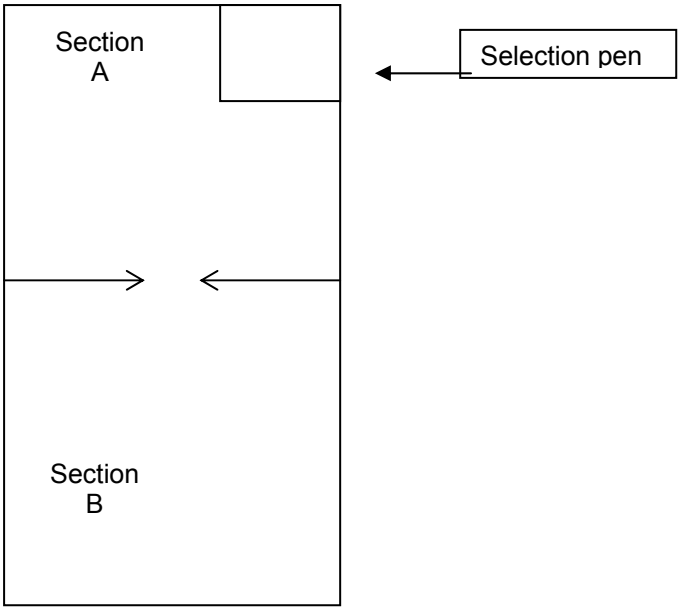


Figure 5: Basic Plan of House 10

40. On 5 December 2006 the whole shed was fumigated using a formaldehyde fume gun inserted into the building in the mid region. Following fumigation a central plastic sheet was rolled down separating Section A (litter spread) and section B (litter still within the bales).

41. On 8 December the day-old poults arrived and were placed in Section A.

42. For the first 4-5 days the newly arrived poults were looked after by specific poultry placement teams who moved through the 22 sheds of the site as birds were placed. During this time they would only work on this site before moving on to another of the company's sites. Previous to this site the poult placement team was employed to populate the company's Stanfield site in the neighbouring county of Norfolk. This premises has also been identified separately as a medium risk spread tracing associated the movement of a collection vehicle for dead stock (see below). After placing all poults on the Holton site, the team left on 19 December 2006 and next worked at the company's site at Breckles, also in Norfolk. Mortality records obtained for this unit show no evidence of disease. However, with the timescale involved potential spread to this site would not be considered possible.

43. All poult placement team workers are British born and no connection with visits to Eastern Europe in the recent past was identified.

44. The poult placement team are then replaced by regular farm staff for the duration of the crop.

45. During the period that the poults occupy only section A of the building, ventilation was controlled by one constant fan (drawing in air along the side vents and out through the roof) and others that come on intermittently dependant on the temperature. In the empty section B one fan was on constantly (at a low level) to equalise the pressure either side of the plastic sheet separating section A and section B. The side inlet vents are reported as not being opened during this time and no intermittent temperature controlled fans come into operation.

46. Around 10-17 days after placing the poults (18 – 24 Dec), the bales in Section B were opened and the shavings spread. The feeders and drinkers in this half of the building were also set up.

47. Additional litter was added to the shed from 25kg bales on ten occasions between 29 December 2006 and 29 January 2007. Additions on 22 January and possibly on 19 January would be most relevant to the start of clinical signs if the bales had been contaminated whilst stored outside the shed
48. At 48 days of age, on 25 January 2007, birds were allowed to move into section B by rolling up, to the ceiling, the plastic dividing sheet.

49. Although there were clinically affected birds throughout the house, the site manager reported that there were more dead birds in Section B of the house than in Section A. It was also noted that the birds in the selection pen, in Section A, were unaffected. The selection pen (measuring approximately 10m x 10m) was used to isolate wrongly sexed hens and small stags. Birds maintained in this pen received the same feed and water as well as being attended to by the same staff as the birds in the rest of the house.

50. These findings suggest that infection occurred initially in birds which first ventured into Section B with infection subsequently spreading to birds in the rest of the house. This finding also indicates that the turkeys had only recently become infected. In addition, Section B would have been more attractive to mice, at least, during the unpopulated period when feed was present which could have increased the likelihood of the introduction of infection.

Investigation of Potential Spread Tracings

51. As indicated above **live poults** arrived from a single GB source, a company owned hatchery the eggs for which were all sourced from the company's own breeder sites, on 8 December. This was therefore outside the tracing window.

52. As indicated above in paragraph 29, two of the **personnel** working on the site had visited another site owned by the company at Ellough some 9km to the north-east of the infected premises. This was considered a high risk

tracing despite the biosecurity precautions in place for the staff. The site was used only as turkey finishing unit and comprised 12 houses. The site was visited and placed under restriction for 14 days. At the visit the birds were inspected clinically and the production records examined. There was no evidence of disease from these examinations. Oro-pharyngeal and cloacal swabs together with blood samples were taken from a sample of 20 birds from each house for virological and serological testing. All laboratory results were negative and at the revisit to lift the restrictions did not reveal any evidence of clinical from an inspection of the birds and production records.

53. Biosecurity precautions were in place for the collection of dead birds (see above). However, the transport of potentially infected birds to other farms, turkey finishing units under the same ownership, during the collection route was considered to present as sufficient risk to require tracing. Four farms were, placed under restrictions and visited and the turkeys inspected clinically and the production records examined for signs of poor production. All investigations proved negative.

54. **Other vehicles**, delivering wood shavings, feed and gas supplies and those used by maintenance companies considered as potential means of causing the spread of infection, were discounted as they presented a negligible risk because of the degree of contact with potentially infected material and birds and the fact that the appropriate biosecurity measures were in place.

Surveillance of Domestic Poultry

Within the Protection Zone (PZ: 3 Km radius around the IP)

55. Awareness of the disease by flock owners in the PZ was raised by messages relayed on the Defra website and on the local and national media and text messages to registrants of the GB Poultry Register (GBPR) who had provided a mobile telephone contact number.

56. Seventy-eight flocks were identified in the PZ, from existing records contained within the GBPR and the Diseases Control System, and from the results of “door-to-door” patrols to identify the smaller, non-commercial flocks.

57. All (78) of these flocks were visited to inspect the birds clinically and examine production records, where the latter were appropriate (see Figure 6).

58. Twenty-one of these 78 flocks contained ducks and/or geese. Oro-pharyngeal and cloacal swabs were taken for virological examination from a sample of 20 ducks and/or geese, unless the total flock size (of ducks and geese) was less than 20, when all ducks and geese were sampled. In addition, a blood sample was taken from the sampled birds. The laboratory results were negative for H5N1 infection.

59. All 78 flocks were revisited on 26 February to inspect the birds clinically and examine the production records. No suspicion of disease was found.

Within the Surveillance Zone

60. Awareness of the disease by flock owners in the SZ was raised by messages relayed on the Defra website and on the local and national media and text messages to registrants of the GBPR who had provided a mobile telephone contact number.

61. All 70 flocks in the SZ were visited to inspect the birds clinically and examine production records, where the latter were appropriate (see Figure 6).

62. Twenty-three of these 70 flocks contained ducks and/or geese. Oro-pharyngeal and cloacal swabs were taken for virological examination from a sample of 20 ducks and/or geese, unless the total flock size (of ducks and geese) was less than 20, when all ducks and geese were sampled. In addition, a blood sample was taken from the sampled birds. The laboratory results were negative for avian influenza, including H5N1 infection.

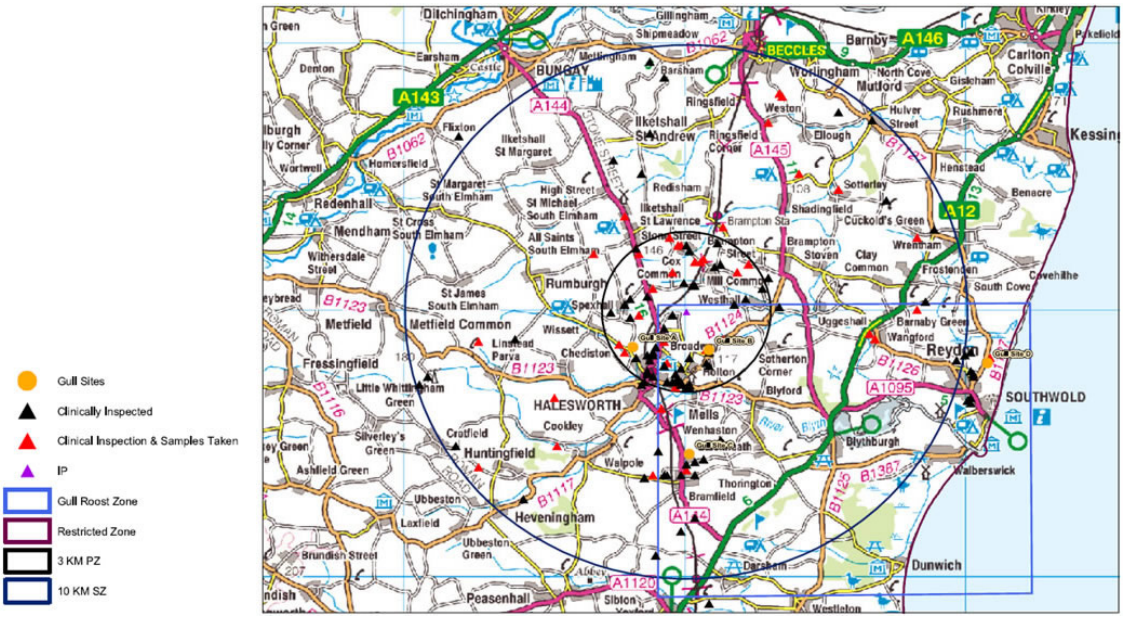


Figure 6: Surveillance of domestic flocks in the Protection and Surveillance Zones

Surveillance of Wild Birds

Background Surveillance

63. Since late October 2006 there has been a targeted surveillance programme for the detection of avian influenza including H5N1 in wild birds in GB. This 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):

(i) Requesting the public to notify dead birds belonging to the species of interest in the areas of GB which have been identified as most at risk in terms of the abundance of species of interest and the density of outdoor reared domestic poultry.

(ii) Identifying bird reserves which support the greatest populations of the species of interest and requesting the wardens at these sites to conduct weekly patrols to identify dead birds for laboratory examination.

(iii) The sampling of live birds at wetland sites with the necessary facilities.

(iv) The submission of samples from birds shot in the normal course of wildfowl shooting.

64. H5N1 has not been isolated during the course of this surveillance programme to date. Similarly the surveillance programmes within EU Member States (MS) have not identified H5N1 infection in wild birds as result of the surveillance in the 2006/2007 migratory and subsequent residency period.

65. More specifically, in the county of Suffolk 30 dead wild birds, found between 1 October 2006 and 2 February, were examined for the presence of H5N1. These comprised 3 Mute Swans, 1 Canada Goose, 1 Herring Gull, 1 Wood pigeon, 19 doves and 6 ducks. In addition, 10 of the 12 Wetland Bird Survey (WeBS) sectors within 20 km of the IP had been included in warden patrols of reserves as described in paragraph 46 (ii) above.

SPECIFIC EPIDEMIOLOGICAL INVESTIGATIONS

Specific Ornithological Investigations

66. A teleconference comprising senior members of the NEEG and the Ornithological Expert Panel (OEP) on the morning of 3 February. One initial finding of the epidemiological investigation was that the staff working on the site had reported an ongoing problem with rooks and gulls. This was discussed and it was decided that two of the Expert Ornithologists should visit the area (approximately 16 km radius around the IP) that afternoon. The objective of the investigatory visit was to assess the nature of the habitat in this area, the wild birds using it, their apparent movements and their potential usage of the site. It was not however possible to visit the IP site itself, because of the health and safety measures that are put in place. The pre-exposure treatment and health checks for entry to the site required more time.

67. Advice from the NEEG and OEP had also been requested from on the size of the statutorily required Restriction Zone (also referred to as Zone B). Some initial advice had been given following the telephone conference that a

16 km zone should be sufficient from an ornithological basis. This was however considered to be too small to establish confidence for international trading and a larger area was designated (see Figure 7).

68. In summary, the results of the investigatory visit indicated the following:

- In the immediate vicinity of the IP did not have especially large concentrations of birds, although viewing was limited due to the restrictions in place.
- There was however evidence of large flocking species such as Black-headed Gull, Common Gull, Herring Gull, Woodpigeon, Rook and Jackdaw were all noted around the buildings, along with smaller species such as Pied Wagtail. Black-headed Gull s were observed on the roofs of the turkey houses.
- Starlings were not noted, but the observation difficulties meant that this species could be present.
- There were no wildfowl or waders noted on the site, but an examination of a map of the area indicated some pools of interest that would be worthy of examination.
- As had been expected, large concentrations of gulls were found at the River Blyth, to the south-east of the IP, in the afternoon but this appeared to be a daytime or pre-roost gathering, and most gulls in the area clearly roosted on the open sea. The choice of roost may, however, have been influenced by very calm sea conditions.
- Gulls also roosted at Weybread Gravel Pits, some 15 km due west of the IP, although these birds did not appear to be coming from the direction of the IP.
- Other small water bodies in the area, and the Blyth valley upstream of Blythburgh, support only very small numbers of waterbirds. Apart from the coast, the general area was notable for the lack of standing water rather than the converse.
- There is considerable contact between flocks of birds (of species which may use the outbreak site) and the outdoor pig rearing units.
- From the observations it was recommended that dead bird searches should be undertaken around the IP and around the Blyth Estuary, as the principal waterbird site in the area, and along as many of the beaches in the region as possible.
- There was clearly a need for members of the OEP to visit the IP site with field epidemiologists.
- Finally, it was noted that as the weather was clement for early (3rd) February repeat observations might be needed if there was a change in the weather.

69. The findings were discussed at a telephone conference on Monday 5 February. It was agreed that a site visit should be made, patrols at the wardened reserves (WeBS sectors, see Figure 7) should be increased to twice weekly, surveillance should be extended to all WeBS sectors within the RZ and the key gull roosts identified for inclusion in the patrol programme.

70. Further discussions took place at this meeting of the results of the initial molecular genetic sequencing of the HA gene of the Hungarian (2) and Suffolk (1) isolates, indicating they were identical, the fact that the isolate was of the Asian lineage and the relevant ornithological data and information.

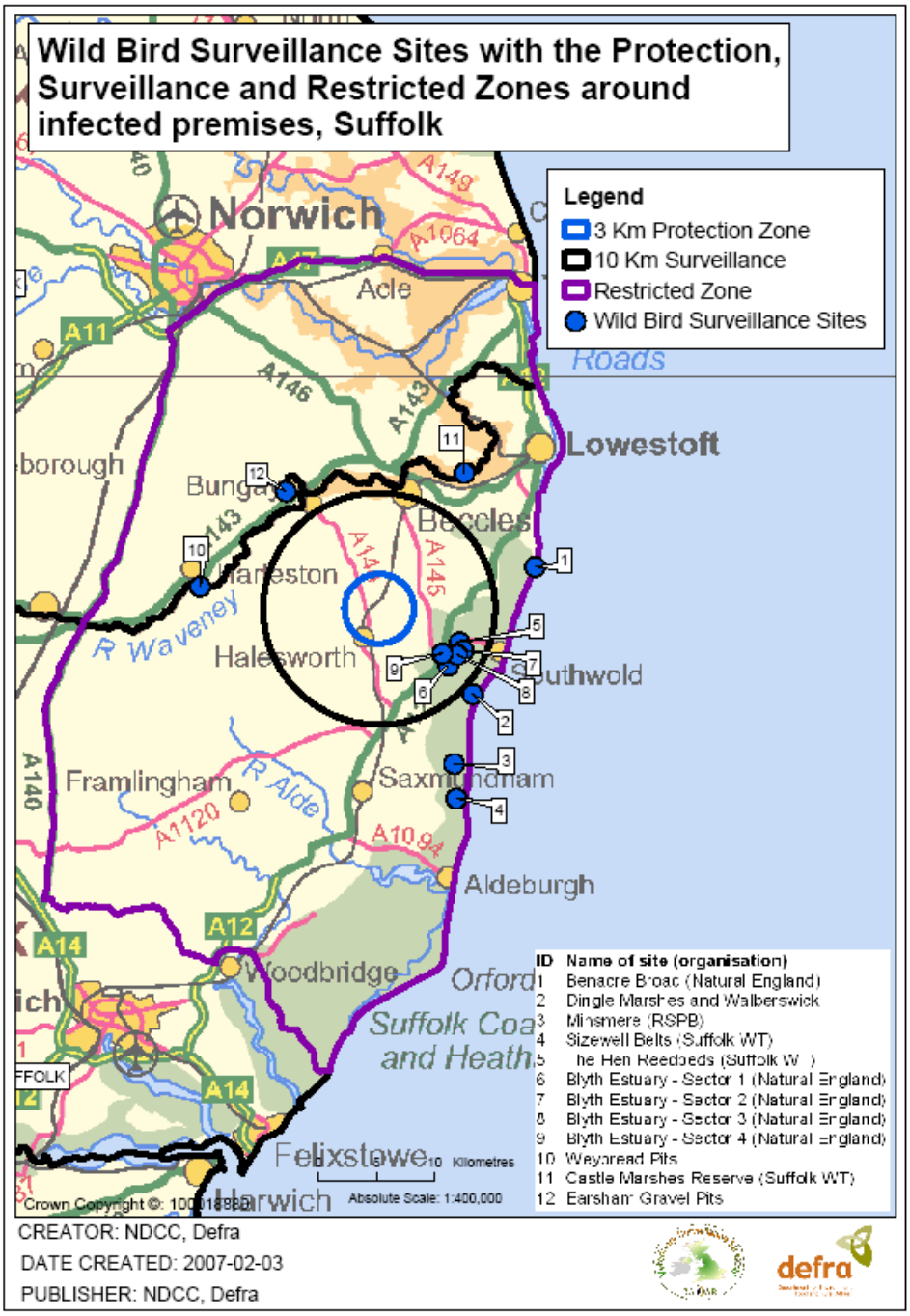


Figure 7: Location of wardened Water Bird Survey sites patrolled for the collection of dead wild birds of the relevant species with in the Restricted Zone

71. There was no evidence to support the hypothesis that wild birds were the source of the outbreak. This was based on the fact that there had been no isolations of H5N1 from wild birds in Europe during the 2006/7 wild bird migration period and subsequent residency. There had been no weather induced movements of wild birds from mainland Europe as occurred in the early part of 2006 which could provide a link between Hungary and Great Britain, especially as the first outbreak in Hungary and that in Suffolk occurred within a short time of each other and no common source of migratory birds was evident. However, there was no reason to stop the current surveillance of wild birds for H5N1 infection.

72. The site was visited by expert ornithologists and a field epidemiologist on Tuesday 6 February. The main objectives of the visit were:

- To determine whether activities on the IP site, notably the processing plants, were the main attractants for wild birds, notably gulls or whether neighbouring farms were playing a role.
- To provide a field assessment of bird usage of the various parts of the site.
- To identify possible methods of entry of the virus into the affected house. (The results of this component of the investigation have been described above.)

73. This revealed relatively large numbers of gulls, mostly Black-headed Gulls (70%), Herring Gulls (25%) and Lesser Black-backed Gulls with single figures of Common Gull. These were clearly attracted to the site by the presence of the processing plant and more particularly the access to waste trimmings held in bins outside the plant and from spillage from the bins. The site staff commented that the number of birds present on the site was less than normal. This was probably because the processing plants were not working at full capacity.

74. Gulls were observed feeding on these trimmings and carrying trimmings away from the processing plant and into the area containing the then empty finishing units. Gulls had been observed loafing on the roofs of the finishing unit sheds more than 0.5 km from the processing plant on 3 February.

75. Polythene bags which had apparently contained meat products and contained residual liquid were also seen in the uncovered bins and have the potential to be blown across the site. Some of the bags were labelled HU 106.

76. There was a significant number of gull droppings in the areas around the waste bins. Samples of these droppings were taken for virological examination. All were negative for H5N1.

77. There were a number of pools on the site. None of these held ducks and geese and there was no evidence of recent use by waterfowl. However site staff stated that waterfowl had been present in the previous year. The only birds seen on pools were bathing gulls and 2-3 moorhens.

78. A single dead Herring Gull and three dead starlings were found, two of the latter being raptor kills. None of these were recent (less than three weeks old). Four Woodpigeon corpses were found, one of which was a fox kill; all were very long dead. None of these birds were suitable for submission for laboratory investigation.

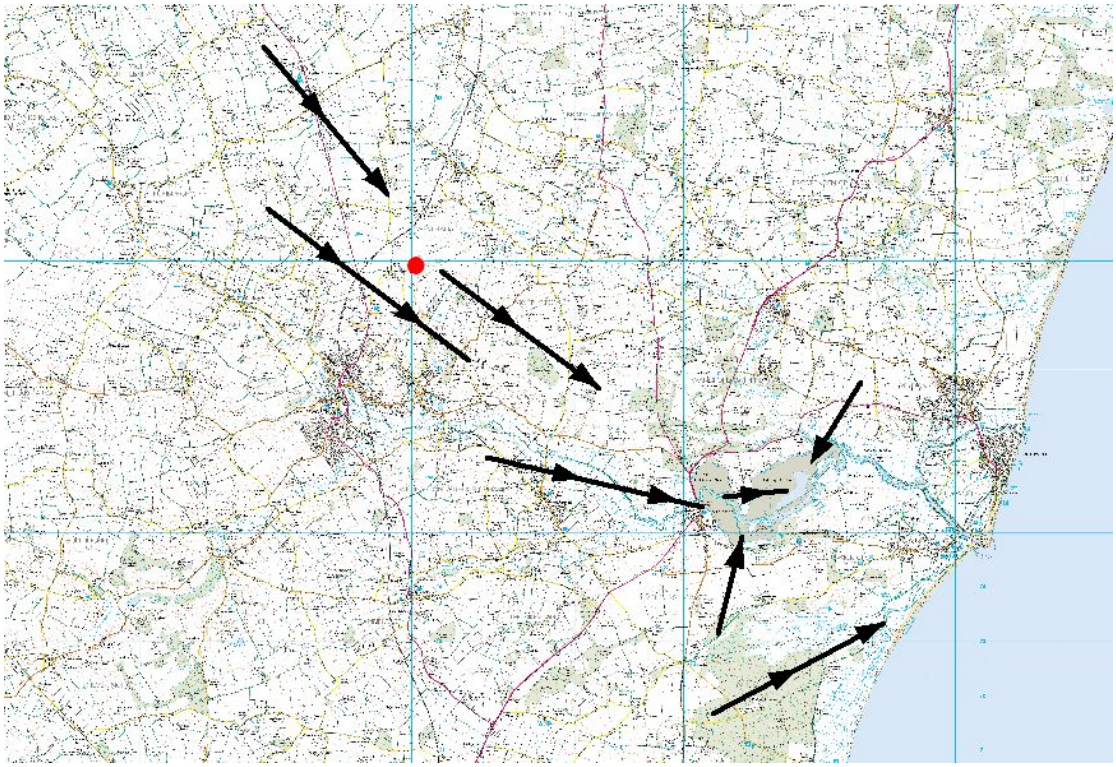
79. Rooks were present around the site throughout the visit, with more than 20 pairs nesting adjacent to the factory. There were also smaller numbers of Jackdaws present. At no point were corvids seen feeding in the factory area. However, several hundred corvids were seen flying in a westerly direction at dusk to roost, overflying the turkey sheds. No sparrows or starlings were seen or heard on site. However, site staff informed the team that there is a large starling roost (several thousand strong) around the furthest north pool, which had a reed fringe.

80. A further visit was made to the area around the IP by three expert ornithologists on Thursday 8 February. The objectives of this visit were:

- To identify the evening roost used by the gulls which spent the daytime around the IP
- To identify which other poultry premises in the area were the most likely to be visited by gulls to assist in targeting surveillance of domestic poultry flocks.
- To determine whether the landfill site at Wangford, some 8km to the east of the IP, was visited by the gulls using the IP. (This was the only landfill site in the area around the IP.)

81. Gulls feeding at the IP all appeared to fly south-east towards the major roost site in the area, at the Blyth Estuary. No gulls appear to leave the IP in the evening in a westerly direction (i.e. towards Weybread Pits which had been identified on 3 February as supporting a large population of gulls). Observations of gull flight lines are summarised in Figure 8.

82. By far the largest concentrations of gulls in the area occurred on the Blyth Estuary, and around the pig fields to the immediate south of the estuary. This area supports thousands of birds throughout the day. Although small numbers of gulls were observed widely throughout the remainder of the area, these were in numbers well below those around the estuary (less than 50 birds in any one place). The only other gull counts in excess of 100 birds (except for high-flying flocks going to roost) were along the coast around Southwold.



● location of infected premises

Figure 8: Results of observations of gull flight lines to roosts from the Infected Premises made on 8 February

83. A number of premises and areas were identified which were considered to be at risk from visiting gulls. This information was incorporated into the surveillance plan for domestic poultry in the area, the results of which are described above.

84. A visit to the landfill site at Wangford indicated that it did not attract gulls in large numbers. The site manager employs a full-time bird scarer for this very purpose.

85. Although not a primary objective, no dead gulls or other birds were found during this day-long field investigation.

Results of wild bird surveillance since the detection of H5N1 infection

86. A total of 485 samples of bird droppings were collected **from the IP** in the period 3 – 22 February for virological examination (see Table 3). All were negative for H5N1.

Species	No. samples
Rooks	134
Gulls	78
Pheasants	10
Partridges	26
Pigeons	8
Lapwings	2
Seagulls and Rooks*	140
Unidentifed wild birds*	87
Total	485

* More detailed speciation was not possible

Table 3: Distribution of bird droppings samples examined from the IP site from 3 February to 22 February 2007

87. During the period 3 – 22 February, 49 dead birds of the species considered by the EFSA Expert Group to be most at risk from H5N1 infection were examined virologically for H5N1 infection. Twelve birds were found in the PZ, excluding the IP, 15 in the SZ and 22 in the RZ. These were identified by members of the public and as a result of the specific patrolling of wardened reserves in these three restricted zones.

88. H5N1 was not found from wild birds as a result of the surveillance in the rest of Great Britain, or in other EU Member States. It is not possible to formally interpret, in the statistical sense, the results of this surveillance. First, there is no relevant data from EU MS on the location and species of wild birds sampled during the course of their surveillance programmes in2006 and 2007, especially during the 2005/6 migratory and residency season when H5N1 was isolated from wild birds. This means that no relative comparisons, and therefore interpretations, are possible, although improvements in the data collection and availability are being attempted. Secondly, the true prevalence of infection in wild birds, by species and geographical location is unknown, except that we know that it is very low. This coupled with an absence of quantitative information on population sizes, by species and location, and expected mortality rates means that it is impossible to design a surveillance system that has a known power of detection of the presence of infection, given an expected (design) prevalence of infection. For this reason the surveillance programme in GB has been targeted, using available ornithological data, to maximise the detection of H5N1 in wild birds should it be present. As a result of this best effort we can conclude that H5N1 infection has not been introduced via migratory birds during the 2006/7 migratory and residency period. However, the molecular genetic evidence from the Suffolk and Hungarian isolates together with the ornithological data and knowledge provides strong evidence that the Suffolk outbreak was not associated with infection wild birds from which had migrated to GB. This leaves the question of whether species, such as gulls, associated with the IP became infected as a result of exposure to infected material on the IP and associated sites. The sample size (485) of the droppings samples examined is relatively large.

Although we obviously do not know how many repeat samples from individual birds were obtained during the sampling period the negative results provide some evidence against H5N1 having become infected in the local population of wild birds, particularly gull species. We believe this to be sufficient evidence to support the decision to relax the control measures implemented, notably to remove the requirement to house birds normally kept outside.

Introduction of infection via, or from, Hungary associated with the importation of poultry products

89. As indicated above the IP is unusual in that it is adjacent to a turkey slaughterhouse and two large processing plants to produce turkey based products for which turkey meat is purchased from Hungary. It occupies an area of approximately 0.9 square kilometres. The slaughterhouse and processing plants are physically separated from the finishing units by a fence and has a separate entrance. There is no interchange of staff between the factory units and the turkey finishing component.

90. The processing plant receives regular consignments of turkey meat, trimmed and skin-on or skinless, breast meat, imported direct from Hungary.

91. From information supplied by the company, the imports were supplied by two slaughterhouses in Hungary. One in the west of Hungary in Sarvar, owned by the company and one owned by an independent company in Kecskemet in the county of Bács-Kiskun (see Figure 9).

92. During the period 1 January to 2 February 2007 11 consignments from The slaughterhouse in Kecskemet to Bernard Matthews totalling 82,400 kg and 14 consignments from the slaughterhouse in Sarvar totalling 193,200 kg. Both of these slaughterhouses are dedicated to the slaughter of turkeys.

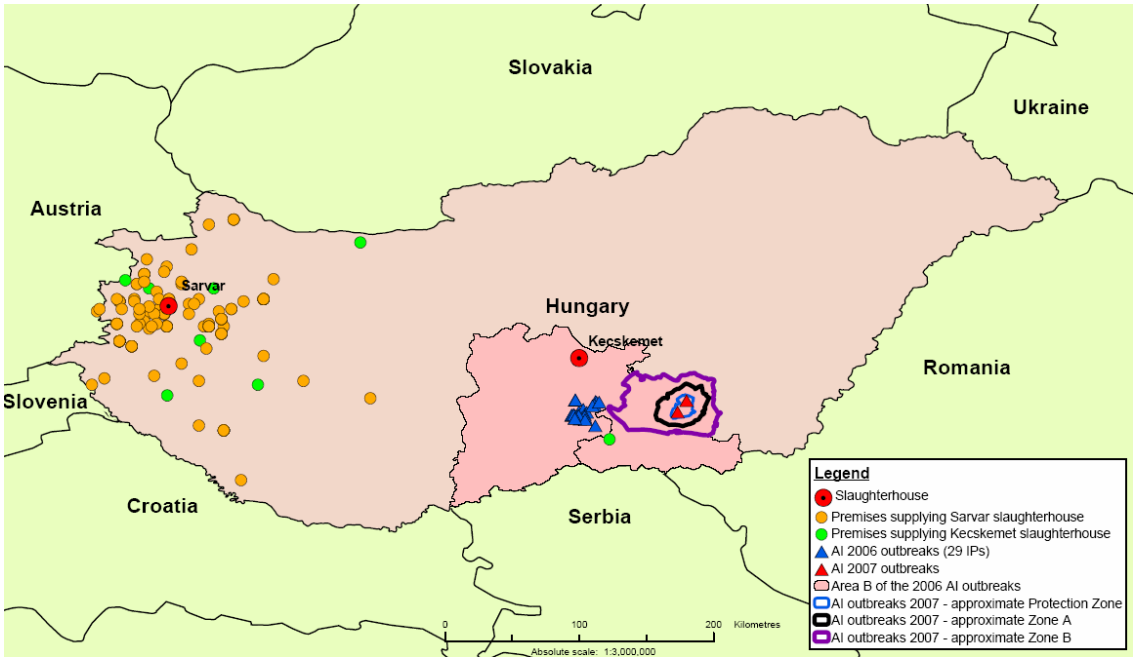


Figure 9: Location of the two slaughterhouses supplying the processing plant in Holton, the turkey farms from which exported turkey meat was derived from November 2006 to mid-January 2007, the location of the infected premises in 2006 and 2007 and the control zones associated with the 2007 outbreaks

93. Investigations of the hypothesis involving a common ultimate source with recent outbreaks in Hungary with infection being carried in turkey meat imported via the processing plant adjacent to the infected premises centred on the slaughterhouse in Kecskemet at which only turkeys are slaughtered. This was because the other slaughterhouse, in Sorvar, was some 400km from the designated infected area in 2007 (and that in 2006) in Hungary.

94. There were 8 turkey premises supplying turkeys to the Kecskemet slaughterhouse from November 2006 to mid-January 2007, the meat (turkey breast) from which was exported to the Holton plant. These premises are indicated on Figure 9. Five of these premises were sources of turkey meat exported to the Holton site in January 2007.

95. The slaughter dates of most interest given the timelines of infection for the infected flocks in Hungary and for the Suffolk flock were 9, 10 and 11 January. Consignments of turkey breast from three farms (of the five source farms in January) from which turkeys were slaughtered on these dates contributed to two batches exported on 12 January. These arrived at the Holton site on 15 January and were processed on 16 January. Only one of these source farms was near (approximately 40 km) to the goose farms infected in 2007 (see Figure 8). This turkey farm was the subject of detailed investigations during our collaborative investigations with Hungarian counterparts. There was no evidence of infection and there were no epidemiological links between this farm and the two affected goose farms.

96. Investigations at the processing plant revealed that normally waste trimmings were minimal because the turkey breasts are pre-prepared before export and only minimal trimming to remove fascia is required. However, some waste can occur during decanting from the transport containers and 60 kg (approximately 30 breast lobes) were lost on 15 January and discarded via waste bins.

97. Investigations at the Kecskemet slaughterhouse revealed that there is a veterinary inspection of birds within 24 hours of their departure to the slaughterhouse. These certificates are held by the slaughterhouse and the consignment notes indicate which houses on each farm had contributed to the day's consignment. In addition, the slaughterhouse had an excellent computer-based traceability system to identify each batch of turkeys. A batch is defined as the total birds from one farm on one day. Batches of turkey meat are separated within the slaughterhouse to enable the tracing and identification of any batch. These investigations indicated that the risk of mis-identification of the source of the meat exported was at an absolute minimum.

DISCUSSION

Observations on the clinical findings and infection on the affected site

98. The clinical picture of the affected birds was one of high morbidity (90%) and mortality (38%). The relatively rapid increase in morbidity and mortality resulted in the timely identification of H5N1 infection. The mortality rate was notably greater than in the outbreak of H5N1 infection in a 11,700 strong turkey flock of the same age in Versailleux, France in February 2006, but the morbidity rates were similarly high. This provides some confidence that H5N1 infection in turkeys will be reported sufficiently early to effect successful control measures.

99. The detailed investigations of the clinically affected house suggest that infection was first introduced into the initially unoccupied half of the house. The mortality rate in this part of the house was reported to have been greater than the other half. Feed and water was in place two days before the birds were given access to the whole house. There was clear evidence that small rodents (rats and mice) could have gained access to the house and therefore contaminated feed, at least (see below). The water leakage from the roof also provided a means of introduction of the virus as a result of wild birds acting as carriers of infection in addition to contaminated packaging of the bales of wood shavings that had been stored outside.

100. The detection of H5N1 infection, but with no evidence of clinical disease being reported, in three of the other houses as a result of sampling birds at the time they were culled was a notable finding. The on-site investigations indicated that these houses were most likely to have become infected as a result of a reduction of biosecurity measures, following the initial laboratory results from the clinically affected birds. All staff previously assigned to groups of houses were used for the depopulation of the affected house, but

following this returned to care for their allocated houses. Personnel movements between the houses is therefore the most likely means of dissemination. Unpublished results of research conducted by the research group within the Community Reference Laboratory, VLA, Weybridge indicate that the results are consistent with true infection of the birds in these sheds. Detectable excretion of the virus following exposure occurs one to two days after exposure, dependent on the virus dose. The finding in these three houses are of note because it indicates that turkeys might be slaughtered in the initial stages of infection.

101. House 10 was unusual in that it was in poor condition and had low side ventilation vents making it susceptible to infestation by rats and mice and therefore was most at risk from infection of all of the houses. However, on-site staff suggested that birds in this house suffered more from diseases in general. This raised the hypothesis that the birds in this house were more likely to experience a higher morbidity and mortality following infection with a particular strain of AI virus than the birds in the other sheds because of intercurrent disease. We found no evidence for the suggestion made by the staff from analyses of production and mortality data. This lends weight to the conclusion that the infection detected in birds in sheds 12, 15 and 22 at slaughter was in the pre-clinical phase and would have caused clinical signs if the birds had not been slaughtered within 2 days of infection. The IVPI test result which produced a maximum value of 3.0 also provides weight to this conclusion.

102. The absence of transmission from the premises was a result of a number factors:

- The fact that an all-in-all out policy was being practiced
- Infection was introduced at a stage in the production cycle when personnel and vehicle movements were at a minimum
- Personnel and vehicle biosecurity on the IP was generally high

103. This said, the routine collection and transport of dead birds, apparently dying from the usual causes before AI infection was suspected, (see paragraph 31) represented a medium risk for the onward transmission of infection.

Hypotheses for the introduction of infection

Infection from wild birds

104. No isolation of H5N1 virus has been made in the course of the wild bird surveillance in Great Britain or in EU MS during the 2006/2007 migratory season.

105. Expert virological advice on the results of sequencing the virus isolates from the Suffolk outbreak and the two outbreaks in Hungary in 2007 indicating that they were almost identical together with the ornithological information on

bird migration and movements rule out a wild bird common source. There is no common source (breeding grounds) for migratory birds arriving in Great Britain and in Hungary. Similarly, there have been no weather induced movements of wild birds from mainland Europe, as occurred in the early part of 2006, which could provide a link between Hungary and Great Britain via wild birds. (The possible role of wild birds in the intra-site transmission of infection is discussed below.)

Introduction from a domestic poultry flock (with undisclosed infection) in GB by the movement of live birds, personnel movements or vehicles.

106. There was no evidence of undisclosed infection in domestic poultry in Great Britain. The severity of clinical signs and the maximum IVPI indicate that it is unlikely that clinical disease in domestic poultry would remain unreported. In addition, the surveillance in the PZ and SZ did not identify any evidence of infection.

Introduction via personnel who have recently visited countries with outbreaks of H5N1

107. No links were identified to provide any credence to this hypothetical possibility.

Mutation of a low pathogenic AI virus within the turkeys in the affected house

108. As indicated in paragraph 12 the presence of HPAI was not a result of mutation of a low pathogenic AI virus within the turkeys in the affected house.

Introduction of infection as a result of turkey meat products from Hungary to other sites

109. Thirteen businesses in GB import poultry products from Hungary. Three of these including the company owning the affected flock are based in East Anglia. There were no epidemiological links between these other sites and the affected premises.

Transfer of infection from the January 2007 outbreaks in Hungary to the Holton site

110. The timelines of the infection process do not provide any evidence to support this hypothesis.

111. There were no epidemiological links with the Kecksemet slaughterhouse, which only slaughters turkeys, and the infected goose flocks. This rules out the possibility of fomite transmission from these infected farms, via lorries, from this slaughterhouse to the Holton site.

Introduction of infection as a result of turkey meat products from Hungary to the Holton site

112. Despite our extensive epidemiological investigations we have been unable to refute this hypothesis. There are a number of findings which are inescapable:

- The absence of evidence for other means of introduction, *e.g.* wild birds.
- The molecular identity of the three virus isolates isolated from the Suffolk outbreak and the two Hungarian isolates in 2007
- The unique presence of a processing plant, importing turkey meat from Hungary, which is contiguous to the turkey finishing unit
- The opportunity for wild birds, notably gull species in large numbers, to gain access to waste material from the processing plant and for them to transport these tissues across the turkey finishing unit
- The presence of a relatively insecure turkey house with respect to the access of rats and mice, which could transport infected material into the house, and having the possibility of the introduction of infection via a leaking roof from infected bird droppings
- The fact that the affected house was unique in this respect among the other houses on site.
- The occurrence of a large amount of waste material (60 kg) occurring, disposed of in waste bins on 16 January, which is most likely to have been imported from Hungary during the most likely high risk period for the birds in house 10.

Deliberate introduction of infected material from Hungarian outbreaks

113. The molecular genetic identity of the isolates from the three outbreaks, one in Suffolk and two in Hungary in 2007, is significant in the consideration of this hypothesis.

114. The timeline of the first Hungarian outbreak (Figure 3) indicates that the flock was infectious at the time the Suffolk premises was infected. In any event, the first flock of geese was slaughtered before H5N1 had been confirmed.

115. We have not found any evidence to support this hypothesis.

116. In summary, we appear to have encountered an unusual situation in that should infected turkey meat be processed on-site, the IP site was unusual in

having the potential for the transmission of infected material to the growing birds, should sufficient infected tissues be accessible to scavenging species such as gulls. The latter was made more probable by the amount of waste meat discarded on 15 January

117. Our joint investigations with our Hungarian counterparts have, not unexpectedly, not identified the turkey farm that could have been the source, but there is a possibility that meat products from pre-clinically infected turkeys might have been slaughtered and exported to the Holton site. It is possible that a turkey flock in Hungary did become infected from, possibly, the same wild bird source as for the infected goose flocks and was slaughtered in its pre-clinical phase**.** If infection was confined to the slaughtered birds then there would be no evidence of past infection in the existing poultry population at the time of the investigations. We have not identified any other possible source to explain the introduction of infection into the Suffolk flock.

CONCLUSIONS

118. Our conclusion is that infection was most likely introduced to GB via the importation of turkey meat from Hungary. Such meat could have originated from a sub-clinically infected turkey flock in Hungary which had been infected from a wild bird source which had also infected the two goose farms in Hungary. This is the most plausible explanation although no evidence of undisclosed infection in Hungary has been found and the possibility of infection going undetected in Turkeys is considered to be a rare event.

119. Disease surveillance and control measures were effective in detecting disease early, which limited the potential for spread and enabled the outbreak to be controlled rapidly.

120. The difficulty in identifying the precise source is in part due to the fact that this is a very unlikely occurrence and an isolated event that occurred in January. The infection in turkeys in Suffolk must have been the outcome of a series of highly unlikely events which did occur in this case. Most potential routes of infection are controlled through current procedures both in the industry and nationally/internationally; this was confirmed by the epidemiological investigations.

121. The incident highlights the importance of good personnel biosecurity between turkey houses on site, which limited the outbreak to a single house and also between separate premises which prevented spread of disease off the site). It also emphasises the importance of implementing effective animal by-product controls which could have reduced the risk of infection.

122. This outbreak also highlights the risks associated with poor building maintenance, which can allow the introduction of infection despite effective biosecurity practices among personnel.

123. There remain uncertainties about the epidemiology of H5N1 infection.

124. The balance of the benefits of adjacent location of commercial poultry production and processing plants, in terms of protecting welfare and limiting environmental impact by reducing travelling time, need to be weighed against the increased risk of disease transmission, particularly where imported products are handled.

ACKNOWLEDGEMENTS

We would like to thank the staff of the company owning the premises for their help in the epidemiological investigation, members of the NEEG's Ornithological Expert Panel, colleagues in the Avian Virology Unit, VLA Weybridge, the GIS team in SZEID, Defra, staff in the State Veterinary Service for sample collection and the Hungarian Authorities for the information that they provided and their helpful collaboration.

National Emergency Epidemiology Group
Food and Farming Group
Defra,
London

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