Satellite data reveal why migrating birds have a small window to spread bird flu

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In 2005 an outbreak of the H5N1 'bird flu' virus in South East Asia led to widespread fear with predictions that the intercontinental migration of wild birds could lead to global pandemic. Such fears were never realised, and now research published in the British Ecological Society's *Journal of Applied Ecology* reveals why the global spread of bird flu by direct migration of wildfowl is unlikely but also provides a new framework for quantifying the risk of avian-borne diseases.

The highly pathogenic H5N1 bird flu virus is primarily a disease of poultry, often resulting in mass mortality for infected flocks. However, the virus can also infect other species, including wild birds and humans. Experimental infection has also revealed that some wild ducks, geese and swans can carry the virus asymptomatically, that is before the symptoms of the virus become apparent, meaning that they have the potential to spread the virus as they migrate.

"The potential risks to humans led to extensive media coverage often focusing on migratory birds, which fuelled public concern and led to calls for the mass culling of wild birds," said lead author Dr Nicolas Gaidet. "However, the actual risk of H5N1 spread through migratory birds depended on whether infected individuals were capable of migratory movements while shedding virus, and the distance over which such individuals could travel. Our research has answered these questions using analysis of infection and migratory routes and timings for many bird species."

Dr Gaidet's team analysed 228 birds from 19 species using satellite telemetry from 2006 to 2009 over the bird flu affected areas of Asia, Europe and Africa. The results indicated that migrating wildfowl do have the potential to disperse H5N1 over extensive distances as mass migration can result in infected birds covering as much as 2900km before symptoms become apparent.

However, while this is theoretically possible the team found that direct virus dispersal by migrating birds would require asymptomatic infection to coincide precisely with the migration season. The results revealed a very small 'window' of between 5 to 15 days when dispersal of the virus over 500 km could occur.

It is crucial to the spread of disease over such a distance that an infected bird must not be showing the symptoms of infection. If the symptoms are evident then it is highly likely that the individual may not migrate, or at least they will be unable to cover the distance as well as a healthy bird.

Along with the precise timing required to spread the virus across the maximum distance, the migrating birds would also have to fly the shortest route possible, as quickly as possible. However, the team found that most migrating wildfowl stop at various staging posts throughout the trip for periods longer than the asymptomatic duration period. Virus transfer between staging birds or infection from the environment would allow a greater potential for spread, and while neither of these routes of transmission are well documented, the latter is most likely.

"Our results indicate that individual migratory wildfowl do have the potential to disperse H5N1 over extensive distances, however the likelihood of such intercontinental virus dispersal by individual wildfowl is very low," concluded Gaidet. "Our results provide a detailed quantitative framework for the dispersive potential of avian borne viruses, which will help to better understand the risk posed by other

avian-borne diseases such as the West Nile Virus".

Provided by Wiley