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RELATIONSHIPS BETWEEN THE SPREAD OF PATHOGENS AND THE MIGRATORY CONNECTIVITY OF EUROPEAN WILD BIRDS

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ABSTRACT

Among emerging infectious diseases, 75 % are zoonotic. Migratory birds are important to public health because they carry emerging zoonotic pathogens or infected arthropod vectors. Disease is an important factor in the evolution of avian migrations and patterns of migratory connectivity. Research suggests that pathogen densities and diseases may influence the evolution of migratory behaviour. During the annual life cycle, European migratory birds spend: 2—4 months at the breeding locality, approximately 6 months on the wintering grounds, and several months (3 and more) on migration routes. There are many factors which determine when and where an outbreak of a disease may occur. Therefore, a complete understanding of the avian migratory systems has a high priority in the prevention of future outbreaks.

Key words: birds; climate change; infectious diseases, migratory connectivity

INTRODUCTION

The research on wildlife diseases has significantly increased across Europe due to the growing concern of emerging and re-emerging pathogens. This interest has also concentrated on investigations into the risk to human and domesticated animal health.

The aim of this paper was to provide a reference text on links between migration of European wild birds and infectious diseases.

AVIAN MIGRATION

Migration is defined as a large-scale return movement of a population, which occurs each year between regular breeding and wintering areas [16]. Avian migrations occurs primarily in response to seasonal changes in food resources. Food abundance varies with the climate. Within the sphere of migration, there is a whole range of movements from long distance trans-continental or oceanic migration to short distance wanderings [6].

The European territory is included in the Palearctic-Afrotropical migration system [14]. The Palearctic-Afrotropical migration system consists of three migration corridors: East Atlantic, Black Sea/Mediterranean (Central Europe included), and West Asia/West African corridor [1]. European breeding birds migrate mainly through the Euro-African flyway. It was assumed that 1.52—2.91 billion of European passerine and non-passerine birds cross the Sahara desert each autumn [8].

According to the length of the migratory movement or the proportion of species population involved in migration, we can distinguish 3 main categories of avian migrants. The first category are referred to as the partial migrants which form populations consisting of 2 groups of individuals. The first group migrate periodically and the second group consists of non-migratory specimens, which usually reside on the particular area during the whole annual life cycle [24]. Which portions of population migrates and which portion does not migrate is controlled by variable factors that are often unknown. Migration can be initiated by behavioural interactions between dominant and subdominant individuals under intraspecific pressure, which forces them to move away from the breeding grounds [24]. Portions of partial migratory population can differ genetically [19]. Or, partial migration can be initiated by a combination of environmental factors in coincidence with social interactions [7].

The second category of migrants are the short-distance migrants who migrate to specific nonbreeding grounds which are situated not farther than 2000 kilometres from the breeding localities. And the third category are the long-distance migrants which move usually farther than 2000 kilometres from the particular breeding range [20].

IMPACT OF GLOBAL ENVIRONMENTAL CHANGES ON AVIAN MIGRATION

There are many reports which demonstrate that global climatic changes affect populations of migratory birds [22]. Climate can affect birds directly, or indirectly. Different species vary in their ability to compensate for the influences of weather [15]. In migratory species, the climate change has shifted migration schedules in Europe [29].

Spring migration is generally considered more important for birds than autumn migration. Spring migration determines the arrival at breeding grounds, which is critically important for mating territory choice [11]. It was assumed that birds migrate earlier in spring in correlation with warming. In general, long-distance migrants lag behind short-distance migrants in terms of their response on short-term changing climatic conditions on breeding grounds [28].

One of the strongest signals that climate change is affecting avian life histories can be seen in recent shifts in the timing of migration and breeding in many bird species, potentially altering survival of species and populations [3, 5]. Birds can respond to changing climate in four ways:

1. They could adapt facultatively, adjusting their behaviour within its pre-existing limits to cope with changing conditions.
2. Birds could adapt by evolutionary change which would entail genetic modification under the action of natural selection.
3. Birds could change their distributions and migrations so as to remain within regions of a favourable climate.
4. They could respond insufficiently in any of these ways, and so decline to extinction in at least some parts of their range [17].

It is likely that man-made changes to the environment will contribute to changes in the characteristics and patterns of long distance migration. Continued loss and fragmentation of important habitats at stopover sites along major migration corridors will create bottlenecks, resulting in increased displacement and mixing of bird species [21]. These changes will affect also the ecology of avian pathogens [21].

MIGRATORY CONNECTIVITY

During their annual life cycle, European migratory birds spend 2—4 months at the breeding locality, approximately 6 months on the wintering grounds and several months (3 and more) on migration routes.

Movements through a diverse mosaic of biotopes and environmental conditions create a complex of ecological interactions between migrating birds and numerous factors of the environment, biotic and abiotic. These situations can result in exposure to many pathogens, non-native for European ecosystems [26].

Knowledge about migratory connectivity, the degree to which individuals from the same breeding site migrate to the same wintering site, is essential to understand the processes affecting populations of migrants throughout their annual cycle [25]. Consequently, it is crucial to know where birds travel and winter and to what degree individuals from a certain population are using the same migration route or migrate to the same wintering site, i.e. how and to what extent breeding and non-breeding populations are connected [26, 27].

When this connectivity is strong, individuals from one breeding site migrate mainly to one wintering site [27].

MIGRATORY CONNECTIVITY AND INFECTIOUS DISEASES

Among emerging infectious diseases, 75 % are zoonotic; originating principally from wildlife [2]. Migratory birds are important to public health because they carry emerging zoonotic pathogens, either as a reservoir host or by dispersing infected arthropod vectors. In addition, bird migration provides a mechanism for the establishment of new endemic foci of disease at great distances from where an infection was acquired [21].

Understanding migratory connectivity for a population can give insight into adaptive behaviours that reduce pathogens and disease. Understanding the biology and conducting effective conservation of migratory species requires knowledge of migratory connectivity, the geographic linkage of individuals, or populations between phases of the annual cycle [13].

Quantifying the degree to which individuals move from a breeding range to the same nonbreeding region is necessary for understanding how epizootiological events during one phase of the annual cycle influence subsequent phases [12, 23, 26].

THE ROLE OF EUROPEAN WILD BIRDS IN THE SPREAD OF PARTICULAR ZOONOSES

Birds are susceptible to fewer zoonotic agents than mammals, reflecting the evolutionary distance between birds and humans [4]. Despite their lower susceptibility, birds participate effectively in the transmission and spread of zoonoses, even over great distances, by acting as natural hosts, reservoirs and amplifying or liaison hosts for zoonotic agents [10]. The stress of migration can lead to immunosuppression and increased disease susceptibility, as well as reactivation of latent infections [21].

A notable example of HPAI (H5N1) risk is when migrating birds from Asia and northern Europe congregate in sub-Saharan Africa. Migratory birds also interact with populations of domestic and free living sedentary birds at stopover sites or at the end of their journey. This makes concentration points along migration corridors (such as the Straits of Gibraltar, Messina, Bosphorus and Sinai Peninsula) especially important.

Apart from acting as a reservoir of zoonotic agents, migratory birds can be infested with arthropod vectors, which in turn transmit pathogens that can be carried by birds over long distances and may be responsible for diseases of major importance. Borreliosis, or Lyme disease, is the most prevalent vector-borne zoonosis in humans in the Northern Hemisphere, which, a few decades ago, occurred on only an occasional and localised basis [9, 18].

Another prominent epidemiological role of birds (especially wild ones) is to act as liaison hosts, or even amplifying hosts, for some arboviruses (arthropod-borne viruses). They include arboviruses caused by flaviviruses antigenically related to Japanese encephalitis, which often cause acute clinical symptoms (encephalitis) in horses and humans [21].

CONCLUSIONS

There are many factors that determine when and where a disease outbreak will occur; one of these factors is wildlife as a reservoir and vectors for the pathogen. Therefore, a complete understanding of the world's migratory systems is a high priority in the prevention of future outbreaks. The Palearctic-Afrotropical migratory system and its connection with pathogens is both broad and complex. The number of birds involved and the vast area that the migration encompasses, ensures us that additional research is needed.

As the current extent and understanding of migratory birds are limited, tracking is necessary in order to better understand the migration routes, population dynamics, site fidelity, migration timing, origin of pathogens, etc. The surveillance of pathogens in wildlife is in the interest of both veterinary and human medicine.

There have been several epidemics in the past. And wildlife including birds has helped fuel these epidemics by both being reservoirs for the pathogens and by actively spreading the disease. The best way to control and prevent further epidemic outbreaks is to increase our understanding of the migratory systems of birds and the ways of transmission of diseases, in addition to the surveillance of wildlife.

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