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## HIGHLY PATHOGENIC AVIAN INFLUENZA – H5N1

### RECENT DEVELOPMENTS AND THE LIKELIHOOD OF THE INTRODUCTION INTO THE UNITED KINGDOM

#### An update and a Commentary Working Document – Version 1

Prepared by:  
Dr Mirzet Sabirovic  
Simon Hall  
John Wilesmith  
Dr Nick Coulson

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# 1 Summary

This document considers worldwide outbreaks and epidemiological developments concerning the worldwide developments regarding Highly Pathogenic Avian Influenza virus since June 2006. It builds upon previous risk assessments which considered various pathways by which the virus might be introduced into the UK.

During the period June 2006 to May 2007, the H5N1 virus continued to be detected and reported sporadically across some continents, most recently in Asia, the Middle East, Indian Subcontinent, East and West Africa and Europe. Outbreaks have been reported mainly in poultry (commercial and backyard) and occasionally in captive birds and wild birds. It remains unclear to what extent any of these outbreaks may have been caused by movements of infected domestic poultry or captive birds.

The risk of an introduction of H5N1 to the UK through legal trade from affected areas remains negligible due to bans on trade. However, the possibility of illegal imports from affected countries provides a constant background risk of infection which is difficult to quantify. This emphasises the need for continuing vigilance and enforcement measures at the borders.

Wild birds may have a role to play in the introduction and dissemination of virus. There have been sporadic reported detections of the H5N1 virus in various species of wild birds worldwide since June 2006. We consider that recent epidemiological developments do not significantly alter our previous overall conclusion that there is an increased but still low likelihood that the virus may be introduced from the affected areas to the UK.

A programme of active surveillance of wild birds is in progress in all EU Member States and so far has not resulted in any reports of positive findings. It is also understood that surveillance of wild birds in Africa is ongoing and has not resulted in any positive findings, though the situation in the continent remains largely unknown. It is also possible that under usual conditions the H5N1 virus may be present in wild birds at a very low level that is impossible to detect.

The mild winter of 2006/2007 was likely to result in 'normal migration movements' of wild birds with less crowding compared to the winter of 2005/2006 when erratic movements and significant overcrowding occurred due to unusually cold weather. Nevertheless, these 'normal migration movements' may have also created a number of discrete pockets where virus may be maintained at a low level in wild bird populations over a period of time, but remain unnoticed. Therefore, sporadic outbreaks may continue to occur within a wider region worldwide and in Europe leading to more outbreaks in the summer of 2007 when birds congregate for moulting.

This risk assessment acknowledges that conclusions are based on much uncertainty. Nevertheless, they will be subject to scrutiny when more structured epidemiological information becomes available in the future from epidemiological and surveillance studies that are now in progress. Defra continues to monitor developments and re-assess the situation.

## 2 Introduction

This update and commentary builds on a number of our previous risk assessments (Defra, 2005; 2006) that considered several pathways by which HPAI H5N1 may be introduced to the UK. The information on outbreaks presented in this paper summarised HPAI H5N1 developments during the period from June 2006 and is current as of 4 May 2007 at 12.00pm. The information on HPAI H5N1 outbreaks has been received from the European Commission (ADNS e-mail alerts and urgent faxes) and the World Organisation for Animal Health (OIE) unless otherwise stated.

In this paper we consider whether the developments since June 2006 have altered the risks of the introduction of H5N1 virus to the UK.

## 3 HPAI (H5N1) – Official Disease Reports (June 2006 – early May 2007)

### 3.1 Asia

#### 3.1.1 South east Asia

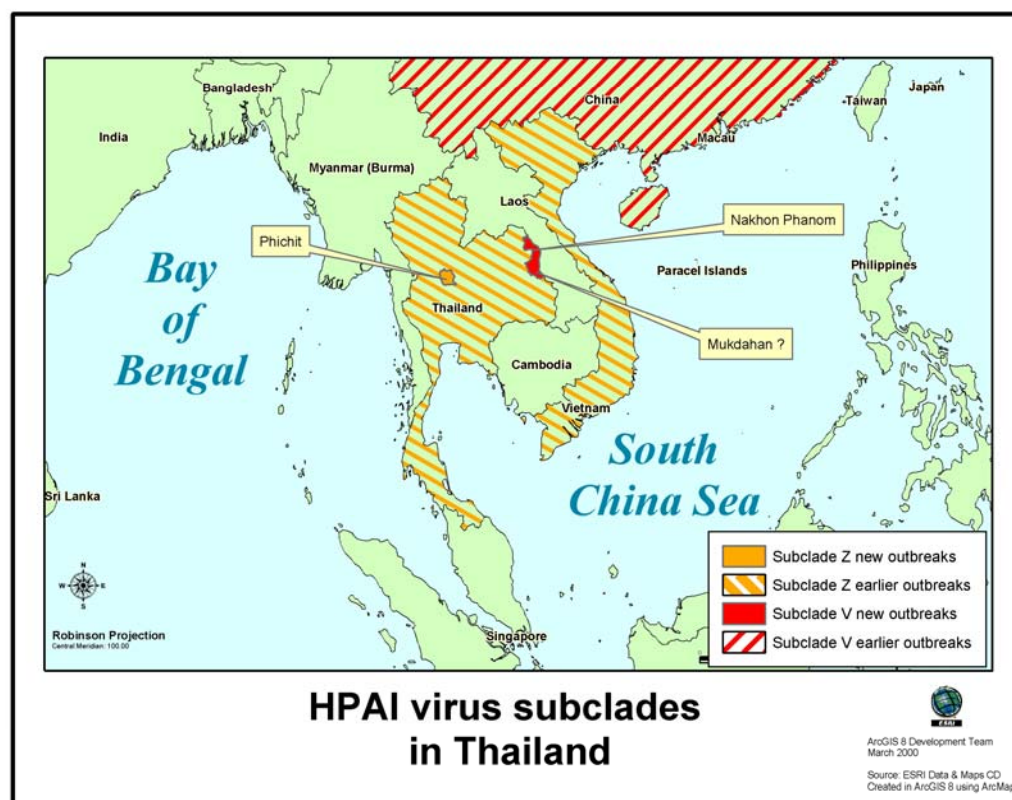
Since June 2006, the H5N1 virus has been detected in domestic and commercial poultry in South East Asia in Cambodia, China, Indonesia, Laos, Myanmar, Thailand and Vietnam. H5N1 has also been reported in wild ducks in Vietnam in August 2006 and in resident wild birds in Hong Kong in January 2007.

A number of outbreaks of H5N1 were reported in village poultry in the Chinese provinces of Shanxi, Xiang, Ningxia Hui, Xinjiang, Hunan and Inner Mongolia between June and October 2006. A further case was reported in Tibet in March 2007. China carries out a vaccination programme.

Thailand reported outbreaks in domestic poultry in Phichit and Nakhon Phanom in July and August 2006 and most recently in free range domestic ducks in the central part of the country (Phitsanulok province) in mid-January 2007. These particular ducks were known to forage in rice fields during the day where they were in contact with wild species.

Two different genotypes, or subclades, of the H5N1 HPAI virus have been found in Thailand (see map 1). One, subclade V, from Nakhon Phanom province in the Northeast is a strain new to Thailand and more closely related to H5N1 strains that have been circulating since 2005 in southeast China. Viruses isolated from Phichit are genotype Z, that is similar to viruses isolated in the 2004 and 2005 outbreaks in Thailand and Viet Nam. An outbreak in Mukdahan, immediately south of Nakhon Phanom, was regarded as being likely to be also due to subclade V viruses. There has been concern that these two viruses could combine to form a new mutated form. However, it was also considered that existing vaccines would be effective against this new strain (Chutinimitkul and others, 2007).

Map 1: HPAI virus subclades in Thailand



Cambodia reported the virus in free ranging ducks in central and southern provinces in August and September 2006 and again in backyard chickens and ducks in the east in early April 2007.

Monitoring of Vietnamese markets resulted in the detection of H5N1 virus in broiler ducks in Hanoi in early September although no clinical disease was found. Vietnam reported two further outbreaks in unvaccinated ducks and chickens in the southern part of the country (Bac Lieu and Ca Mau) in mid December. Illegal movements of poultry from China is suspected to have caused these outbreaks. Following these outbreaks in December 2006, Vietnam reported a large number of cases in January 2007 in the southern provinces of the country (Bac Lieu, Kien Giang, Ca Mau, Soc Trang, Vinh Long, Tra Vinh and Hau Giang). A further case was reported in Hai Duong, northern Vietnam in March 2007. H5N1 was also detected in samples of wild ducks collected in the field during routine testing in the southern province of Ben Tre in mid and late August 2006. Vietnam carries out a vaccination programme.

Four outbreaks of H5N1 were reported to the OIE in July 2006 in back-yard chickens in Papua, Indonesia. No further outbreaks have been reported although it is believed that the disease may be endemic in poultry in Indonesia (European Commission, 2007)

Laos reported an outbreak of H5N1 at the end of July 2006 in commercial poultry in Xaythani. In February 2007, there was a further outbreak in the southern city of Vientiane.

Myanmar reported an outbreak of H5N1 in poultry in the southern region of Rangoon at the end of February 2007. The source of infection is reported to be low biosecurity. A further outbreak occurred in the nearby region of Yangon (Rangoon) in March. Prior to this, the last report of H5N1 in Myanmar occurred in April 2006.

### **3.1.2 Far East Asia**

Since June 2006, the H5N1 virus has been detected in domestic and commercial poultry in Far East Asia in South Korea and Japan.

In South Korea there were outbreaks of H5N1 in commercial poultry in Jeollabuk-do, in November 2006 and then three further outbreaks in December; two in Jeollabuk-do and one in the neighbouring province of Chungcheongnam-do. South Korea reported further cases of HPAI H5N1 between January and March 2007 in the provinces of Cholla-buckdo and Ch'ungch'ong-Namdo and close to areas affected since December 2006.

In Japan, the virus was reported in farms in Miyazaki, southern Japan and Okajama further north of the country in January and February 2007.

It is interesting to note that all outbreaks have been reported in commercial poultry. There were no reports on isolates from wild birds in this region during these latest episodes of H5N1 outbreaks.

### **3.1.3 Central Asia**

Mongolia reported H5N1 in migratory birds (gulls, geese, and swan) in Bulgan, central Mongolia in June 2006. Afghanistan reported a number of outbreaks of H5N1 in village chickens in the eastern regions of the country during February and March 2007.

### **3.1.4 Middle East**

In February 2007, Kuwait reported its first cases of HPAI H5N1. The first outbreak occurred in captive falcons at Kuwait zoo in the Eastern region of Al Farwaniyah. Reports then continued in February and March 2007 with outbreaks in poultry at a number of locations in the regions of Al Farwaniyah, Al Ahmadi, Hawalli, Al Jahra and Mubarak al Kabeer. Saudi Arabia reported an outbreak in hobby birds (ostriches) in the north-east at Ash Sharqiyah in birds at a private rest house. Vaccination is permitted but stamping out was undertaken.

### 3.1.5 Indian Subcontinent

Bangladesh reported outbreaks of H5N1 in commercial layer poultry in late March. Vaccination is not allowed. Pakistan reported outbreaks of H5N1 and H9N2 in broiler farms in Islamabad during July 2006. Vaccination was carried out. In February 2007, Pakistan reported two further outbreaks, one in backyard poultry including fancy birds (i.e. peacocks, pheasants, pigeons, ducks and parakeets) in the Northwest frontier and the other in a poultry farm in Punjab. New outbreaks have been reported in backyard poultry, ostriches, peacocks, pigeons and wild crows in North-West Frontier, Punjab and Islamabad in March.

## 3.2 Europe

Since June 2006, the H5N1 virus has been detected in domestic and commercial poultry in Europe in Ukraine, Russia, Hungary, Turkey, the UK and Afghanistan.

The last reported case of H5N1 in a wild species in Europe occurred in August 2006 in a black swan at Dresden Zoo, Saxony, Germany. The only other report in this period was a case in a great crested grebe that occurred in Spain in June 2006.

Ukraine reported an outbreak of H5N1 in hens, ducks and geese at the beginning of June 2006.

In July 2006, Russia reported an outbreak of avian influenza (H5N1) in the Tomsk region which appeared to have been on-going since February 2006. In January 2007 H5N1 cases in domestic poultry were reported at three farms in the southern region of Krasnodar, close to the Black Sea. Vaccination was carried out in response to this outbreak. In February 2007, there were reports of H5N1 outbreaks in five areas of the Moscow region. These outbreaks occurred in small private backyard poultry and the source of infection was attributed to a live bird market in Okrug, Moscow.

Hungary reported outbreaks of H5N1 in domestic geese and poultry in Bács-Kiskun in early June 2006. In January 2007 two outbreaks of H5N1 were reported in commercial geese in the central county of Csongrad and in a flock of 4-8 week old geese in Derekegyhaz-Ordongos, some 9km from the first outbreak.

The UK reported an outbreak of H5N1 in February 2007 in a commercial turkey flock in the Suffolk area. Subsequent investigations by the UK and the Hungarian authorities found that the close genetic sequence match of the viruses found in geese in Csongrad and the turkeys in Suffolk suggested that a link existed between these outbreaks. Several possibilities for the introduction of the virus including the virus being carried by vehicles, people's clothes or crates, trade in poultry or poultry products and wild birds have been investigated. A final report of epidemiological findings is available at the following Defra website ([http://www.defra.gov.uk/animalh/diseases/notifiable/disease/ai/pdf/epid\\_findings050407.pdf](http://www.defra.gov.uk/animalh/diseases/notifiable/disease/ai/pdf/epid_findings050407.pdf)).

In Turkey H5N1 was reported in early February 2007 in a mixture of birds (i.e. chickens, turkeys, geese, ducks, pigeons) in a village located in the south eastern region of Batman. Further cases were reported in mid February in Batman and the neighbouring region of Diyarbakir.

### **3.3 Africa**

Since June 2006, the H5N1 virus has been reported in domestic and commercial poultry in Sudan, Cote D'Ivoire, Egypt and Ghana. Although not officially reported to the OIE, few outbreaks in south-west Nigeria (Lagos) in June 2006 were mentioned in a FAO report (Adene & Oguntade, 2006).

Sudan reported outbreaks of H5N1 in poultry in Khartoum, central Sudan in July 2006 and again in early October 2006 in backyard poultry in the region of Juba, Central Equatoria.

Cote d'Ivoire reported outbreaks of H5N1 in June 2006 in the southern region of San Pedro. The outbreaks were in backyard chickens and in a dead wild bird. Vaccination was carried out.. In November 2006, further outbreaks were reported in the country in domestic turkeys.

Egypt reported outbreaks of H5N1 in backyard poultry in eight governorates in northern and central Egypt (Cairo, Damietta, Giza and Sohag) in early September 2006. Vaccination of backyard poultry with an inactivated vaccine took place in 25 governorates. There were further outbreaks in 15 governorates in December 2006.

It is interesting to note that one case in Alexandria was in a chicken from Sohag which is a governorate which has not reported any outbreaks. This may suggest under-reporting by some governorates.

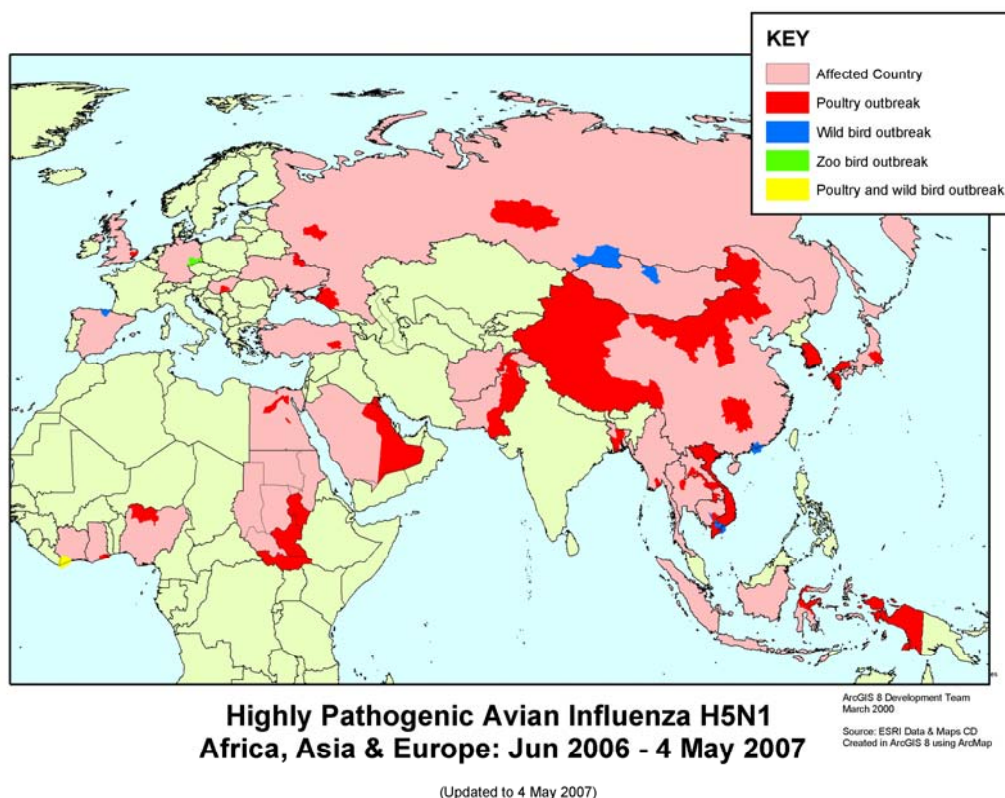
Ghana reported an outbreak in intensive layer poultry in greater Accra in the south in April 2007. Control measures included modified stamping out. Vaccination is not allowed. This is the first report of H5N1 from Ghana.

## **4 Comments**

### **4.1 Outbreaks worldwide**

Map 2 summarise the outbreaks of HPAI H5N1 reported from countries since June 2006. While most countries reported outbreaks in domestic poultry (backyard or commercial), only a few reported the detection of the virus in wild birds.

**Map 2: Summary of reports of HPAI H5N1 worldwide between June 2006 and 4 May 2007.**



## 4.2 Poultry and Captive birds

The virus appears to be endemic in backyard poultry in a number of countries in south-east Asia. As in previous years, the recent outbreaks occurred mainly in rural areas where farming and animal husbandry are the main means of livelihood and poultry are mostly raised for domestic consumption. Therefore, depopulation of infected domestic poultry may be hampered by people not reporting unusual mortality or failing to present poultry for destruction. On the other hand, depopulation in the affected countries would require restocking to enable domestic production to continue and prevent food shortages, which, if not controlled, may in turn create opportunities for the disease to spread due to increased long-distance transport of poultry from unchecked sources. These are some of the difficulties that the authorities may be facing in the attempt to control outbreaks in this region. It is, however, noticeable that, once made aware of the cases, the authorities report and take action to deal with them.

The disease was reported in commercial poultry in South Korea and Japan. In previous outbreaks, it was found that the virus involved in these outbreaks was derived from a common ancestor. Nevertheless, the means of introduction of H5N1 to domestic poultry in earlier and recent outbreaks still remains unknown.

In the case of Pakistan, the outbreaks in commercial poultry were attributed to introduction of live birds into commercial operations. We do not have information on

what these birds may be and whether they were of domestic origin or imported from another country. The same uncertainty remains with regard to India.

Reported outbreaks in Europe have mainly occurred in commercial poultry operations. On two occasions (in Russia and Turkey), the virus was reported in backyard poultry.

Most of the reported outbreaks in Africa have occurred in domestic poultry, mainly in commercial operations. The virus was reported for the first time in Ghana in May 2007.

The EU and the UK continue to ban legal imports of risk commodities (e.g. live poultry, fresh and frozen poultry meat, captive and wild caught birds, pet birds, unprocessed feathers) from affected Third countries or any Third country that is not on the approved EU list for any of these commodities. Furthermore, the EU has extended its ban on imports of unprocessed feathers from any Third country. The ban on trade in captive birds and wild caught birds has been extended to include all Third Countries at present until 30 June 2007 and additional protection measures and restrictions are in place for the importation of pet birds.

Even when EU rules for legal trade in live poultry, either within the Community or with approved Thirds Countries, are fully complied with, there is an inherent but very small risk that birds will be consigned in good faith from a holding or region where disease may be present but remains undetected. In both cases, trading partners from Third countries must implement laws on disease surveillance, notification and control which minimises the likelihood of this happening. However, this likelihood can never be completely eliminated. The risk is increased during the incubation period when by definition there are a very few or no clinical signs of disease.

As with all disease agents, illegal imports from infected countries worldwide give rise to a constant, background risk of infection, subject to the survival of the infectious agent in the illegally imported product. Furthermore, there are concerns that the ongoing ban of imports of wild birds may increase incentives for illegal imports. Defra is monitoring this with the help of other government bodies. The risk of transmission of viable virus in illegal consignments or personal imports of poultry meat is difficult to quantify. This emphasises the need for continued enforcement measures at the EU and the UK border.

In cases of infection either in domestic poultry or wild birds, humans can also transmit disease by transferring infected bird faeces (on footwear for example) if they come in contact with infected birds. However, the likelihood of such events is difficult to quantify and these risks are difficult, if not impossible, for governments to control.

### **4.3 Wild birds**

The epidemiological evidence, albeit circumstantial, suggests that wild birds may have a role to play in the introduction and dissemination of the HPAI H5N1 virus. However, it largely remains uncertain whether any species of migratory birds infected with the virus could successfully commence and complete migration in the first instance.

In the EU, a programme of active surveillance of wild birds is in progress in all Member States but so far has not resulted in any reports of positive findings. We also understand that surveillance of wild birds in Africa has not resulted in any positive findings. Therefore, if the virus is present in wild birds, it is likely to be present at such a low level that it would be impossible to detect unless the vast majority of wild birds populations were tested worldwide using standardised tests. In practice, this would be impossible to achieve.

#### **4.3.1 Spring migration (year 2007)**

The weather conditions in Europe this year were relatively mild, unlike last year, when severe weather conditions coincided with a number of cases of H5N1 in wild birds in many countries in Europe. The situation in Africa still remains uncertain with regard to the presence of H5N1 in wild birds and the potential for it to arrive in the UK during the spring migration. As a consequence, our consideration of the likelihood associated with spring migration in 2007 remains at low but increased.

The bulk of spring migration in Europe usually takes place between the beginning of March and the end of May. It would be expected that birds that have migrated in autumn to East Africa will return in spring over eastern Europe to their breeding grounds in southern Siberia. At the same time, birds from West Africa will return over Europe to their breeding grounds in Arctic areas and over the Mediterranean basin to their breeding grounds in North Russia.

There are currently no reports of the detection of H5N1 virus in migratory birds in any part of Africa. A single case of H5N1 was reported in a dead wild bird in southern Cote d'Ivoire in June 2006. However, the situation in Africa still remains uncertain.

Although there are no reports of the virus in wild birds in East Africa, the virus has been reported from backyard poultry from some countries in north-east Africa. The possibility that wild birds could come into contact with such poultry and become infected cannot be excluded. Therefore, there is a low likelihood that some species of waders and passerines (perching birds) that migrate to the UK during spring from eastern Europe, Mediterranean and East Africa regions could be infected with the virus. According to expert ornithologists only one passerine species (i.e. Lesser Whitethroat) is likely to come to the UK. Other species do not come to the UK from Eastern Mediterranean in any numbers.

Direct movements of wild birds from eastern Europe to the UK are unlikely. However the likelihood should be reviewed in light of detections of the virus in wild birds in north-east, central and southern Europe. These areas are mainly within the flyway of waterbirds migrating from southern Siberia southwards via the Volga Basin and the Caspian Sea region. The potential for limited 'mixing' at some 'contact' points between the existing wild waterbird populations from eastern Europe with the populations in the EU cannot be excluded.

A recent development is the detection of H5N1 in backyard poultry in western Russia. It remains uncertain whether these poultry may have been infected due to contact with wild birds or by some other possible ways of the introduction of the virus.

Nevertheless, should the virus be widely present in wild bird populations in western Russia, this mild winter may have created an opportunity for the wider dissemination of the virus in Europe. The winter of 2007 was mild compared to the winter of 2006 which was characterised by harsh conditions that appear to have caused an erratic displacement of birds and caused them to gather in restricted areas.

## 5 Conclusions

During the period June 2006 to May 2007, the H5N1 virus continued to be detected and reported sporadically across parts of Africa, Asia and Europe. Most recently cases have occurred in the Indian Subcontinent, elsewhere in Asia, the Middle East, North-East and West Africa and Europe. Outbreaks have occurred primarily in poultry (commercial and backyard) and occasionally in captive birds. There have been a number of reported sporadic detections of the H5N1 virus in various species of wild birds worldwide.

At the moment of writing the species susceptibility and ecology of the H5N1 virus are largely unclear. Uncertainties remain regarding the routes by which the virus may have been introduced and disseminated in the affected regions in the past. There is also much uncertainty as to whether the virus may be present in various parts of the world in backyard poultry or susceptible wild birds at very low levels while remaining undetected. The existing monitoring and surveillance systems in the EU Member States should be able to detect cases if they start occurring on a larger scale in their territories.

If the virus is present in domestic poultry in the affected areas, it is likely that local practices could contribute to the dissemination of the virus within the affected country or sometimes beyond should local or international trade in undetected but infected domestic live poultry take place. Infection in back-yard poultry in particular could also increase the opportunities for local wild birds to become exposed to the virus.

A programme of active surveillance of wild birds is in progress in all EU Member States. So far this has not resulted in any positive findings. Surveillance of wild birds in Africa is ongoing and has not resulted in any positive findings, though the situation in the continent remains largely unknown. Furthermore, it is also possible that under normal conditions the H5N1 virus may be present in wild birds at a very low level that is impossible to detect.

The mild winter is likely to have resulted in 'normal migratory movements' of wild birds. Because the birds would have been less crowded there is an increased potential for the creation of a number of discrete pockets where the virus may be maintained at a low level in wild bird populations over a period of time, but remain unnoticed. Therefore, sporadic outbreaks may continue to occur within a wider region worldwide and in Europe leading to increase in number of outbreaks in summer 2007 when the birds congregate for the moult.

We consider that recent epidemiological developments do not significantly alter our previous conclusion that there is an increased but still low likelihood that the virus may be introduced through the spring migration of waterfowl from affected locations in eastern Europe to the UK. This is because of the potential for a limited mixing

between wild waterbird populations from Eastern Europe with populations in the EU at some areas of contact.

We also consider that there is an increased but still low likelihood that spring migration from western Africa would result in the introduction of the virus to the UK.

There is a low likelihood that some species of waders and passerines (perching birds) that migrate to the UK during spring from eastern Europe, the Mediterranean and East Africa would be infected with the virus.

This risk assessment acknowledges that these conclusions are based on much uncertainty. Nevertheless, they will be subject to scrutiny when more structured epidemiological information becomes available from epidemiological and surveillance studies that are now in progress. Defra continues to monitor developments and re-assess the situation.

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