



GRIPAVI

Zimbabwe – South Africa

Follow-up mission of the GRIPAVI project

Ecology and Epidemiology of Avian Influenza Virus in Wild Birds in

Zimbabwe Observatory

2 September – 10 October 2008

GAIDET Nicolas



Follow-up mission of the GRIPAVI project

Ecology and Epidemiology of Avian Influenza Virus in Wild Birds in Zimbabwe Observatory

Abstract:

This mission has been implemented in the framework of the GRIPAVI project in order to provide a support to the component Ecology and Epidemiology of Avian Influenza Virus (AIV) in Wild Birds of the Zimbabwean Observatory, and in particular to provide some scientific and technical inputs the two Gripavi PhD candidates, Josphine Mundava and Alexandre Caron.

This mission also provided the opportunity to participate to the symposium “Wild birds and avian influenza in Africa” of the 12th *Pan-African Ornithological Congress* in Cape Town – South Africa, and to present past and current research activities on host ecology of AIV in tropical ecosystem, and in particular the Gripavi project to a large international audience of ecologists and ornithologists. It also provided the opportunity to organise a meeting with the team of the Percy FitzPatrick Institute (University of Cape Town) that develop similar research activities on wild birds and AIV in southern Africa and to discuss potential for collaboration.

1. Schedule:

02-03/09/08: trip Montpellier - Cape Town

04/09/08: meeting with the team from the Percy FitzPatrick Institute at the University of Cape Town

08/09/08: participation to the 12th Pan-African Ornithological Congress in Rawsonville

27/09/08: trip Cape Town – Harare

28/09/08 – 09/10/08: support to the implementation of the component Ecology and Epidemiology of Avian Influenza Virus (AIV) in Wild Birds of the Gripavi project.

09-10/10/08: trip Harare - Montpellier

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2. Activities:

Meeting at Percy FitzPatrick Institute (PFI) at the University of Cape Town:

- Presentation of Cirad research activities on wild bird diseases, recent results on the AIV host ecology in tropical ecosystems and current research activities conducted within the framework of the Gripavi project.
- Discussion on the opportunities of collaboration between the Gripavi and PFI teams on recent results of AIV surveillance in Africa (analysis of patterns of AIV circulation in wild bird at a continental scale) as well as on common current surveys of ecology of AIV wild bird hosts.
- Field visit and participation to a point count of water birds at one of the study site (Strandfontein).

This team from the Percy FitzPatrick Institute, coordinated by Graeme Cumming, is currently running a project, with support from the USAID-funded GAINS initiative, looking at the distributions and movements of ducks and the prevalence of avian influenza viruses in wild duck populations in five sites spread across South Africa, Mozambique, Botswana, and Zimbabwe. The primary aims of their project are to document the prevalence of influenza viruses in wild duck populations in Southern Africa and to obtain a better understanding of the regional movement patterns of wild water birds. Samples for influenza testing are currently collected from ducks at each site. These data are supplemented by standardized duck counts, measures of water quality and quantity, and a range of other satellite image-derived measures of habitat type and quality. Individuals of two species, Red-Billed Teal and Egyptian Geese, are currently tracked using GPS telemetry. The results of the study will contribute to a regional and global understanding of the potential role of wild birds in the epidemiology of avian influenzas, as well as shedding light on patterns of duck movements through the year and the causes of nomadism in duck populations in semi-arid areas.

This PFI team is collaborating with the Gripavi team on the Zimbabwean site (Lake Chivero and Lake Manyame, near Harare) since 2007. Both teams are sharing methodology and protocols for bird counting catching, and sampling. This collaboration provides an opportunity to the Gripavi project to extend our analysis of AIV circulation pattern to other southern African sites. This also provides an opportunity for a wider coverage of Southern African ecosystems, in order to improve our understanding of AIV maintenance process at the continental scale.

12th Pan-African Ornithological Congress in Rawsonville:

- Participation to the symposium “Wild birds and avian influenza in Africa”
- Oral presentation entitled: “Wild bird surveillance for avian influenza and monitoring in Africa and related conservation implications” (see Annex 2): Presentation of recent results on the AIV host ecology in tropical ecosystems and of current research activities conducted within the framework of the Gripavi project and Gains funded operations.

Symposium outlines: Across the world, the Highly Pathogenic strain of Avian Influenza H5N1 has had enormous impacts on people, through policies that affect poultry and backyard farming, wild bird trade and hunting, and wetlands and protected areas, whilst there have also been human cases of the disease, with fatalities. H5N1 arrived in Africa in early 2006, and

soon affected several countries. It was initially widely assumed that migratory wild birds had carried H5N1 from outbreak areas of eastern Europe, though it now appears that combinations of poor biosecurity and poultry trade have been largely responsible for most outbreaks in Africa. Nevertheless, wild birds form an important part of the avian influenza equation, and a range of emergency efforts were made to investigate their role in the potential spread of the disease. This symposium examined these efforts and the impacts of avian influenza on wild bird utilization and conservation in Africa. Information about the conference program is available at http://paoc12.adu.org.za/sciprog_symposia.htm

Follow up and support to the “Avian Influenza in Avian Systems” (AIAS) project:

The Gripavi project is implemented in the Zimbabwean observatory under the “Avian Influenza in Avian Systems” (AIAS) project. It aims at describing and understanding the role of various avian compartments (wild birds, backyard chicken, industrial chicken, and semi-extensive ostrich farming) and their interactions in the process of maintenance and dispersion of Avian Influenza viruses (AIVs).

Gripavi Team:

- Dr. Alexandre Caron, Phd Candidate, Zimbabwean site coordinator
- Miss Josphine Mundava, Phd Candidate from the University of Bulawayo (NUST)
- Dr. Michel de Garine-Wichatitsky, Researcher
- Mr. Ngoni Chiweshe, Research Assistant

The Gripavi team is collaborating with Zimbabwe Veterinary Services and the Percy FitzPatrick Institute.

One-day field trip to the study area was organised to visit each type of study units identified by the Gripavi team (semi-extensive ostrich farming, industrial chicken, backyard chicken and wild birds).

Discussion and meetings with the Gripavi team allowed to provide a scientific and technical support to the current and future research activities implemented under the AIAS project in the Zimbabwean observatory, including:

- Advices to insure the scientific coherence with other research activities conducted in the other Gripavi observatories within the component Ecology and Epidemiology of Avian Influenza Virus (AIV) in Wild Birds.
- Specific discussions about the PhD project of Alexandre Caron on research hypothesis tested, field opportunities, planning of activities (time table of protocols), analysis constrains and potential for valorisation.
- Finalisation of the PhD proposal of Josphine Mundava: a half-day meeting with Dr de Garine-Wichatitsky, Dr Caron and Josphine Mundava allowed reviewing her PhD project, including objectives, research questions, methodologies, protocols and expected outputs (proposal available in Annex 3). Professor Mundy (University of Bulawayo NUST) who had planned to attend this meeting unfortunately could not reach Harare due to transport problems.
- Meeting at the Forestry Commission – Harare: discussion on possibilities to develop a Geographical Information System (GIS) covering the study area, to characterize and quantify the various wild birds' habitats.

- Provide an update literature (research articles) on AIV molecular biology, epidemiology and ecology to both PhD candidates.
- The preparation/finalisation of two abstract submissions for the next Second Pan-European Duck Symposium (23-26 March 2009, Arles, France):
 - ✓ Mundava et al. Trends in Waterbird numbers in Lakes Chivero and Manyame (Zimbabwe), 1993-2003 (Annex 4).
 - ✓ Gaidet et al. Epidemiological investigations of Avian Influenza Viruses in wild birds in Eastern Europe, the Middle East and Africa (Annex 5).

The work with Alexandre Caron also allowed to finalise a research paper entitled “Evolutionary Biology, Community Ecology and Avian Influenza Research” for a re-submission to the Journal “Infection, Genetics and Evolution” (see abstract in Annex 6).

Meeting at the French Embassy with Stephane TOULET, Conseiller de Coopération et d’Action Culturelle:

Presentation of objectives of the wild bird component of the Gripavi project in Zimbabwe and complementarities between longitudinal surveys that will be implemented in both domestic and wild birds in the several African observatories.

3. Recommendations:

Josphine Mundava – PhD project:

_ a support to Josphine Mundava in model development and running would be needed, in order to test the relative role of various ecological factors on the potential introduction, maintenance and spread of AIVs (including H5N1 HPAI) in the wild bird compartment;

_ analysis of currently available database should be done before the end of 2008 for the identification of relevant spatial units and seasonal periods required to characterise the spatial and temporal variability in the composition/ abundance of the wild bird community, in order to plan the field work for the Jan.- Dec. 2009 period;

_ evaluate which of the selected ecological factors, suspected to influence the maintenance of AIVs in wild waterbird community, could be appropriately evaluated from the literature, from the existing or already collected database or would request specific field protocols to be implemented.

Alexandre Caron – PhD project:

_ available or already collected wild bird count data base should be analysed as soon as possible to i) evaluate the range of variability in the data already collected and potentially re-evaluate the sampling effort, ii) identify specific species assemblages in the bird community to formulate hypothesis on the potential process of AIV maintenance within and between the different bird compartment, in order to plan future specific protocols;

_ the development of a GIS database may be helpful to evaluate (and weighted if requested) the representativeness of the actual bird sampling scheme (either during catching or counting operations) compared to the entire study area. Such database may also be requested for Josphine Mundava to develop a habitat utilisation model for wild waterbirds in the study area;

_ the investigation of the availability of water bodies around the study area (<100 km radius) may be useful to evaluate the potential range and timing of dispersal of waterbirds from the study area.

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Annex 2. Oral presentation at the symposium Wild birds and avian influenza in Africa of the 12th Pan-African Ornithological Congress

Title: Wild bird surveillance for avian influenza and monitoring in Africa and related conservation implications

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When highly pathogenic avian influenza (HPAI) H5N1 was first detected in Africa in early 2006, it was widely assumed that wild birds had brought the virus from affected areas in Europe on migration. However, there have been very few cases of HPAI H5N1 in wild birds in Africa and no major die-offs reported. Conversely, HPAI H5N1 has been found in domestic poultry in 11 African countries, with potential epicentres in Nigeria and Egypt. Resources and capacity for wild bird surveillance of Avian Influenza Viruses (AIVs) in Africa are limited. One programme launched by FAO, and coordinated by CIRAD and Wetlands International evaluated occurrence of HPAI H5N1 in healthy wild birds, built surveillance capacity and improved understanding of AIV ecology. Thirty field operations were conducted in 19 countries (13 in Africa) between January 2006 and April 2007. Further wild bird surveillance continues under the GRIPAVI project and GAINS initiative.

Samples were collected mostly from wild waterbirds (Afro-tropical and long distance migrants), and screened by real-time RT-PCR. Around 2% of samples tested positive for low pathogenic avian influenza; four wild Anatidae samples from Nigeria tested positive for HPAI H5N2. Results indicate the possibility for persistence and transmission of AIVs in the Afro-tropics, but no HPAI H5N1 was detected, despite a large sample base (>10,000 birds). An important element was capacity development for wild bird surveillance, achieved through field missions, training courses and workshops. A related satellite telemetry project investigating duck movements in an AIV perspective yielded insights into movements of Garganey *Anas querquedula*, Knob-billed Duck *Sarkidiornis melanotos* and whistling ducks.

HPAI H5N1 presence and related government policies have important conservation implications for wild birds in Africa, though the potential for interactions between waterbird communities and poultry, and patterns of HPAI H5N1 spread do not support a major role of wild birds in virus transmission. Further insights require resource availability and capacity development for wild bird surveillance in Africa, with particular focus at the interface between domestic and wild birds. Wild bird monitoring should be strengthened around potential disease epicentres, along key migratory flyways and in habitats with connectivity to poultry production areas.

Annex 3. Josphine Mundava PhD Proposal

Title: Using Waterbird Ornithological Data in Predicting the Transmission, Maintenance and Spread and AIV in Zimbabwe.

Introduction/Rationale

Waterbirds have long been recognised as a source and reservoir for all subtypes of avian influenza viruses (AIVs) (Tracey *et al.*, 2004, Stallknecht *et al.* 2006). Wild waterbirds are considered to be natural reservoirs of low pathogenic avian influenza (LPAI) viruses (Webster *et al.*, 1992 and Olsen *et al.*, 2006), but high pathogenic avian influenza (HPAI) viruses responsible for high mortality in domestic birds do not have recognised wild bird reservoirs (Gaidet *et al.*, 2008). The AIV occurs naturally in many species of wild aquatic birds and it is maintained in the wild populations. The viruses infect the gastrointestinal tracts of the natural host species but it can also infect the respiratory and tract and other organ systems (Tracy *et al.*, 2004). The viral particles are shed in the faeces for a time shortly after infection, after which viral replication stops, presumably because the immune system has cleared the infection. The virus is transmitted efficiently via bird to bird transmission and faecal shedding into the water supply (Webster *et al.*, 1992, Murphy and Webster 1996). Considerable quantities of viruses are excreted with faeces and this contaminates the water to the extent that the virus may be isolated from untreated lake water where large amounts of waterfowl are found (Webster *et al.*, 1992). The contaminated water may therefore result in infection by faecal/oral route, or possibly by the faecal/cloacal route as a result of cloacal drinking (Alexander, 2006).

The virus can remain infective outside an avian host for up to 35 days in faecal matter in cold moist at 4 °C though less long in warmer conditions (20°C) (Muzaffar *et al.*, 2006).

The amounts of time a virus can survive are largely determined by temperature, surviving for longer in cooler condition (Brown *et al.*, 2007b). Persistence of the virus in the environment also depends on such factors as pH, temperature, salinity and other physicochemical factors (Stallknecht *et al.* 1990, Brown *et al.* 2007b). Ultra violet radiation may also play a role in influencing the period of infectivity. Recent standardised experiments by Brown *et al.* (2007) analysed the tenacity of 8 HPAs of subtype H5 and H7 and 2 H5N1 HPAIV strains in water. Results showed that persistence was inversely correlated with increase in water temperature and salinity. Generally, the factors contributing to AI transmission and its persistence are complex and variability exists between virus subtypes, birds species and environmental factors (Tracey, 2004).

Waterbirds, particularly Anatidae, are natural reservoirs of LPAI and have been implicated as a primary source of infection in HPAI outbreaks. The avirulent nature of AI in ducks may be the result of virus adaptation that ensures its perpetuation (Webster, 1992). The complex interactions, behaviour and ecology of these diverse hosts have not received adequate attention (Stallknecht *et al.*, 2006). There is need to examine the interactions, behaviour and ecology of these waterbirds and link the results to the transmission, maintenance and spread of the avian influenza in waterbird communities in the wild.

To date, research shows that the ecology, behaviour and interactions of waterbirds are important in the transmission and spread of avian influenza. The study aims to address the global questions of how the characteristics of the ecology, behaviour and interactions of waterbirds can provide insights to the understanding of the mechanisms of the persistence and dispersion of the AIV in its natural reservoirs. The project is at the interface between ornithology and epidemiology where the results of ornithology are used in the understanding of AIV epidemiology. The project selects those aspects of waterbird communities that have relevance to the transmission, maintenance and spread of AIV in the environment.

The ecology, epidemiology, genetics and evolution of pathogens cannot be fully understood without taking into account the ecology of their hosts (Olsen *et al.*, 2006). Spread, transmission and maintenance should be looked at in the context of host ecology, particularly bird's behaviour, ecology and interactions.

There are several aspects of behaviour, ecology and interactions that can be used in the prediction of the roles of waterbirds in the transmission of avian influenza. These aspects include: community species composition, waterbird abundance within an area, gregariousness, proportion of juveniles within a population, the use of wetlands by waterbirds, the degree of mixing among species, pH, temperature, habitat sharing and water levels.

As the frequently detected hosts of the H5N1 virus, waterbirds are an appropriate target for active disease surveillance. Birds such as ducks, geese, gulls, shorebirds, herons, egrets, storks, rails, coots, gallinules, cormorants and grebes are common wetland species and as such, are also frequently detected as host to AIVs. If a community is composed of all such bird groups, then the likelihood of AIV presence and transmission among the groups is high.

List of taxa in which H5N1 HPAI virus has been detected in the wild

Order(family)	Common species	Habitat Preference	No. Species detected
Anseriformes Anatidae	Ducks, geese and swans	Wetland, marine	11
Charadriiformes Laridae Scolopacidae	Gulls Shorebirds	Marine,wetland Wetland	3 1
Gruiformes Rallidae	Rails, Coots	Wetland	4
Pelecaniformes Phalacrocoracidae	Cormorants	Marine,wetland	2
Podicipediformes Podicipedidae	Grebes	Wetland,marine	2
Falconiformes Accipitridae Falconidae	Hawks, eagles Falcons	General General	5 1

Source: *FAO 2007*.

The mode of wetland use by a species is also important in the transmission of AIV. If more time is spent in water, then there is a high likelihood of the virus having ample time to infect the host. The presence of a species in a wetland also means that it may come into contact with contaminated water and with other waterbirds.

Feeding behaviour is also important in the transmission of AIV. Dabbling ducks can be used as an example. These ducks tend to feed superficially (skimming the surface of the water for feed), but can also feed on filter mud in shallow waterways. This means that virus particles that are suspended in water or that are in the mud in the shallow water will be ingested and the risk of infection and transmission is increased.

Ducks in water are also reputed to practice 'cloacal sipping' in which water is sucked into the cloaca. This would potentially enhance the spread of infection if the water is contaminated. Differences in virus prevalence between ecological guilds of ducks are likely in part related to the behaviour of the species.

Gregariousness is another factor that may be used to predict a species role in the transmission of AIV. Substantial loss natural wetlands, the attraction of altered wetlands (dams) and the natural biology of species may result in the concentration of waterbirds in smaller habitats. The high density increases the risk of virus transmission, primarily among and between waterfowl and shorebirds that populate these habitats (Efsa, 2008). Waterbirds breeding colonially also have an increased risk in the transmission of AIV. The risk increases with colony size, nest density and the amount of defaecation near the nest.

Roosting concentrations also have a potential risk of spreading AIV either through direct contact between birds (especially in large and dense roosts) or through contact contaminated faeces that would have accumulated at the traditional roosting sites. Species gathering for moulting also have an increased risk of contamination through direct contact and also through faeces.

In a recent study (Gaidet *et al.*, 2008), HPAI genotype was detected in healthy wild birds for the first time. The affected species were the white-faced duck *Dendrocygna viduata* and the spurwinged goose *Plectropterus gambensis*. They both are anatids which is a group of wild birds with a predominant role in the perpetuation of LPAI viruses. Both species forage in shallow water and are highly gregarious outside their breeding season, two ecological factors associated with increased exposure to AIV infection (Wallensten *et al.*, 2007 and Olsen *et al.*, 2006).

The proportion of juveniles in a population is important in the transmission of AIV. Young birds are an area of fast AIV recruitment of LPAI (Medscape, 2006) because of their immunological naivety. The recruitment rate and the juvenile proportion in a waterbird population have been shown to be key factors in the prevalence of AIV. Hinshaw *et al.*, (1980) considered that the perpetuation of AIV in Canadian free-living waterfowl was related to the passage of the virus from adults to juvenile birds on the lakes where birds congregated before migration. It is therefore important to understand the patterns of breeding and recruitment in populations and species in order to estimate the risk of AIV in a specific ecosystem.

Migration is another aspect that can contribute to the spread and transmission of AIV. If AIV is introduced during migration and in the movements during the non-breeding period, further spread can potentially take place by other species coming into contact with these migrants. The degree to which a species mixes with other species is also important in AIV transmission and spread. This behavioural factor is mainly given for the migration and wintering period when species tend to be in mixed flocks.

Environmental parameters can also be used to predict the risk of AIV transmission, spread and maintenance in an ecosystem. Temperature salinity and pH are the main parameters that can be used in the prediction. Seasonal changes in these parameters can be used to predict when the rates of infection would likely be high.

In general, the study aims to address questions related to the epidemiology of avian influenza under an ecological perspective. It will look at the various components of the avian influenza cycle and study the role of various ecological factors associated with various bird species on the maintenance, transmission and spread of the virus in space and in time.

Objectives

- ✚ To address the global question of how the characterization of the ecology of waterbirds can be used as an insight into how avian influenza is transmitted, maintained and spread among species within a waterbird community in space and in time.

- ✚ To assess the responses of waterbird communities to annual cycles of seasonal variations in the habitat.
- ✚ To assess how environmental variables (habitat type, water level, water quality, water depth, prey availability/presence of predators and human disturbance) influence waterbird abundance and diversity. Determine the influence of these parameters on the maintenance, transmission and spread of the virus within a waterbird community.
- ✚ To identify the patterns in the use of the habitats by the whole bird community in the lake systems and identify which biogeographical variables influence the changes in the community.

Testable Hypotheses

- ✚ The composition of a waterbird community can be used to predict the risk of avian influenza virus occurrence in an ecosystem
- ✚ Juvenile birds in a population represent the main reservoir of AIV infection in a population
- ✚ Species which are highly gregarious with a high degree of mixing with other species pose a higher risk of transmitting and being infected by AIV.
- ✚ Species which are migratory pose a risk in the spread of AIV.
- ✚ Environmental parameters can be used to predict the success of AIV transmission in an ecosystem.
- ✚ The mode of habitat use by waterbirds can be used to predict the risk of AIV transmission and spread.
- ✚ Waterbird interactions are a key factor in the transmission of AIVs.

Research Design and Methodology

- ✚ Data collected from Lake Manyame and Lake Chivero.
- ✚ Develop a protocol to stratify the habitats and decide on the sampling effort.
- ✚ Use available data on AIV prevalence in waterbirds to identify species that can be observed to determine interactions.
- ✚ Count data, water depth, rainfall data, temperature, water quality data and habitat assessment data will be carried out from predetermined sample points along the shorelines of the two lakes.
- ✚ Data will be collected once in two months – starting in January 2009 up to December 2009.
- ✚ Use the available 10-year dataset of the two lakes. The data was collected four times a year- January, April, July and October.
- ✚ Use field cards to map the distribution of the species in the whole of Zimbabwe.
- ✚ Use the available data on Zimbabwean wetlands to compare with the acquired dataset.
- ✚ Use the nest record cards to acquire data on the breeding biology of waterbirds in Zimbabwe.

Timetable

- ✚ October to December 2008 – Analysis and write up of the Tracy Couto data.
- ✚ January to December 2009 – Collection of data from Chivero and Manyame lakes, done once in two months. Will result in a total of six counts representing all the seasons.
- ✚ January to June 2010 – analysis of the collected data.
- ✚ June to December 2010 write up the project and papers.

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Annex 4. Abstract submitted at the Second Pan-European Duck Symposium (23-26 March 2009, Arles, France)

Trends in waterbird numbers, community structure and species diversity in lakes Chivero and Manyame (Zimbabwe), 1993-2003.

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Presentation eligible for student awards

Total counts of waterbirds were conducted for two Zimbabwean lakes (Manyame and Chivero) over a ten-year period. The lakes are permanent, artificial and are under government protection. The counts were carried out four times a year (January, April, July and October). In addition, data on lake levels and habitat characteristics were also collected.. This ten year data set covers a full cycle of low and high lake levels and incorporates all seasons. This may form an adequate baseline for further studies aimed at conservation and protection of species that may be declining, as well as conservation of the habitat. Trends in species diversity, species richness and species abundance were quantified in relation to habitat characteristics and lake levels. Statistical analyses were carried out to test for significant differences in species abundance, species diversity and species evenness over the years (and seasons) and between the two sites. A grand total of 39 and 32 surveys were done for lakes Chivero and Manyame respectively, covering all the seasons of the year. Analyses revealed that the most abundant species was the red-billed teal *Anas erythrorhyncha* and the redknobbed coot *Fulica cristata*. The total number of birds censused and the number of species in each survey was positively associated with lake levels and habitat composition. The years with good rains resulted in high lake levels and an increased abundance of herbivore and invertebrate-eater bird species. The drought years with low rainfall resulted in an upsurge of waders on the two lakes. Knowing that waterbirds are the main reservoir (in Europe and North America) of low pathogenic avian influenza (LPAI), we would like in future to understand the population dynamics of some key species of waterbirds in relation to the potential endemicity of some LPAI and possible emergence of HPAI.

Annex 5. Abstract submitted at the Second Pan-European Duck Symposium (23-26 March 2009, Arles, France)

Title: Epidemiological investigations of Avian Influenza Viruses in wild birds in Eastern Europe, the Middle East and Africa

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Abstract: A large scale surveillance program of avian influenza viruses (AIVs) in wild birds was implemented during 2006 and 2007 within the framework of Technical Cooperation Programmes of FAO. More than 16,000 samples were collected and tested from more than 11,000 wild birds in 19 countries. Overall, 2.8% of birds tested positive for AIV by real-time RT-PCR, but no H5N1 HPAI virus was detected, including in birds sampled in countries that had experienced recent avian influenza outbreaks.

However, AIVs of H5N2 subtype with a highly pathogenic viral genotype were detected in four healthy waterfowls sampled in Nigeria. The survival and regional movements of one of this infected bird was monitored through satellite telemetry, providing a rare evidence of a non-lethal natural infection by an HP viral genotype in wild birds. Combined results from molecular analyses and the satellite tracking survey suggests that some AIV strains with a potential high pathogenicity for poultry could be maintained in a community of wild waterfowl.

Results on the prevalence of low pathogenic AIVs in a wide range of wild bird species, in a large variety of ecological contexts and climatic conditions, also provide new insights on the geographical pattern of circulation of AIVs in their natural hosts and on the potential for persistence and transmission of AIVs in tropical and sub-tropical ecosystems. In particular, the relatively high prevalence of AIVs (up to 14%) found in Eurasian ducks in several of their major over-wintering sites during winter months supports the hypothesis that AIVs can persist in wild duck populations all year round, and that these birds may play a role in the perpetuation and transmission of AIVs in the Afro-Eurasian system. Further research investigations on the patterns of circulation of AIVs in wild and domestic birds in tropical regions are currently conducted under the GRIPAVI project in five African observatories.

Annex 6. Abstract of a Research Article re-submitted to the Journal “Infection, Genetics and Evolution” (Elsevier)

Title: Evolutionary Biology, Community Ecology and Avian Influenza Research

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Abstract: The epidemiology of H5N1 HPAI is still unclear despite the efforts of the research community. Studies bringing new insights add more variability in the host-pathogen system and uncertainty in the prediction of local risks. Global analyses of the pathways of wild birds in parallel with virus outbreaks have brought limited conclusions once the raw information was extracted from relevant maps. In this article, we propose an integration of epidemiology, evolutionary biology and community ecology on a local level in a research framework. This multidisciplinary approach aims at understanding the pathogen transmission processes at the interface between different bird groups whether wild or domesticated. We believe that this ecological data brought together with the epidemiological and molecular data is a key element to explore the mechanism of the AIV ecology in their hosts.

Key words: Avian Influenza; Epidemiology; Community Ecology; Evolutionary Biology.