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HIGHLY PATHOGENIC AVIAN INFLUENZA (H5N1)

MIGRATORY WATERBIRDS IN CENTRAL ASIA

(AN UPDATE AND COMMENTARY)

Working document (Version 1)

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1 Summary

Between May and August 2005, outbreaks of HPAI (H5N1) virus have been reported in domestic poultry in China, the southern part of Russia and north-east Kazakhstan. China also reported that H5N1 virus had been isolated from dead wild migratory waterbirds in May 2005. Mongolia reported that H5 virus had been isolated from a few dead wild migratory waterbirds in the northern part of the country close to the Russian border in August 2005. This virus is yet to be confirmed as H5N1.

Currently, detection of H5N1 virus in wild migratory waterbirds has not been reported from any country, apart from China and Mongolia. The reports of HPAI in dead wild migratory waterbirds from China and Mongolia demonstrate that only a relatively small number of birds may be infected and that these birds are highly likely to die as a result of the infection. The report from Mongolia also highlighted that the virus has not been detected in live, apparently healthy wild waterbirds that may have been in contact with infected birds. The virus has also not been found in a significant number of live apparently healthy waterbirds or other wild birds in Hong Kong. Caution is required when generalising trends that may relate to carriage of the virus to different regions or countries because wild migratory waterbirds use different routes (flyways). Systematic studies are therefore required to understand the species susceptibility, pathogenesis and ecology of the virus.

Ringling recoveries indicate that there is limited movement of wild migratory waterbirds between the UK and southern Russia. Many of the waterbirds wintering in the UK are from species and populations that are highly unlikely to act as carriers of the virus to the UK from the current outbreaks in Asia, using different migratory flyways. The inferences about the scale and regularity of movement of these birds between southern Russia and the UK can only be preliminary and should be treated with caution.

This update and commentary does not alter our previous conclusion regarding the increased (but still low) likelihood of the introduction of H5N1 virus by migratory waterbirds from the affected region to the UK during the autumn (post-breeding) migration season. This assessment should be viewed in the context of the lack of epidemiological evidence and the uncertainties regarding the bird populations on southern Russian breeding grounds. Defra continues to advise industry and poultry farmers on disease surveillance and reporting. It also reiterates the importance of biosecurity in preventing contact between domestic poultry and migratory or wild birds or their faeces.

The EU Standing Committee on the Food Chain and Animal Health (SCoFCAH) is also of the opinion that the recent outbreaks in Central Asia are of concern but consider that the likelihood of the virus introduction and spreading into the EU via migrating birds is remote or low. Nevertheless, the EC has asked Member States to broaden their surveillance for AI to include migratory waterbirds.

We continue to monitor developments and will re-assess the situation when required.

2 Introduction

This qualitative risk assessment considers the likelihood of the introduction of highly pathogenic avian influenza (HPAI) H5N1 to the UK via migratory waterbirds and other various possible pathways following outbreaks in Central Asia.

3 Hazard identification

3.1 Outbreaks of HPAI in Central Asia – Official Disease Reports



Between May and August 2005, outbreaks of HPAI (H5N1) virus (see map) have been reported in Central Asia.

Outbreaks of the disease in domestic poultry have been reported in China (Youling, 2005), the southern part of Russia (Nepoklonov, 2005) and north-east Kazakhstan (Mynzhanov, 2005).

In May 2005, H5N1 was detected in dead wild migratory waterbirds in China (Youling, 2005). In August 2005, Mongolia reported that an H5 virus has been detected in dead wild migratory waterbirds in the northern part of the country close to the Russian border. The virus is yet to be confirmed as HPAI (H5N1) (Sanjaatogtokh, 2005).

The reports of the virus finding in dead migratory waterbirds raised concerns on the potential role of these birds in

the rapid dissemination of the virus over large geographic distances. Therefore, migratory waterbirds have been identified as a hazard for consideration in this qualitative risk assessment regarding their potential for the introduction of H5N1 virus to the UK from the affected regions in Central Asia.

4 Risk assessment

4.1 Release Assessment

This release assessment considers the likelihood of H5N1 virus introduction to the UK by wild migratory waterbirds from the affected regions in Central Asia. For the purpose of the release assessment (Section 4.1) the following definitions will apply:

Term	Definition
HPAI	"HPNAI viruses have an IVPI in 6-week-old chickens greater than 1.2 or, as an alternative, cause at least 75% mortality in 4-to 8-week-old chickens infected intravenously. H5 and H7 viruses which do not have an IVPI of greater than 1.2 or cause less than 75% mortality in an intravenous lethality test should be sequenced to determine whether multiple basic amino acids are present at the cleavage site of the haemagglutinin molecule (HA0); if the amino acid motif is similar to that observed for other HPNAI isolates, the isolate being tested should be considered as HPNAI" (OIE, 2005)
Waterbirds	"Means those species of birds that are ecologically dependant on wetlands for at least part of their annual cycle..." (UNEP, 2005)

For the purpose of the release assessment (Section 4.1) the following terminology will apply (OIE, 2004):

Term	Definition
Likelihood	Probability; the state or fact of being likely
Likely	Probable; such as well might happen or be true; to be reasonably expected
High	Extending above the normal or average level
Highly	In a higher degree
Low	Less than average; coming below the normal level
Negligible	Not worth considering; insignificant
Remote	Slight, faint
Would	To express probability; past of Will: expressing a wish, ability, capacity, probability or expectation

4.1.1 H5N1 virus – affected species during recent outbreaks

Table 1 demonstrates that on two occasions, HPAI (H5N1) virus was isolated during outbreaks in wild migratory waterbirds reported in China in May 2005 and Mongolia in August 2005. No further outbreaks in wild migratory waterbirds in the affected areas have been reported since. In the outbreaks in domestic poultry, the reports attributed the introduction of the virus to contact with migratory waterbirds.

Table 1. Affected species during recent outbreaks of HPAI

Species	China	Russia	Kazakhstan	Mongolia
Wild birds				
Ducks	Ruddy shelducks (<i>Tadorna ferruginea</i>)			
Geese	Bar-headed (<i>Anser indicus</i>)	Bar-headed (<i>Anser indicus</i>)		Bar-headed (<i>Anser indicus</i>)
Swans				Whooper swan (<i>Cygnus cygnus</i>)
Gulls	- Great black headed (<i>Larus ichthyaetus</i>) - Brown-headed (<i>Larus brunnicephalus</i>)			
Egrets				
Cormorants	Great cormorants (<i>Phalacrocorax carbo</i>)			
Domestic birds				
Ducks				
Geese				
Chickens				
Turkeys				
Legend: Species involved in ■ outbreaks or considered as a □ suspected source of the virus for domestic poultry				

4.1.2 Wild migratory birds

4.1.2.1 Recently reported outbreaks

Laboratory investigation into a die-off of migratory waterbirds in China in May 2005 revealed 28 H5N1 virus isolates from 92 cloacal, tracheal and faecal swabs from three affected species (bar-headed geese, brown-headed gulls and great black-headed gulls). A further 5 isolates were obtained from tissue samples from affected bar-headed geese. Gene analysis showed that these isolates were almost identical to poultry isolates obtained in China in 2005. These results led to consideration that the virus may have had a single introduction into migratory waterbirds, probably from poultry. Subsequently, this may have led to the transmission of the virus between wild waterbirds in the affected area (Chen and others, 2005). There is no information on whether any differential diagnostic laboratory tests were carried out to exclude other potential causes of death of these migratory waterbirds (e.g. other diseases, poisoning, natural die-off or some other natural ecological impact) or whether samples from unaffected cohorts were tested.

According to the Wildlife Conservation Society, (2005), laboratory investigation in the wild waterbird die-off in Mongolia included testing of both dead and apparently healthy live wild waterbirds. This investigation indicated that the percentage of sick or dead waterbirds was very low (100 dead birds out the observed population of approximately 6,500 apparently healthy birds of 55 species). A single H5N1 virus isolate was obtained from one dead whooper swan. No virus was detected in samples collected from a significant number of apparently healthy wild waterbirds (approximately 700 birds sampled) that may have shared the same habitat. This investigation concluded that although the H5N1 virus *“can be carried across long distances, the waterfowl species typically identified in recent outbreaks appear to be victims rather than effective carriers of the disease”*.

4.1.3 AI virus in wild birds

“The complete host ecology of influenza is unlikely ever to be fully understood” (Tollis and Di Trani, 2002) because of the complex interactions between the virus and wild waterbirds. In these birds, low pathogenic AI (LPAI) virus replicates in the cells lining the intestinal tract and is excreted in high concentrations in the faeces (up to $10^{8.7}$ 50% egg infectious doses/gram) (Webster, 1998).

There are numerous examples in the literature of different AI viruses being detected in wild waterbirds. It is generally understood that the distribution of LPAI viruses varies to a great extent and their detection depends on the year and season. Accumulated surveillance data of wild waterbirds indicate that the detection of LPAI of H5 and H7 subtypes is infrequent, unpredictable and proportionally very low compared to other detected AI viruses. However, there is no information regarding the effect that the antibody response against other types of AI viruses will have on the establishment and regular circulation of LPAI of H5 or H7 subtypes in wild waterbirds.

4.1.4 Waterbirds migration in Central and South-East Asia

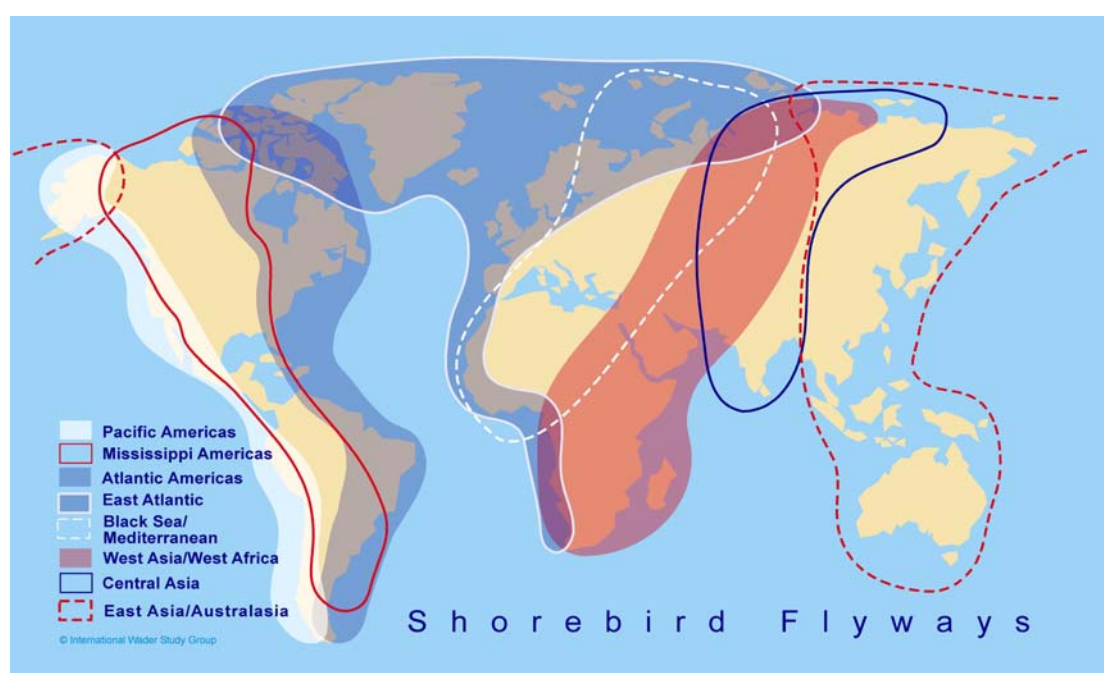
“Migratory populations include species in which the entire population or a significant proportion of the population cyclically and predictably crosses one or more national jurisdictional boundaries. Waterbirds use a wide variety of habitats during their

annual cycle, from the arctic tundra, forested wetlands of the temperate taiga, forest-steppe, steppe grasslands, deserts, inland and coastal wetlands, wet and dry agriculture croplands, rivers, floodplain wetlands, marshes, lakes, tanks, ponds, irrigation tanks, sewage and waste treatment farms” (UNEP, 2005).

Wetland habitat in Siberia support large numbers of breeding waterbirds, many of which migrate in the autumn to wintering areas in Europe, Africa, India and East and South-East Asia using various routes (“flyways”) (BirdLife International (2005). “A “flyway” is the total area used by (groups of) populations or species of birds, throughout their annual cycle, including the breeding areas, migration stop-over and non-breeding (wintering) sites. Many of these sites tend to be highly productive and are thus also of importance to non-migratory birds and other biodiversity”) (UNEP, 2005).

For migratory waders (shorebirds) the principal flyways of Eurasia (Hötcker and others, 1998; Stroud and others, 2004) are:

- The East Atlantic Flyway
- The Black Sea/Mediterranean flyway,
- The West Asia/West African flyway
- The Central Asia/India flyway,
- The East Asian-Australasian flyway.



(Map from: Stroud and others, 2004)

Anatidae (ducks, geese and swans) have different migration systems (Scott and Rose 1996; Miyabayashi and Mundkur 1999). For ducks especially, flyways tend to be poorly defined, and migration occurs on a broad front, typically between a number of wetland staging areas. (See also Stroud *et al.* 2005 for a recent review of migratory waterbird biogeographic populations).

Around 5 million waterbirds are present in Britain in winter. While some species are resident in the UK (i.e. birds present in winter that have bred here) many species

arrive in the UK from arctic areas of North America, Greenland, Iceland, Fenno-Scandia and further east in northern Russia. Many of the waterbird species or populations wintering in the UK derive from northern (arctic or sub-arctic) areas and are highly unlikely to act as carriers of the virus to the UK from the current outbreaks in central Asia. Further, several species of wildfowl have a marine distribution during winter, and, remaining at sea, will therefore not come in to contact with farms or domestic livestock (Cromie, 2005).

Ringed recoveries (Wernham and others, 2002) show there is some, albeit limited movement of birds between the UK and southern Russia. Therefore, the inferences about the scale and regularity of movement of birds between there and the UK can only be preliminary and need to be treated with caution. For example, some of the extreme eastern recoveries of UK birds are highly unlikely to have travelled that far in a single winter. Rather, they may have paired with different mates in different breeding seasons and their wintering and breeding grounds may have moved progressively east only over a period of several years. Lastly, the UK plays host to only a proportion of these species' populations during the winter: the majority of individuals breeding in Russia are highly unlikely to reach Britain because they winter further east in Europe, for example in the Mediterranean, and for some species in the Baltic (Cromie, 2005). Nevertheless, it needs to be emphasised that *“although bird banding has enabled scientists to gather very detailed information on birds, tracking the birds to understand their movements is a difficult task”* (Anonymous, 2005).

4.1.5 Some other possible pathways

At the beginning of March 2004, the Chinese authorities emphasised difficulties they were facing in the attempt to control outbreaks of HPAI in domestic poultry. Poultry production in China is considerable and covers extensive areas. Depopulation of infected domestic poultry requires significant replenishment to continue production. This creates opportunities for spread of the disease in the region due to increased long-distance transport of poultry (Zhenzhao, 2004).

Unregulated trade would also have to be considered as a potential mechanism for the virus to spread. Whether coincidentally or not, it is noticeable that the recent outbreaks in western Siberia broadly occurred in the regions through which the main Trans-Siberian railway lines pass. Some consider (Chu and others, 2005) that illegal hunting and catching of wild waterbirds in the two bird reserves in China (Quinghai lake and Zhalong reserve) are still happening.

Although H5N1 virus has not been isolated from apparently healthy wild waterbirds in Mongolia in August 2005 and Hong Kong in January 2005, it has been isolated from two crested hawk-eagles (*Spizeatus nipalensis*) from Thailand that were seized at the Brussels International Airport in 2004. The birds showed no apparent clinical signs of the disease. However, necropsy indicated that both eagles suffered from enteritis and one of them had bilateral pneumonia. This study highlights the notion that *“international travel and smuggling represent major threats for introducing and disseminating H5N1 virus worldwide”* (Van Borm and others, 2005).

4.1.6 General comments

Any significant wild waterbird migration from Asia to their breeding grounds in Russia is likely to have occurred south to north during April/May. It is interesting to note that the detection of H5N1 virus in migratory waterbirds has not been reported from any country that may be covered by the flyways described above, apart from China and Mongolia. It is currently unclear as to why outbreaks of H5N1 virus are being detected in wild waterbirds in 2005 whereas similar outbreaks were not reported during the post-breeding migration of 2004 during the height of the south-east Asia epidemic.

It is not clear to what extent populations of waterbirds that migrate to both European and Asian overwintering grounds mix on their Russian breeding grounds. Some species of ducks migrate from their breeding grounds in western Siberia to the area around the Caspian Sea. That is, *“the complex migratory pathways meant there was a possibility that a small number of individual birds, from a few species, could migrate to Western Europe and the UK from areas affected with highly pathogenic AI (HPAI). These represent only a small proportion of individual birds arriving in the UK, the vast majority of which are not from the infected areas”* (Defra, 2005). A recent study carried out over a few years indicated that several H5 subtypes (H5N2, H5N3, H5N6, H5N9) have been isolated from Mallards *Anas platyrhynchos* from various sites in the Netherlands and Sweden during autumn migration seasons. Among other findings, this study highlights that these H5 subtype isolates have a close genetic relationship with HPAI virus subtypes isolated in Europe in the past but not the HPAI (H5N1) virus isolates obtained during the on-going outbreak in South-East Asia (Munster and others, 2005). Another long term study in the Volga River basin and in the North Caspian region carried out between 1975 to 1999 detected several AI virus subtypes (H4N3, H4N6, H5N2, H6N2, H9N2, H13N3, H13N8, H14N5, H14N6) but not H5N1 (Lvov and others 2001).

The reports of HPAI in dead wild migratory waterbirds from China and Mongolia demonstrate that only a relatively small number of birds may be infected and that these birds are highly likely to die as a result of the infection. Prior to these outbreaks in migratory waterbirds, H5N1 virus was found in a single dead migratory waterbird on three occasions in Hong Kong in late 2004 and early 2005. However, there is no information on the pathogenicity (intravenous pathogenicity index or HA0 cleavage site sequence) of these virus isolates. This would have provided information on whether they belong to a low- or a high-pathogenicity strain.

It is generally important to note that the detection of actual pathogen does not always mean that that particular pathogen is the primary cause of the clinical disease syndrome, unless proper investigation and differential diagnosis tests are carried out. This situation again emphasises the need for comprehensive and careful epidemiological investigation involving a range of specialists and laboratory disease experts to ensure that field and laboratory findings are balanced.

The report from Mongolia also highlighted that the virus has not been detected in live, apparently healthy wild waterbirds. This was also the case in Hong Kong where no virus has been detected during testing of a significant number of samples (more than 10,000) collected from live apparently healthy waterbirds in recreational parks and other live wild birds as a part of routine surveillance programme (AFCD, 2005).

Caution is required when generalising trends that may relate to carriage of the virus to different regions or countries because migratory waterbirds use different routes (flyways). Systematic studies (Anonymous, 2005a) are required to learn more on “*species-related differences in virus susceptibility, shedding patterns and pathogenesis; effects of dose and route of infection on the extent of viral shedding and environmental persistence of H5N1 viruses*”.

In contrast to the possibility that infection could have been carried to the region and remain undetected for two months, it is also possible that wild waterbirds in their breeding grounds could have acquired H5N1 virus from undetected infection in local poultry. It would appear that the virus has become endemic in free range domestic ducks, certainly in countries like Thailand, Vietnam and probably some parts, if not all, of China. Inevitably there could have been some spill-over into wild waterbirds probably as a result of the extensive nature of rearing domestic ducks and their frequent movement, especially on paddy fields where they are used for pest control (Alexander, 2005). These conditions can accelerate virus transmission (Matsiu, 2005) between birds and other susceptible species. Nevertheless, both past and recent work has shown that experimentally infected ducks had detectable HPAI virus in a variety of organs including the brain. This raises questions on how efficient such birds would be at travelling over any substantial distance (Alexander, 2005).

There is no information on whether there has been systematic clinical or laboratory surveillance in wild migratory waterbirds or domestic poultry in the affected regions on a regular basis. It is, therefore, possible that recent awareness of HPAI has also impacted on raising the level of surveillance, hence, these cases are now more readily noticed and reported and investigated in more detail. It is hoped that more information will become available from the affected or potentially affected regions. On the other hand, increased surveillance of wild migratory waterbirds, combined with ringing data should provide a better insight on the virus ecology in migratory waterbirds, including information on their movements.

5 Conclusion

This update and commentary does not alter our previous conclusion regarding the increased (but still low) likelihood of the introduction of H5N1 virus by migratory waterfowl from the affected region to the UK during the migratory season (<http://defraweb/animalh/diseases/monitoring/pdf/ai-asia170805.pdf>). This estimate should be viewed in the context of the lack of epidemiological evidence and the uncertainties regarding the wild waterbirds in the breeding grounds of Russia.

The EU Standing Committee on the Food Chain and Animal Health (SCoFCAH) also considered that “*the recent outbreaks in Russia are a cause for concern but the risk of the virus spreading into the EU via migrating birds is remote or low*” at their meeting on 25 August 2005 (Defra, 2005).

We continue to monitor developments and will re-assess the situation when required.

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