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Short communication. Can highly pathogenic avian influenza (HPAI) reach the Iberian Peninsula from Asia by means of migratory birds?

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Abstract

This work discusses the possibilities of direct and indirect contact across Central Asia, between migratory bird populations from the Iberian Peninsula, South western Eurasian and Eastern Asian countries. This fact should be considered when preparing surveillance studies for highly pathogenic avian influenza viruses. Records were checked from birds ringed or recovered between 1980 and 2002 in the Iberian Peninsula, an important wintering area for waterfowl in the European Union. This study only addresses migrations covering more than 5000 km and exclusively to or from Asia. A total of seven species have developed migratory routes between Europe and the Caspian Sea/Central Asia in the following proportions to the total of birds recovered: *Podiceps nigricollis* (17%), *Anas penelope* (11.1%), *A. clypeata* (2.17%), *A. platyrhynchos* (1.86%), *Pluvialis squatarola* (33.33%), *Calidris ferruginea* (1.36%) and *Sterna sandvicensis* (0.67%). These recovery rates suggest the possibility of interchange - at the Central Asia and Caspian breeding grounds- between the populations originating in Europe and those from Southeast Asia. Over the following seasons, through direct migration, misorientation or, as frequently observed in certain duck species, through a phenomenon of abmigration, some birds with *a priori* Asian wintering quarters could conceivably escort their 'European' brethren to this continent and thus contribute to the propagation of avian flu to so far virus-free areas.

Additional key words: bird migration, influenza A virus, Portugal, Spain, wintering breeding areas.

Resumen

¿Puede llegar la gripe aviar altamente patógena desde Asia a la Península Ibérica por medio de las aves migratorias?

Este trabajo señala las posibilidades de que existan contactos directos e indirectos, a través de Asia Central, entre poblaciones de aves migratorias de la Península Ibérica, y países de Asia del este. Este hecho debería ser considerado en los planes de vigilancia del virus de influenza aviar altamente patógeno. Se han cotejado las recuperaciones procedentes de aves anilladas o recuperadas en la Península Ibérica desde 1980 hasta 2002, considerando solamente aquellos individuos que tuvieron un desplazamiento superior a 5000 km, y en una dirección desde o hacia Asia. Un total de siete especies desarrollan rutas migratorias entre Europa y el mar Caspio/Asia central en las siguientes proporciones respecto al total de recuperados: *Podiceps nigricollis* (17%), *Anas penelope* (11,1%), *A. clypeata* (2,17%), *A. platyrhynchos* (1,86%), *Pluvialis squatarola* (33,33%), *Calidris ferruginea* (1,36%) y *Sterna sandivicensis* (0,67%). Las recuperaciones demuestran la posibilidad de confluencia entre la poblaciones que provienen de Europa y las del sureste asiático en las zonas de cría de Asia central y la región del Caspio. En próximos inviernos, y debido a fenómenos de migración directa, abmigración o desorientación, algunas aves cuyos zonas de invernada son *a priori* asiáticas, podrían acompañar a sus congéneres «europeos» a este continente y contribuir a la propagación de la gripe aviar hacia zonas libres del virus.

Palabras clave adicionales: áreas de invernada y reproducción, España, migración de aves, Portugal, virus influenza A.

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Wild birds present different subtypes of low virulence avian influenza (AI) viruses which circulate freely (Arenas *et al.,* 1990; Stallknecht *et al.,* 1990; Astorga *et al.,* 1994; Pasick *et al.,* 2003; Kraus *et al.,* 2004; Munster *et al.,* 2005; Abolnik *et al.,* 2006). Different avian influenza A viruses have been isolated in various areas such as Russia, the Caspian Sea (Roslaia *et al.,* 1984; Iamnikova *et al.,* 1989) and Central Asia (Podcherniaeva *et al.,* 1979). Since 2003, lethal outbreaks of highly pathogenic HPAI H5N1 in Eastern Asia were reported by the World Organization for Animal Health (OIE) in wild birds from the Republic of Korea, Hong-Kong (China), Vietnam, Cambodia, Thailand and, subsequently, in Central and Western China, Mongolia and Western Russia, concurrently related to outbreaks in poultry (Ellis *et al.,* 2004) but no uniform pathogenesis pattern and clinical signs could be assigned. Given the highly infectious nature of HPAI and the fact that East Asia is still considered an important viral reservoir, the Food and Agricultural Organization of the United Nations (FAO) has designed strategies for early detection of infection in wild birds of disease-free countries, including the study of unusual mortalities and the mapping of migration patterns. Regarding these patterns, potential contacts across Central Asia between populations from the Iberian Peninsula, South western Eurasian and Eastern Asian countries should be considered when preparing surveillance studies for HPAI viruses.

The Iberian Peninsula, located in south-western Europe, is an important Mediterranean wintering quarter for ducks and coots. In fact, the number of Spanish wintering birds has currently increased to 1,500,000 birds (Martí and Del Moral, 2002). Since Spain is currently the third ranking European country in importance of wintering birds after Turkey and Romania, the aim of this paper was to analyze the theoretical possibilities of indirect contact among autumn migratory bird species between the Iberian Peninsula and Eastern Asia.

The data come from records of some wild bird species ringed in Asia, and recovered in the Iberian Peninsula and *vice versa*. As bird migration can change over short periods of time (Hubálek, 2004), only records from 1980 to 2002 were considered, not long from the last influenza outbreaks. Only recovery records reflecting flights to or from Asia, and longer than 5,000 km, thereby the only ones with any possibility of reaching that continent, have been addressed in this study. Data were analysed by sampling all published records available in scientific papers. Spanish data came from the journal «Ecologia», which gave up-to-date information on the number of birds ringed and recovered over previous years (see last issue in Pinilla *et al.,* 2003). Data from Portugal (Candeias and Castro, 1982; Silva and Castro, 1991; Silva and Canto, 1992) were pooled together with Spanish data. Information from the different sources is comparable because bird-ringing and recovery is a current worldwide method with a one-hundred-year history which has led to our present knowledge of migratory routes, winter quarters and the migration strategies of birds. The ringing method is organized within the European Union for Bird Ringing (Euring) and to date more than 120 million birds have been marked. Selected Iberian wintering areas come from Fernández-Cruz *et al.* (1987) and Costa and Rufino (1997).

According to these records, only seven bird species, all of them waterfowl such as divers (Podicipedidae), ducks (Anatidae) and waders (Charadriidae), followed irregular routes between Europe and Asia (Table 1). These species use selected wetlands within the Peninsula as wintering areas (Fig. 1) arriving mostly from their breeding grounds in north central Europe and beyond (Fig. 2). Among them, the species covering the greatest distances are the black-necked grebe (*Podiceps nigricollis*), which covers up to 5,500 km from south western Spain to eastern Siberia; the mallard (*Anas platyrhynchus*), which can fly up to 6,100 km from southern Spain to Kazakhstan; the shoveler (*A. clypeata*), which flies up to 5,400 km from southern Andalusia to Siberia, and the wigeon (*A. penelope*), with flights of 5,900 km between northern Andalusia and Siberia. Among the waders, the grey plover (*Pluvialis squatarola*) can perform flights up to 5,498 km from Siberia to north western Spain, and the curlew sandpiper (*Calidris ferruginea*), with flights up to 5,980 km from its breeding Siberian localities to the south-western Andalusian marshes. The longest Portugal-Asia recovery is a sandwich tern (*Sterna sandvicensis*) from eastern Russia at 5,300 km, as most wintering birds in Portugal come from Britain, the Netherlands and the Scandinavian countries, but not from Asia.

Most migratory bird species whose flyways pass over or who are wintering in the Iberian Peninsula, come from central Northern Europe within a

Table 1. Number of birds ringed and recovered in the Iberian Peninsula up to 2002, with percentage of individuals involved in flights longer than 5,000 km (Asia/Europe). For sources see text

Species	Total number of birds ringed from 1980-2002	Total recoveries from 1980-2002	% of recoveries > 5,000 km to/from Asia
Podiceps nigricollis	4,527	34	17.0
Anas clypeata	955	46	2.1
Anas platyrhynchos	14,004	186	1.8
Anas penelope	147	9	11.1
Pluvialis squatarola	240	3	33.3
Calidris ferruginea	5,072	73	1.3
Sterna sandvicensis	829	148	0.6
Total	17,227	499	2.89

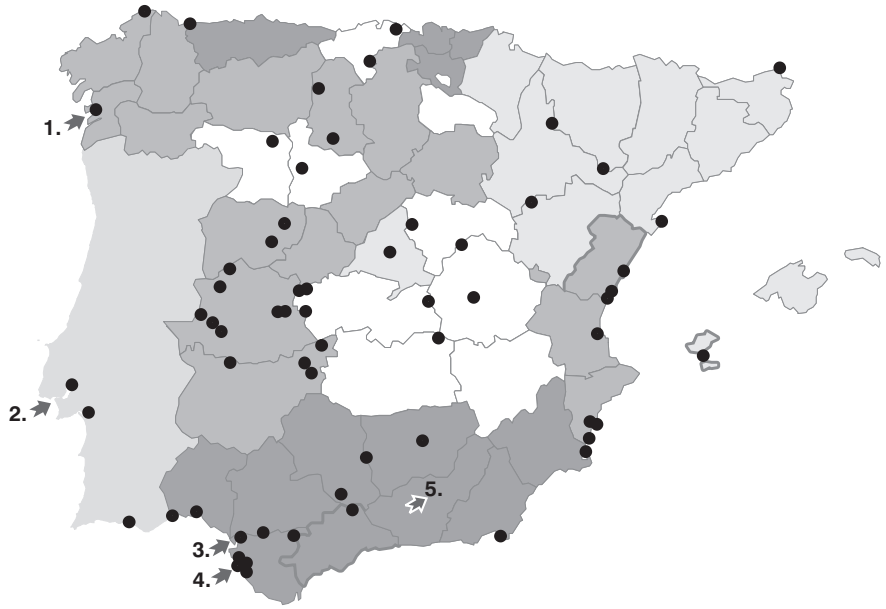

Figure 1. Some main wintering areas of waterfowl and waders in the Iberian Peninsula (modified from Fernández-Cruz *et al.,* 1987). Arrows indicate ring recoveries of birds from Central Asia. 1. Pontevedra estuary. 2. Tagus delta. 3. Odiel delta. 4. Doñana National Park. 5. Baza pond.

south-north migration flyway (Bairlein, 1995; Davidson *et al.,* 1999). However, bird migration is an adaptive and highly versatile behaviour (Pryde, 2002), as a bird species may modify its normal wintering and stop-over areas in only 30 generations (Berthold, 2001). Also, it is well known that some individuals from sedentary stocks, mainly duck species, may pair with migratory mates, moving with them to unfamiliar areas - an evolutionary fact known as «abmigration», a term proposed by Thompson (Bernis, 1966). Another possibility of contact between Asian-European birds comes about because some migratory birds are affected by misorientation and do not migrate in the normal southerly direction from Central Asia to Vietnam but,

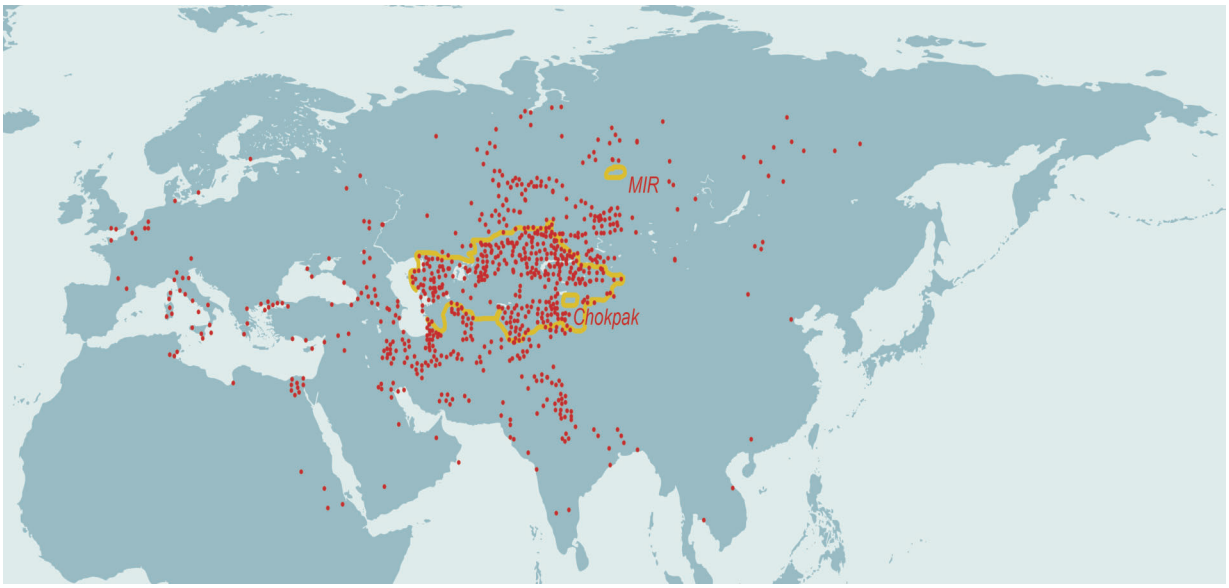

Figure 2. Recoveries of bird species ringed in Central Asia (around Chokpak and MIR ringing areas). The data show the convergence of birds from Europe and eastern Asia into the region (modified from Boere, 1992).

in the opposite one; mainly to north-western Europe (Mead, 1983). This apparent predominance of westward vagrancy by Siberian birds has led to the hypothesis known as «reverse migration» (Phillips, 2000). As far as we know, migratory activity and orientation performance are population-specific, but also quantitative genetic traits can be transmitted even to descendants of non-migratory individuals; and, this transfer can be accelerated if marked changes in global climate should occur, changing migratory populations to sedentary under strongly directed selection in about 40 years (Berthold, 2001). In fact, long distance migrants can winter in the Mediterranean region instead of further south in Africa and an expansion of subtropical populations to higher latitudes could be expected in the future (Alestam *et al.,* 2003). The evolutionary aspects of bird migration are not covered in the present work, but they should certainly be taken into consideration to prevent future disease outbreaks (Banet-Noach *et al.,* 2004).

Although only 2.9% of the birds from the Iberian Peninsular reach the Caspian Sea and Central Asia, this part of the world is a meeting point for birds from southern Asia and Europe and is one of the areas where HPAI transmission between birds from different geographical origins could be possible. The breeding distribution of the species cited maintains an extensive common ground throughout Central Asia and the Caspian regardless of their wintering quarters (Del Hoyo *et al.,* 1996). The large number of waterfowl in Europe and southern Asia, estimated at 2.4 million mallards, 1.8 million wigeons and about 4.1 to 5 million waders (Delany *et al.,* 1999), with concentrations of hundreds of thousands at the southern end of the Caspian, suggests possible contact, although ringing and recoveries from this part of the world are lacking.

It is a well documented fact that some bird species and individuals cross over the Peninsula to wintering grounds in Africa, especially in the northern and western areas of the continent (Moreau, 1972; Mead, 1983). However, this work does not concern African-European bird migration patterns and differences according to species and populations between western and southern Africa ones.

According to OIE (2006) reports, genetic analysis of isolates from Mongolia (July, 2005) show a close genetic relationship to wild bird isolates from the Qinghai Lake outbreak (April/May, 2005). Genetic sequences from virus isolates obtained from the 2005 wild bird outbreaks in Kazakhstan, Russia, Turkey and Rumania and more recently in Italy, France, Slovenia

and the Ukraine, have also established a relationship with the virus strain isolated in China around the Qinghai Lake and Guangdong (Southern Asia, 1996). This indicates that wild birds could contribute to spreading this virus by migration, abmigration and/or misorientation. OIE recommends that a surveillance epidemiological network be set up in order to identify reservoir species for the virus and their movements over long distances. Surveillance should be established in the most important Iberian wetlands, including the marshes of Doñana and Odiel (southern Spain), with 16.3% and 0.69% respectively, of all the wintering waterfowl population in Spain (Martí and Del Moral, 2003), and where 78% of the long distance recoveries were reported. Of course, the seven species observed as occasional migrants from Central Asia to the Peninsula would be considered as potential reservoirs and must be the targeted species of any surveillance. The European Union (OJ, 2006) should consider the inclusion of four of the seven species - *Podiceps nigricollis, Pluvialis squatarola, Calidris ferruginea* and *Sterna sandvicensis*- which are recorded in the present document and are not included in the list of species with the highest risk of having AI in Spain. The Plan of AI monitoring (MAPA, 2006) must, therefore, include these species.

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