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GROUPE D'ETUDE SCIENTIFIQUE SUR LA GRIPPE AVIAIRE ET LES OISEAUX SAUVAGES

Réponse de la CMS à la grippe aviaire hautement pathogène de sous-type H5N1

Introduction

1. La grippe aviaire hautement pathogène de sous-type H5N1 (HPAI H5N1) est une maladie extrêmement contagieuse qui a affecté des oiseaux captifs, domestiques et sauvages dans plus de 60 pays depuis qu'elle a été constatée pour la première fois en 1997. Plus de 200 millions d'oiseaux domestiques sont morts de l'épizootie ou ont été abattus pour essayer de limiter sa propagation; les économies des pays les plus affectés du sud-est asiatique en ont grandement souffert avec des pertes de revenu estimées à plus de 10 milliards de dollars et il y a eu de sérieuses conséquences pour la santé humaine. En juin 2008, l'Organisation mondiale de la santé (OMS) avait confirmé plus de 380 cas humains, dont plus de 60% mortels. En avril 2005, le premier déclenchement important chez les oiseaux sauvages a été rapporté; plus de 6 000 oiseaux sauvages migrateurs seraient morts au lac Qinghai en Chine centrale. Depuis, le virus a infecté des oiseaux sauvages dans certaines parties de l'Asie centrale, de l'Europe et de l'Afrique.

2. Avant la HPAI H5N1, les rapports sur la HPAI chez les oiseaux sauvages étaient très rares. L'importance et l'étendue géographique de la maladie chez les oiseaux sauvages sont à la fois extraordinaires et sans précédent, et les impacts de la HPAI H5N1 sur la conservation ont été significatifs. On estime qu'entre 5 et 10% de la population mondiale d'oies à tête barrée *Anser indicus* sont mortes au lac Qinghai, Chine, au cours du printemps 2005. Au moins deux espèces menacées mondialement ont été affectées: la grue à cou noir *Grus nigricollis* en Chine et la bernache à cou roux *Branta ruficollis* en Grèce. Environ 90% de la population mondiale de bernaches à cou roux est confinée dans tout juste cinq sites de reproduction en Roumanie et en Bulgarie, pays qui ont tous deux signalé des déclenchements de la maladie, de même que la Russie et l'Ukraine où elles hivernent.

3. Le nombre total connu d'oiseaux sauvages affectés par la maladie a été peu important par rapport au nombre d'oiseaux domestiques, et le nombre d'oiseaux sauvages morts chaque année de maladies aviaires plus communes est beaucoup plus élevé. Une plus grande menace qu'une mortalité directe a été peut-être le développement d'une crainte du public concernant les oiseaux d'eau, ce qui a conduit à des tentatives maladroites de limiter la maladie en perturbant ou en détruisant des oiseaux sauvages et leurs habitats. De telles réponses sont souvent encouragées par des messages exagérés ou trompeurs dans les médias.

4. Suite aux inquiétudes concernant le rôle des oiseaux migrateurs comme vecteurs potentiels de la HPAI H5N1, la Convention du PNUE sur les espèces migratrices (CMS), en étroite coopération avec l'Accord sur la conservation des oiseaux d'eau migrateurs d'Afrique-Eurasie (AEWA), a créé un Groupe d'étude scientifique sur la grippe aviaire et les oiseaux sauvages (Task Force) en août 2005. Il comprend 15 membres et observateurs, provenant d'organes de l'ONU, d'accords multilatéraux sur l'environnement, et des spécialistes d'organisations intergouvernementales et non gouvernementales. Depuis août 2007, le Secrétariat de la CMS et la FAO ont fourni au Groupe d'étude une coordination conjointe.

5. Les membres actuels du Groupe d'étude relèvent de: l'AEWA, Accord du PNUE sur les oiseaux d'eau d'Afrique-Eurasie; de BirdLife International; de la CDB, Convention du PNUE sur la diversité biologique; du CIC, Conseil international pour la conservation du gibier et de la vie sauvage; de la CMS, Convention du PNUE sur les espèces migratrices; de la FAO, Organisation de l'ONU pour l'alimentation et l'agriculture; de l'ISDR, Stratégie internationale de l'ONU pour la réduction des désastres; de Ramsar, Convention Ramsar sur les zones humides; du WWT, Fonds pour les oiseaux sauvages et les zones humides; de la WCS, Société pour la conservation de la vie sauvage et de la ZSL, Société zoologique de Londres. Les observateurs du Groupe d'étude relèvent de: l'OIE, Organisation mondiale pour la santé animale; du PNUE, Programme des Nations unies pour l'environnement et de l'OMS, Organisation mondiale de la santé.

6. Le Groupe d'étude cherche à obtenir le meilleur conseil scientifique sur l'impact en matière de conservation de la propagation de la HPAI H5N1, et l'évaluation du rôle potentiel des oiseaux migrateurs comme vecteur du virus. Il a diffusé un avis sur les causes premières de la propagation de cette maladie et encouragé la mise au point de systèmes de 'détection précoce'. Le Groupe d'étude favorise la diffusion de renseignements objectifs sur le rôle des oiseaux sauvages en tant que vecteurs de la HPAI H5N1 et s'efforce d'éviter des réactions excessives de décideurs qui pourraient nuire à la conservation d'espèces d'oiseaux d'eau et de leurs habitats. Les membres du Groupe d'étude travaillent au moyen de téléconférences, de contacts par courriel et de réunions.

7. Le Groupe d'étude gère également une plateforme unique basée sur le Web concernant la grippe aviaire, la vie sauvage et l'environnement, (AIWEb; www.aiweb.info), par laquelle sont facilités l'échange de renseignements et les communications d'experts sur les sujets en cours et émergeants relatifs à la HPAI H5N1, aux oiseaux migrateurs et à l'environnement.

8. La Résolution 8.27 de la CMS – 'Espèces migratrices et grippe aviaire' - a demandé des réponses intégrées aux niveaux national et international, une capacité de recherche accrue, une meilleure application et un renforcement des normes de biosécurité, la coopération de la communauté des chasseurs, des programmes pour l'éducation et la sensibilisation du public pour ce qui est de la HPAI H5N1, et a fait appel aux Parties contractantes pour qu'elles appuient l'élaboration de programmes à long terme de contrôle et de surveillance des oiseaux migrateurs. La résolution s'oppose vigoureusement à l'abattage des oiseaux d'eau sauvages et à la destruction des habitats de ces oiseaux en réponse à la HPAI H5N1, car ces mesures n'auraient pas été conformes à la sage application recommandée par les Articles 1 et 8 de la CDB et auraient pu exacerbé le problème en entraînant une dispersion supplémentaire des oiseaux infectés. La résolution a également appuyé la poursuite du travail du Groupe d'étude.

Evolution depuis la huitième session de la Conférence des Parties à la CMS (COP 8)

9. Depuis COP8, le Groupe d'étude a tenu neuf téléconférences, deux réunions techniques, a organisé un événement sur la grippe aviaire dans le cadre de la COP9 de la CDB, a fourni un certain nombre de conseils à des gouvernements en réponse à la HPAI H5N1, a produit divers documents et publications en plusieurs langues, a tenu à jour un site Web et a participé à des réunions internationales sur la HPAI dans le monde fournissant des renseignements modérés et scientifiques sur le rôle des oiseaux sauvages dans la propagation de la HPAI H5N1.

10. A la première réunion technique du Groupe d'étude, un séminaire scientifique sur 'La grippe aviaire, l'environnement et les oiseaux migrateurs' (Nairobi, Kenya; 10-11 avril 2006), assistaient plus de 50 experts dans les domaines de la virologie, de l'épidémiologie, de la santé humaine et animale, de l'élevage de volailles, de l'écologie et de la conservation. Le séminaire s'est penché sur les dernières études scientifiques concernant l'évolution et la propagation de la lignée asiatique de la HPAI H5N1, ses impacts sur les oiseaux sauvages et l'environnement au sens large, et a débattu des problèmes relatifs aux risques d'une autre transmission et du risque effectif de stratégies d'atténuation. Les recommandations du séminaire figurent à l'Annexe 1 du présent document et les travaux complets dans le document d'information UNEP/CMS/Inf.9.17: Le Groupe d'étude scientifique sur la grippe aviaire et les oiseaux sauvages. Le séminaire a reconnu que le Groupe d'étude serait le principal mécanisme pour mettre en œuvre les recommandations.

11. La seconde réunion technique du Groupe d'étude, un atelier international sur 'Les leçons pratiques apprises' (Aviemore, Ecosse, 26-28 juin 2007), a conclu que les futurs déclenchements doivent être traités rapidement par des experts en oiseaux sauvages ainsi que des vétérinaires et autres spécialistes. La réunion a estimé que si les oiseaux sauvages sont affectés par le virus, les oiseaux domestiques, spécialement l'industrie et le commerce de la volaille, détiennent la clé pour limiter une future propagation internationale. En outre, il y a un besoin permanent de développer davantage la capacité interministérielle nationale et la collaboration interdisciplinaire ailleurs pour répondre aux défis posés par la HPAI H5N1. Les conclusions et recommandations de l'atelier figurent à l'Annexe 2 au présent document et les travaux complets dans le document d'information UNEP/CMS/Inf.9.17: Le Groupe d'étude scientifique sur la grippe aviaire et les oiseaux sauvages.

12. Un séminaire tenu conjointement par la CMS et le Musée Koenig en mai 2008 sur 'Animaux, humains et maladie: Question croisée pour la conservation de la biodiversité' traitait le sujet de la grippe aviaire dans le contexte plus large de la santé de la vie sauvage et suggérait d'adapter les méthodes qui ont été mises au point pour le traitement de la HPAI H5N1 à d'autres maladies de la vie sauvage. Le séminaire se tenait à Bonn en tant qu'événement marginal de la COP9 de la CDB. Le séminaire soulignait à nouveau la nécessité d'accroître les capacités nationales pour répondre aux défis posés par la HPAI H5N1. Notamment, une préparation aux déclenchements par une planification de circonstance et une évaluation des risques a été soulignée. Le séminaire a souligné également la nécessité de considérer des perspectives à long terme et intégrées pour répondre aux défis posés par ces maladies. La réponse mondiale à la HPAI H5N1 fournit une occasion importante d'apprendre et de créer des moyens d'action pour assurer une surveillance de la maladie affectant la vie sauvage et la gestion de l'habitat afin de réduire les risques associés. Ceci aidera à contrôler les maladies émergentes et ré-émergentes de la vie sauvage qui pourraient avoir des impacts étendus sur l'agriculture, les économies, la vie, la santé humaine et la conservation de la vie sauvage.

13. Les documents préparés par le Groupe d'étude ou avec des intrants provenant du Groupe d'étude comprennent une édition révisée de la brochure d'information du Groupe d'étude (maintenant disponible en sept langues); les travaux de l'atelier sur la grippe aviaire et la vie sauvage: 'Les leçons pratiques apprises' (Aviemore, Ecosse; 26 – 28 juin 2007); un résumé scientifique sur la grippe aviaire et ses implications sur la vie sauvage et la conservation (voir Annexe 3); des projets de résolutions et des directives pour la COP9 de la CMS, la MoP4 de l'AEWA et la COP10 de Ramsar. Les autres publications relatives à la grippe aviaire diffusées par la CMS peuvent être trouvées sous le lien suivant http://www.cms.int/avianflu/index.htm.

14. Le résumé scientifique (voir Annexe 3) a été élaboré pour fournir un résumé de ce que l'on connaît actuellement sur la grippe aviaire et la façon dont la maladie influe sur la vie sauvage et la conservation. Le document donne une définition de la grippe aviaire, décrit comment survient le virus de la HPAI, étudie la propagation de la HPAI H5N1, dont les principaux déclenchements chez les oiseaux sauvages et précise les implications de la HPAI H5N1 en matière de conservation. Le document fournit une information scientifique de base à l'intention des décideurs, du public et de la presse. La déclaration scientifique sera soumise à la COP10 de Ramsar et à la MoP4 de l'AEWA pour approbation, de même qu'à la COP9 de la CMS.

15. Le site Web sur la grippe aviaire, la vie sauvage et l'environnement (Wildlife and the Environment) (AIWEb; www.aiweb.info) a été lancé par le Groupe d'étude en automne 2006 et est régulièrement mis à jour par le coordinateur du Groupe d'étude. Le site contient de nouvelles mises à jour, des documents clés, des renseignements sur les sujets actuels et divers autres données. En outre, il fournit une plateforme publique pour l'échange d'informations et la communication sur des questions actuelles et émergentes relatives à la grippe aviaire et aux oiseaux sauvages, et reçoit environ 5 000 visiteurs par mois. Pour qu'il soit une ressource active, actuelle et utile, une collaboration permanente des membres du Groupe d'étude et autres experts contribuant au site Web est essentielle et très encouragée.

Coordination du Groupe d'étude et futurs projets

16. Un financement est nécessaire pour garantir la continuation effective des travaux du Groupe d'étude. Ce financement sera d'abord utilisé pour la gestion de l'AIWEb, la production de publications et l'organisation d'événements. Le Wildfowl & Wetlands Trust (WWT) a été sollicité par contrat pour couvrir un certain nombre de tâches de coordination effectuées précédemment par un coordinateur basé à la CMS. Le travail permanent du Groupe d'étude est appuyé dans les projets de résolutions soumis à: la COP9 de Ramsar, la MOP4 de l'AEWA et la COP9 de la CMS.

17. En plus des téléconférences régulières, le Groupe d'étude envisage d'organiser sa troisième réunion technique en 2009 comme suite des réunions réussies de Nairobi et d'Aviemore (voir UNEP/CMS/Inf.9.17: Le Groupe d'étude scientifique sur la grippe aviaire et les oiseaux sauvages).

18. Le Groupe d'étude continuera de fournir des renseignements scientifiques et des conseils sur le rôle des oiseaux sauvages dans la propagation et la perpétuation de la HPAI H5N1 en participant à des réunions internationales, en produisant des documents d'information, en publiant des renseignements sur l'AIWEb et en communiquant par courriel ou autre méthode adéquate.

Action requise:

La Conférence des Parties est invitée à:

a) fournir, par l'intermédiaire du Groupe d'étude scientifique sur la grippe aviaire et les oiseaux sauvages les intrants pertinents sur les mesures pratiques pour réduire le risque de transmission de la maladie entre les oiseaux sauvages, captifs et domestiques, aux agences élaborant des plans de circonstance et de gestion des zones humides ayant trait à la HPAI;

b) collaborer avec le Groupe d'étude sur les espèces migratrices en tant que vecteurs de maladies et le Secrétaire exécutif pour faire des recommandations concernant la nature et l'étendue des risques associés à d'autres maladies chez les espèces migratrices, et les domaines possibles de mesures susceptibles d'être prises par des parties contractantes en abordant ce problème;

c) réaffirmer les dispositions de la Résolution 8.27sur les espèces migratrices et la grippe aviaire hautement pathogène, et en particulier:

   i. la nécessité d'intégrer totalement les méthodes, tant au niveau national qu'international, pour traiter la HPAI et autres maladies animales en apportant une expertise de gestion en matière d'ornithologie, de vie sauvage et de zones humides avec ceux qui sont traditionnellement responsables de la santé publique et des zoonoses, dont une expertise vétérinaire, agricole, virologique, épidémiologique et médicale; et

   ii. la nécessité pour les gouvernements d'appuyer des programmes de contrôle et de surveillance coordonnés, bien structurés et à long terme pour les oiseaux migrateurs afin d'évaluer, notamment, les risques de maladies actuelles et futures, en faisant le meilleur usage possible des projets existants et en les développant, dont ceux qui ont été élaborés depuis 2005;

d) féliciter les membres du Groupe d'étude pour leurs efforts inlassables et leurs résultats au cours de la période 2005-2008, qui ont apporté une contribution significative pour améliorer la compréhension et la prise de conscience des causes du rôle des oiseaux sauvages dans la propagation de la HPAI et des réponses à y apporter;

e) demander au secrétaire exécutif de continuer à agir en tant que coordinateur du Groupe d'étude scientifique sur la grippe aviaire et les oiseaux sauvages en partenariat avec la FAO et avec l'engagement du Conseil scientifique de la CMS;

f) approuver le résumé scientifique sur la grippe aviaire hautement pathogène H5H1: Considérations sur la vie sauvage et la conservation, préparé par le Groupe d'étude scientifique et figurant à l'Annexe 3 du présent document; faire appel à d'autres organes pertinents dont la FAO, le PNUE et les MEA pour approuver cette déclaration et demander au Secrétariat d'assurer la diffusion et la compréhension maximales de cette déclaration;

g) convenir de fournir un financement approprié au budget 2009-2011 de la CMS pour les travaux de la CMS concernant le Groupe d'étude et les travaux relatifs à la grippe aviaire, dont les activités sur la sensibilisation et la création de moyens d'action;

h) approuver un projet de résolution à présenter à la COP9 de la CMS en réponse aux défis des maladies émergentes et ré-émergentes chez les espèces migratrices.

Annex 1: Recommendations of the first technical meeting of the Task Force, a scientific seminar on 'Avian Influenza, the Environment and Migratory birds' (Nairobi, Kenya; 10-11 April 2006)

The goal of the meeting was to address the migratory bird and environmental aspects of the highly pathogenic avian influenza (HPAI) subtype H5N1 epidemic.

Sound scientific information, including an understanding of the environment and migratory bird populations, is a necessity for understanding the HPAI H5N1 epidemic.

HPAI H5N1 is an avian virus. Humans and other mammals are currently aberrant hosts.

H5N1 is considered to have been spread between countries by a number of different known vectors, including the movement of live poultry and its by-products, legal and illegal trade in birds, equipment associated with these industries, movement of people, and migrating waterbirds.

The current situation is unique in that the ecology and epidemiology of Asian lineage HPAI H5N1 differs from that observed for previous Avian Influenza Viruses (AIVs). In the present epidemic disease occurs in a wide range of species that include poultry, wild birds, humans and other mammals.

Surveillance and Early Warning System

1. Early detection is essential for the control or eradication of Asian lineage HPAI H5N1.

2. FAO, OIE and WHO – Global Livestock Early Warning and Response System (GLEWS). It has the potential to be enhanced (and must be) to also track the spread of HPAI H5N1 in populations of wild birds. The integration of The Global Avian Influenza Network for Surveillance (GAINS) into this EWS is encouraged.

3. This system must be rapid, transparent and have local, national and international levels.

Risk Assessment

4. All countries should undertake risk assessments which should be transparent, structured, science-based and make use of all available knowledge.

Research Needs

5. We need to increase research on various aspects of the epidemiology and ecology of H5N1 in wild bird populations and the environment. These include:
   - Prevalence of H5N1 in various wild bird populations.
   - Analysis of existing ringing and monitoring data and implementation of targeted work to increase understanding of migratory systems.
   - Ecology of virus in the environment.
   - Natural mortality rates in wild bird populations.
   - Wild bird susceptibility to H5N1 among high risk species.
   - Effective measures to reduce spread of H5N1 between wild birds and poultry.

Other Short and Long-term Needs

6. We must collate data available on trade issues to fully understand the epidemiology of the disease.

7. The development of compensation policies for agricultural losses and for impacts on protected areas must be proactively established.

8. We need to effectively communicate with the media, and ultimately educate the public and policy makers using facts.

9. Interplay between the agriculture, animal (domestic and wildlife) health, human health, ecosystem health, and socio-cultural factors should be emphasized.

10. Maintaining and developing collaborative approaches to address the multiple and complex issues raised by the international spread of HPAI H5N1 will prove to be critical to long-term success.

11. Resources are required to strengthen and broaden the Scientific Task Force on Avian Influenza and Wild Birds to carry forward these recommendations.

Annex 2: Conclusions and Recommendations of the second technical meeting of the Task Force, an international workshop on 'Practical Lessons Learned' (Aviemore, Scotland, June 2007)

The Aviemore workshop identified a number of important conclusions and recommendations for future action. A central theme running through most of these is the continuing need to further develop national inter-ministerial capacities within governments and inter-disciplinary collaborations elsewhere to respond to the challenges posed by H5N1 HPAI - not only in reacting to cases of disease occurrence, detection of infection, or outbreaks, but also preparing for these through contingency planning and risk assessment. Central to this activity is the close and integrated working of various elements of the governmental and non-governmental sectors, bringing together the complementary expertise of epidemiologists, veterinarians, virologists, biologists and ornithologists.

Whilst much attention has been focussed on H5N1 HPAI, other H5 and H7 HPAI subtypes, as well as other avian-borne diseases, also pose major risks for the poultry industry. Developing wildlife surveillance programmes and enhancing biosecurity in relation to avian influenza raises issues common to risks from other zoonoses[1]. The workshop stressed the need to take longer-term, inter-disciplinary and integrated perspectives in responding to the challenges posed by all these diseases.

Contingency planning, risk assessment and response strategies

1. The workshop condemned the continued misplaced practice of actively killing wild birds or destroying their nest sites and wetland habitats in response to disease detection or perception. This is contrary to the recommendations of the UN Food and Agriculture Organisation (FAO), the World Organisation for Animal Health (OIE), World Health Organisation (WHO) and also of the Contracting Parties to intergovernmental treaties such as the Ramsar Convention on Wetlands, the Convention on Migratory Species (CMS) and the African-Eurasian Waterbird Agreement (AEWA). Such approaches to the prevention or control of HPAI are wasteful, damaging to conservation and have no scientific basis. They may also exacerbate the problem by causing further dispersion of infected birds. It highlights the need for policy and management decisions to be based on evidence.

2. There is an important and urgent need to develop national preparedness plans through drafting broad-ranging contingency measures. These should involve not only statutory and other regulatory authorities but also those of the non-governmental sector. Scenario-setting and training exercises are critical to enhance understanding of issues and the responses that will be necessary in the event of disease or infection detection in the country.

3. National contingency planning and preparedness require strong inter-agency/ministry collaboration as well as political support within governments from the highest levels possible. The inter-disciplinary joint collaboration of different ministries (to include at a minimum, Agriculture, Environment, Forestry and Health), and organisations directly results in greater capacity and complementary expertise. Specifically, those ministries and

1 Such as Japanese encephalitis, West Nile virus infections, Crimean-Congo haemorrhagic fever, Equine encephalidities (Venezuelan, Eastern or Western).

agencies with authority and expertise in wild bird science and management need to be included in contingency planning.

4. Guidance on best practice contingency planning should be further developed by relevant international organisations including FAO and OIE. The collation and publication of 'best practice' case studies would be valuable.

5. There continues to be a need to learn from each case of infection by H5N1 HPAI. This would greatly assist with developing better understanding of the epidemiology of H5N1 HPAI. It is important that there should be routine inclusion of ornithological experts in field outbreak investigation or response teams, including at poultry farms. The development of national and international registers of experts able to assist in such missions would be valuable. There is a need to add from a wildlife perspective, protocols that supplement current outbreak investigations at poultry farms, in order to evaluate the role that wild birds may play in disease introduction there, or the potential for disease to be spread from farms into wild bird populations.

6. There is a need to develop international best practice guidance related to responses to cases or outbreaks of infection in wild birds with specific considerations for those events occurring in protected areas or nature reserves. This includes guidance on measures to reduce risks at sites of conservation importance for susceptible birds. The Task Force should help stimulate such guidance.

7. A 'lessons learnt' review should always be undertaken following the application of an HPAI contingency plan and/or outbreak of infection, and any conclusions concerning how better to improve responses or preparedness subsequently implemented.

8. There is a need to integrate responses and strategies for avian influenza and similar zoonoses into Agreements and Action Plans developed under the Convention on Migratory Species, such as the African-Eurasian Waterbird Agreement and the Siberian Crane Memorandum of Understanding.

Surveillance and early warning systems

9. Poor identification and reporting to the OIE remains a major concern. Analysis of recent reports to OIE where wildlife is part of the outbreak or die-off records, often lack species identification using binomial standard nomenclature, information on the precise location and timing of infection, as well as the means by which cases are detected. These deficiencies constrain improved analysis in understanding of the H5N1 HPAI epidemiology. Task Force members should draft a letter to the OIE Scientific or Standards Committee for submission by the Task Force Chair to request the OIE in enhancing member countries' reporting in these respects and so improve the quality of data registered and disseminated. Photographic documentation of affected species should be strongly promoted. The European Commission has developed valuable standards related to the photography of wild birds as an aid to identification. These should be considered for inclusion in relevant FAO and OIE best-practice manuals and other international guidelines. Furthermore, exact reporting of outbreak locations rather than the location of the reporting institute or ministry should be strongly promoted.

10. Openly accessible data and information on the location and extent of avian influenza surveillance, and results in wild birds are important to help build international

understanding of the ecology of this virus. To this end, there would be clear benefit to expanding the use of the Global Avian Influenza Network for Surveillance (GAINS) open database and mapping system to be included as the desirable wild bird module of the Global Early Warning System (GLEWS) for transboundary animal diseases, including zoonoses— a joint initiative of FAO, OIE and WHO. Additionally, the GAINS information management system has the potential to serve the needs of many stakeholders and would benefit from more widespread mandates for its use and recognition by the relevant major organisational stakeholders, in particular FAO, OIE, WHO, UNEP, Wetlands International and BirdLife International.

11. Understanding shared data is only possible if these represent the same information. In this respect the development of international common standards is particularly important, not only as these relate to field-based methodologies (*e.g.* different types of sampling) but also to laboratory diagnostic techniques. The continued development of guidance from FAO and others is essential.

12. It is highly desirable that long-term programmes for avian influenza surveillance (H5N1 HPAI and other LPAI) are established against precisely defined objectives. These will help give a better understanding of incidence of AI in healthy wild birds. Establishment of such programmes will be difficult (*e.g.* in relation to the expected very low prevalence of AI viruses) but nonetheless continuity is an important objective.

13. FAO guidance on the planning and execution of avian influenza surveillance programmes should be further developed, possibly producing separate products for different target audiences. This might also include simplified publications for field audiences.

14. Whilst historically most research into avian influenza has related to ducks, geese, swans and waders, surveillance in the Far East has increasingly detected H5N1 HPAI in a number of other dead birds, traded birds, scavengers and predators. Some of these species, especially those that live in association with people, have the potential to act as 'bridge' species and as foci of infection. Whilst maintaining focus on waterbird surveillance, it is important that such species are included in surveillance programmes where risks are high or disease occurrence is entrenched in the poultry sector, or the disease has become endemic in the country or region.

15. The development of more strategic approaches to surveillance at regional or wider scales should be encouraged through appropriate mechanisms. Parameters to be considered in such developments include migratory patterns of higher risk species and the risk of such species mixing either with other wild species and/or with poultry. This should be followed up by capacity development in terms of establishing logistic as well as human resource competence. In the short-term, this is perhaps most feasible for developed countries, from where learning and programmes can be transferred to other regions.

Epidemiology: tracing sources of infection

16. The ultimate objective of structured epidemiological investigations of outbreaks in domestic poultry should be to identify the most likely source of infection so that the population attributable risk can be quantified. This allows assessment of the population attributable risks as related to the potential means of introduction of infection to domestic flocks so that this can then be used to estimate the proportionate role of the various

potential means of introduction of infection, *e.g.* poultry, poultry products, fomite transmission, wild birds, *etc*. This allows the most relevant and efficient control measures to be put in place.

17. A central element of national contingency planning should be the establishment of multi-disciplinary epidemiological teams which should involve epidemiological, veterinary, virological, biological and ornithological expertise. There are good examples of the success of this approach which demonstrates the advantage of bringing together expert ornithologists so as to be able to advise veterinarians and epidemiologists. The establishment of such national Ornithological Expert Panels is strongly recommended.

18. There are massive international movements of poultry and poultry products, although full details of these are poor, especially for informal or illegal trade. It remains an important priority to develop better information about the national and international trade in poultry and poultry products at various scales, including transparency issues in the industry – which implies for a healthy dialogue to be promoted. As part of the process of tracing bird movements it would be valuable to undertake more field research on market chains and sales so as to better understand the nature and extent of the poultry or ornamental bird trade, fighting cock exhibits, and the like, as well as giving special emphasis to trade through wet (live bird) markets.

19. The Task Force should stimulate the development of accessible guidance which gives general principles for epidemiological investigations related to a range of different outbreak and infection scenarios, as well as best practice case studies, which would have educational value.

20. Training in epidemiological principles is important, especially where there is limited national capacity. Organisations represented on the Task Force should consider how they might assist the development of such training.

21. In regions where synthesised information on the distribution and movements of wild birds does not exist, there remains an important need to gather, collate and provide such information to aid both epidemiologists and decision makers. This should include tools that summarise the likely bird movements at various scales and for various periods.

22. Telemetry provides a valuable tool for better understanding of temporal and spatial movements of wild birds especially in relation to epidemiological investigations. The further use of this technology should be promoted.

23. To more readily understand the spread of infection it is crucial that there is accurate knowledge of the timing and sequence of events (‘time-lines’). Time-lines, together with an understanding of which species are involved and exact locational information are all crucial to the generation of hypotheses that can then be used to direct subsequent epidemiological investigations and conduct meaningful phylogenetic studies based on genome sequencing data. The importance of rapid, official reporting to OIE was stressed..

24. The results of epidemiological investigations should always be published, including where these are inconclusive. Awareness of these would be facilitated by establishing hyperlinks to an international register of such investigations maintained on OIE’s web-site. All organisations involved in the Task Force should continue to encourage

transparency in reporting and openness in data sharing. The reporting of negative data is crucially important.

Communication, education and public awareness

25. Those involved with avian influenza should proactively work with the media to enhance the accuracy of their reporting of science, thus improving public understanding. This should particularly involve the communication of positive messages as well as responses to negative ones. To this end, targeted briefings of journalists are helpful. The development of much more effective communication strategies is necessary to give policy makers, stakeholders and the general public more balanced information on the real levels of risk and appropriate responses.

26. Organisations should identify specific, informed members of their staff who are responsible for media briefings and who work on contingency and communications planning. They should "expect the unexpected" and prepare for it. They should confine themselves to areas of expertise and avoid comment about other issues. Briefing of media should always be evidence-based and avoid speculation in the absence of evidence. The accuracy of facts supplied by others should be repeatedly checked before passing these to the media. Much useful information is available on the Task Force web-site (www.aiweb.info).

27. Task Force members should use the booklet *Avian Influenza and Wild Birds* for media briefings and promote its use by others. It should be reviewed and updated as necessary. English, French, German, Spanish, Russian, Chinese and Arabic versions are now available. However, the Task Force should also develop a media 'tool kit' that brings together national and organisational media best practice and Frequently Asked Questions. This should include factual information that may be adapted for specific national needs and uses.

28. At present much guidance related to H5N1 HPAI is published in a limited range of languages. It is important to translate guidance into a wider range of other, and more local, languages so as to facilitate its dissemination.

29. The Task Force should stimulate the publication of simple bird identification guides in local languages so as to assist field-based staff responses to cases of infection. A web-based list or directory of experts that could assist (at a distance) in identification of bird species based on photographs would also be highly desirable.

30. The degradation of the health of ecosystems as documented by the Millennium Ecosystem Assessment and especially in the decline in extent and condition of wetlands is considered to have had a rôle in the evolution and spread of H5N1HPAI. This environmental change has created the conditions where there is closer contact and mixing between people, livestock (including poultry and domestic ducks), and wild waterbirds, potentially resulting in cross-infections. Reducing the opportunities for such contacts through preventing further loss of wetlands, improving mechanisms for the maintenance and wise use of wetlands is an important long-term requirement. To this end it would be valuable to develop and disseminate practical guidance, *inter alia* in collaboration with the Ramsar Convention.

Research and data needs

31. There remains a need to develop a better understanding of the behaviour and ecology of 'bridge' species, as well as other means of the local or short distance spread of HPAI infection, such that this information might be used to develop enhanced guidance on biosecurity and contribute to risk analysis.

32. It would be valuable to have a better understanding of the duration of viral shedding by bird species likely to be held in captivity. This would inform possible response strategies for zoos and collections in the event of infection outbreaks.

33. Better monitoring and surveillance for avian influenza within markets that trade in wildlife, is highly desirable. This should include research into which species are traded, their origins and movements.

34. There remains a need for better information on relevant cultural and religious practices, such as the widespread purchase and release into the wild of birds at certain times of the year (*e.g.* merit releases), and how those practices might be safeguarded but at the same time, minimize the risk of disease spreading to humans, wild birds and poultry.

35. H5N1 HPAI has affected several non-avian species, although knowledge of its ecology in these taxa is particular poor. Those species that have been infected are thought to be accidental, dead-end hosts, and there is no current evidence for them being involved in the maintenance of infection in any area. However, there is a need to continue to assess this issue during epidemiological investigations as it is possible that in the future a mammalian species may become a maintenance host and thus spread H5N1 HPAI locally.

36. Knowledge of the degree to which H5N1 HPAI may be passed between different bird species (and whether this happens asymptomatically or not) is important information that could help refine risk assessments. Research which leads to the development of serological tests for avian influenza antibodies in different species of birds will ultimately provide the most useful epidemiological information. Serological testing in past LPAI outbreaks has given important insights. Basic research on the immunological responses to H5N1 HPAI infection by birds (possibly using a representative avian model in one species) is important. A current priority is to develop validated serological diagnostic tests for the full range of bird species potentially at risk.

37. There remains a need to continue to gather, collate and co-ordinate data and information on wild bird distributions, their movements, stop-over sites and flyways. Satellite telemetry is a particularly valuable tool for this work. It is also important to continue to gather data at site level, since such local information is very limited in many parts of the world.

38. For many, access to the most recent scientific literature is constrained by inability to subscribe to expensive on-line journals, thus hindering understanding. The Task Force should help tackle this issue, possibly by working with authors to make the most relevant scientific literature available on AIWeB and web-based resources, or by investigating the potential for corporate sponsorship.

Finances

39. Recent events with respect to avian influenza have focussed attention on the need for resources to develop national veterinary capacity and programmes of surveillance and monitoring for wildlife diseases, especially zoonoses, but also to develop background information on wild birds, and especially their movements. A good start has been made, but there remains the need for further investments, particular to allow the development of the wildlife disease sector.

40. The Scientific Task Force on Avian Influenza has provided a valuable co-ordination function between its many collaborating organisations. Financial resources are required to facilitate its continued operation.

Annex 3: Scientific summary of highly pathogenic avian influenza H5N1 of Asian lineage: wildlife and conservation considerations

Definition of avian influenza

Avian influenza is a highly contagious disease caused by influenza A viruses, affecting many species of birds. Avian influenza is classified according to disease severity into two recognised forms: low pathogenic avian influenza (LPAI) and highly pathogenic avian influenza (HPAI). LPAI viruses are generally of low virulence, while HPAI viruses are highly virulent in most poultry species resulting in nearly 100% mortality in infected domestic flocks (Center for Infectious Disease Research & Policy 2007). The natural reservoir of LPAI viruses is in wild waterbirds – most commonly in ducks, geese, swans, waders/shorebirds and gulls (Hinshaw & Webster 1982; Webster *et al.* 1992; Stallknecht & Brown 2007).

To date, influenza A viruses representing 16 haemagglutinin (HA) and nine neuraminidase (NA) subtypes have been described in wild birds and poultry throughout the world (Rohm *et al.* 1996; Fouchier *et al.* 2005). Viruses belonging to the antigenic subtypes H5 and H7, in contrast to viruses possessing other HA subtypes, may become highly pathogenic having been transmitted in low pathogenic form from wild birds to poultry and subsequently circulating in poultry populations (Senne *et al.* 1996).

Notifiable avian influenza is defined by the World Organisation for Animal Health (OIE) as "an infection of poultry caused by any influenza A virus of the H5 or H7 subtypes or by any avian influenza virus with an intravenous pathogenicity index (IVPI) greater than 1.2 (or as an alternative at least 75% mortality)" as described by the OIE's Terrestrial Animal Health Code (OIE 2007).

Genesis of highly pathogenic avian influenza viruses

In wild waterbirds, LPAI viruses are a natural part of the ecosystem. They have been isolated from over 90 species of wild bird (Stallknecht & Shane 1988, Olsen *et al*. 2006; Lee 2008), and are thought to have existed alongside wild birds for millennia in balanced systems. In their natural hosts, avian influenza viruses infect the gastro-intestinal tract and are shed through the cloaca; they generally do not cause disease although some behavioural anomalies have been reported, such as reduced migratory and foraging performance in Bewick's Swans *Cygnus columbianus bewickii* (van Gils *et al*. 2007); instead, the viruses remain in evolutionary stasis as indicated by low genetic mutation rates (Gorman *et al.* 1992; Taubenberger *et al.* 2005). When LPAI viruses are transmitted to vulnerable poultry species, only mild symptoms such as a transient decline in egg production or reduction in weight gain (Capua & Mutinelli 2001) are induced. However, where a dense poultry environment supports several cycles of infection, the viruses may mutate, adapting to their new hosts, and for the H5 and H7 subtypes these mutations can lead to generation of a highly pathogenic form. Thus, HPAI viruses are essentially products of intensively farmed poultry, the incidence of which has increased dramatically with the greatly enhanced volume of poultry production around the world (GRAIN 2006; Greger 2006). In the first few years of the 21^{st} century the incidence of HPAI outbreaks has already exceeded the total number of outbreaks recorded for the entire 20^{th} century (Greger 2006). In general, they should be viewed as something artificial, made possible by intensive poultry production techniques.

After an HPAI virus has arisen in poultry, it has the potential both to re-infect wild birds and to cause disease in various mammalian taxa. If influenza A viruses adapt inside these new hosts to become highly transmissible, there can be devastating consequences, such as the human influenza pandemics of the 20th century (Kilbourne 2006). The conditions necessary for cross-infection are provided by agricultural practices that bring together humans, poultry and other species in high densities in areas where there is also the potential for viral transmission from infected poultry, poultry products and waste to wild birds, humans and other mammals in shared wetlands and in 'wet' (*i.e*. live animal) markets (Shortridge 1977; Shortridge *et al.* 1977).

Highly pathogenic avian influenza H5N1 of Asian lineage (HPAI H5N1)

HPAI H5N1 of Asian lineage has infected domestic, captive and wild birds in more than 60 countries in Asia, Europe and Africa (OIE 2008). By November 2005, i.e. before widespread occurrence in western Eurasia and Africa, over 200 million domestic birds had died from the disease or been slaughtered in attempts to control its spread; the economies of the worst affected countries in southeast Asia have suffered greatly, with lost revenue estimated at over $10 billion (Diouf 2005), and there have been serious human health consequences. By March 2008, the World Health Organisation had confirmed more than 370 human cases, over 60% of those fatal (World Health Organisation 2008).

Sporadic deaths in wild birds have been reported since 2002 and the first outbreak involving a large number of wild birds was reported in May 2005, in Qinghai province, China (Chen *et al.* 2005; Liu *et al.* 2005). Between 2002 and the present, the virus has infected a wide range of wild bird species (Olsen *et al*. 2006; USGS National Wildlife Health Center 2008; Lee 2008), but which species are important in H5N1 HPAI movement and whether the virus will become enzootic in wild bird populations are still unknown (Brown *et al.* 2006).

The virus has also infected a limited number of domestic, captive and wild mammals, including captive tigers *Panthera tigris* and leopards *Panthera pardus* and domestic pigs in southeast Asia, and domestic cats and a wild stone marten *Martes foina* in Germany. These cases were the result of 'spillover' infection from birds. There is no known reservoir of the HPAI H5N1 virus in mammals and there remains no sound evidence that the virus can be readily transmitted from mammal to mammal.

Emergence of HPAI H5N1 in poultry in southeast Asia (1996 – 2005)

HPAI H5N1 first received widespread recognition following a 1997 outbreak in poultry in Hong Kong SAR with subsequent spread of the virus to humans. During that outbreak, 18 human cases were recognised and six patients died. The outbreak ended when all domestic chickens held by wholesale facilities and vendors in Hong Kong were slaughtered (Snacken 1999). A precursor to the 1997 H5N1 strain was identified in Guangdong, China, where it caused deaths in domestic geese in 1996 (Webster *et al*. 2006).

Between 1997 and 2002, different reassortments (known as genotypes) of the virus emerged, in domestic goose and duck populations, which contained the same H5 HA gene but had different internal genes (Guan *et al*. 2002; Webster *et al*. 2006).

In 2002, a single genotype emerged in Hong Kong SAR and killed captive and wild waterbirds in nature parks there. This genotype spread to humans in Hong Kong in February 2002 (infecting two, killing one) and was the precursor to the Z genotype that later became dominant (Sturm-Ramirez *et al.* 2004; Ellis *et al.* 2004).

Between 2003 and 2005, the Z genotype spread in an unprecedented fashion across southeast Asia, affecting domestic poultry in Vietnam, Thailand, Indonesia, Cambodia, Laos, Korea, Japan, China and Malaysia. Later analysis showed that the H5N1 viruses that caused outbreaks in Japan and Korea were genetically different from those in other countries (the V genotype) (Mase *et al.* 2005; Li *et al.* 2004; Webster *et al.* 2006).

In April 2005, the first major outbreak in wild birds was reported. Some 6,345 wild birds were reported dead at Qinghai Lake in central China. Species affected included Great Black-headed Gull *Larus ichthyaetus*, Bar-headed Goose *Anser indicus*, Brown-headed Gull *Larus brunnicephalus*, Great Cormorant *Phalacrocorax carbo* and Ruddy Shelduck *Tadorna ferruginea* (Chen *et al.* 2005; Liu *et al.* 2005).

Geographical spread of HPAI H5N1 out of southeast Asia (2005 – 2006)

In July 2005, Russia reported its first outbreaks; domestic flocks were affected in six regions of western Siberia and dead wild birds were reported in the vicinities of some of these outbreaks. Kazakhstan reported its first outbreak in August 2005 in domestic birds. In the same month, 89 wild birds described as migratory species were reported infected at two lakes in Mongolia.

Europe reported its first outbreaks in October 2005 when infection was detected in domestic birds in Romania and Turkey. In the same month, Romania reported sporadic cases in wild birds as did Croatia and European parts of Russia. In November, the virus spread to domestic birds in the Ukraine, and the Middle East reported its first case: a flamingo kept as a captive bird in Kuwait. During December, two outbreaks were reported in European Russia in wild swans (species unreported) in regions near the Caspian Sea.

In the first half of 2006, the spread of HPAI H5N1 continued across Europe (Sabirovic *et al.* 2006; Hesterberg *et al.* 2007) and the Middle East and into Africa. Between January and May, infection was reported in 24 European countries with the majority of cases occurring in February and March in wild birds. During the same period, outbreaks were reported across central Asia and the Middle East, affecting domestic birds in Azerbaijan, India, Bangladesh, Pakistan, Iran and Iraq, with Azerbaijan also reporting infected wild birds. The first reported outbreak in Africa occurred in January in poultry in Nigeria, and by the end of April, eight other African nations had reported outbreaks: Burkina Faso, Cameroon, Djibouti, Egypt, Ghana, the Ivory Coast, Niger and Sudan (OIE 2008).

By May 2006, reports of outbreaks in Europe, the Middle East and Africa had for the most part decreased in frequency. Small numbers of cases of infection were reported in Hungary, Spain and the Ukraine in June; Pakistan and Russia in July; and one case was identified in a captive swan in Germany in August. Egypt was exceptional, continuously reporting outbreaks throughout 2006. It is also considered likely that outbreaks continued in poultry in Nigeria (UN System Influenza Coordinator & World Bank, 2007).

Throughout the time HPAI H5N1 was spreading across central Asia, Europe, the Middle East and Africa, it maintained a stronghold in poultry in southeast Asia. In 2006, outbreaks were reported in Cambodia, China, Hong Kong, Indonesia, Korea, Laos, Malaysia, Myanmar, Thailand and Vietnam (OIE 2008).

Outbreaks of HPAI H5N1 since 2006 and the current situation

Compared with 54 countries reporting 1,470 outbreaks to the OIE in 2006, 30 countries reported 638 outbreaks in 2007 (OIE 2008). In 2007, six European countries (Poland, Hungary, Germany, the United Kingdom, Romania and the Czech Republic) reported sporadic and relatively isolated outbreaks in poultry that were quickly controlled. Outbreaks in domestic birds were also reported in European parts of Russia and in Turkey. Infected wild birds were reported in Germany, France, the United Kingdom and the Czech Republic; and birds at a rehabilitation centre were affected in Poland. In the Middle East and central Asia, poultry outbreaks occurred throughout 2007. Some 350 outbreaks were reported from Egypt and Bangladesh alone. Poultry (and in some cases captive birds) were also affected in India, Kuwait, Saudi Arabia, Pakistan, Afghanistan and Israel with most outbreaks occurring between February and April, and again between October and December. In Africa, HPAI H5N1 was reported in domestic birds in Togo, Ghana and Benin; and is considered to have become enzootic in Nigeria (OIE 2008; UN System Influenza Coordinator 2007). Again, as in 2006, poultry outbreaks continued across southeast Asia. Sporadic cases in wild birds were reported in Japan and Hong Kong SAR.

In January and February 2008, a small number of wild bird cases were detected in the United Kingdom; large numbers of poultry outbreaks occurred in India and parts of southeast Asia; and the virus was considered to be enzootic in poultry in Egypt, Indonesia and Nigeria; and possibly enzootic in Bangladesh and China (UN System Influenza Coordinator 2007).

Major outbreaks of HPAI H5N1 in wild birds

Prior to HPAI H5N1, reports of HPAI in wild birds were very rare. The broad geographical scale and extent of the disease in wild birds is both extraordinary and unprecedented. The following table (Table A1.1) summarises the known major outbreaks of HPAI H5N1 in wild birds.

Table A1.1. Major known outbreaks of highly pathogenic avian influenza H5N1 in wild birds*

Year	Month(s)	Location(s)	Description of affected birds
2005	April	Qinghai Lake in central China	6345 waterbirds, the majority of which were Great Black-headed Gulls *Larus ichthyaetus*, Bar-headed Geese *Anser indicus* and Brown-headed Gulls *Larus brunnicephalus*
	August	Lake Erhel & Lake Khunt in Mongolia	89 waterbirds including ducks, geese and swans
	October – November	Romania & Croatia	Over 180 waterbirds, mainly swans
2006	January	Coastal area in the vicinity of Baku, Azerbaijan	Unspecified number of birds reported to the OIE as "various migratory birds"
	January – May	23 countries in Europe including Turkey and European Russia	Most cases occurred in ducks, geese and swans but a wide variety of species was infected including other waterbirds and raptors
	February	Rasht, Iran	153 wild swans

Year	Month(s)	Location(s)	Description of affected birds
	May	Multiple locations in Qinghai province, China	Over 900, mainly waterbirds, and mostly Bar-headed Geese *Anser indicus*
	May	Naqu, Tibet	Over 2,300 birds – species composition unclear but 300 infected Bar-headed Geese *Anser indicus* were reported
	June	Lake Hunt in Bulgan, Mongolia	Twelve waterbirds including swans, geese and gulls
2007	June	Germany, France and the Czech Republic	Over 290, mainly waterbirds, found mostly in Germany

* Data sources include OIE disease information reports and the German Friedrich-Loeffler Institute epidemiological bulletins – dates, locations and numbers may differ slightly in other sources.

Numerous species of wild birds, especially waterbirds, are susceptible to infection by the HPAI H5N1 virus. Close contact between poultry and wild birds can lead to cross-infection, from poultry to wild birds and vice versa. Additionally, species that live in and around poultry farms and human habitations may serve as "bridge species" that could potentially transmit the virus between poultry and wild birds either by direct contact between wild birds and poultry kept outside or by indirect contact with contaminated materials. While there is no sound evidence that wild birds have carried the virus long distances on migration (Feare & Yasué 2006), analysis of genetic sequences and other largely indirect evidence suggests that wild birds are likely to have contributed to its spread (Chen *et al.* 2006; Kilpatrick *et al.* 2006; Hesterberg *et al.* 2007; Weber & Stilianakis 2007). The relative importance of different modes of infection transfer, however, is unclear in the present state of knowledge.

Poor planning in response to development pressures has led to the increasing loss or degradation of wild ecosystems, which are the natural habitats for wild birds. This has resulted in closer contact between wild populations, domesticated birds such as chickens, ducks, geese, and other domestic fowl, and humans and has thus provided greater opportunities for the spread of HPAI H5N1 between wild and domestic birds, and thence to humans. The interplay between agriculture, animal (domestic and wild) health, human health, ecosystem health, and socio-cultural factors has been important in the emergence and spread of the virus.

Avian influenza and wetlands

Given the ecology of the natural hosts of LPAI viruses, it is unsurprising that wetlands play a major role in the natural epidemiology of avian influenza. As with many other viruses, avian influenza virions survive longer in colder water (Lu *et al.* 2003; Stallknecht *et al.* 1990), and it is strongly suggested that the virus survives over winter in frozen lakes in Arctic and sub-Arctic breeding areas. Thus, as well as the waterbird hosts, these wetlands are probably permanent reservoirs of LPAI virus (Rogers *et al.* 2004; Smith *et al.* 2004) (re-)infecting waterbirds arriving from southerly areas to breed (shown in Siberia by Okazaki *et al.* 2000 and Alaska by Ito *et al.* 1995). Indeed, in some wetlands used as staging grounds by large numbers of migratory ducks, avian influenza viral particles can be readily isolated from lake water (Hinshaw *et al.* 1980).

An agricultural practice that provides ideal conditions for cross-infection and thus genetic change is used on some fish-farms in Asia: battery cages of poultry are placed directly over troughs in pig-pens, which in turn are positioned over fish farms. The poultry waste feeds the pigs, the pig waste is either eaten by the fish or acts as a fertiliser for aquatic fish food, and the pond water is sometimes recycled as drinking water for the pigs and poultry (Greger 2006). These kinds of agricultural practices afford avian influenza viruses, which are spread via the faecal-oral route, a perfect opportunity to cycle through a mammalian species, accumulating the mutations necessary to adapt to mammalian hosts. Thus, as the use of such practices increases, so does the likelihood that new influenza strains infectious to and transmissible between humans will emerge (Culliton 1990; Greger 2006).

As well as providing conditions for virus mutation and generation, agricultural practices, particularly those used on wetlands, can enhance the ability of a virus to spread. The role of Asian domestic ducks in the epidemiology of HPAI H5N1 has been closely researched and found to be central not only to the genesis of the virus (Hulse-Post *et al.* 2005; Sims 2007), but also to its spread and the maintenance of infection in several Asian countries (Shortridge & Melville 2006). Typically, this has involved flocks of domestic ducks used for 'cleaning' rice paddies of waste grain and various pests, during which they can potentially have contact with wild ducks using the same wetlands. Detailed research (Gilbert *et al.* 2006; Songserm *et al.* 2006) in Thailand has demonstrated a strong association between the HPAI H5N1 virus and abundance of free-grazing ducks. Gilbert *et al.* (2006) concluded that in Thailand "wetlands used for double-crop rice production, where free-grazing duck feed year round in rice paddies, appear to be a critical factor in HPAI persistence and spread".

Wildlife conservation implications

Prior to HPAI H5N1, reports of HPAI in wild birds were very rare. The broad geographical scale and extent of the disease in wild birds is both extraordinary and unprecedented, and the conservation impacts of HPAI H5N1 have been significant.

It is estimated that between 5-10% of the world population of Bar-headed Goose *Anser indicus* died at Lake Qinghai, China in spring 2005 (Chen *et al.* 2005; Liu *et al.* 2005). At least two globally threatened species have been affected: Black-necked Crane *Grus nigricollis* in China and Red-breasted Goose *Branta ruficollis* in Greece. Approximately 90% of the world population of Red-breasted Goose is confined to just five roost sites in Romania and Bulgaria, countries that have both reported outbreaks, as have Russia and Ukraine where they also over-winter (BirdLife International 2007).

However, the total number of wild birds known to have been affected has been small in contrast to the number of domestic birds affected, and many more wild birds die of commoner avian diseases each year. Perhaps a greater threat than direct mortality has been the development of public fear about waterbirds resulting in misguided attempts to control the disease by disturbing or destroying wild birds and their habitats. Such responses are often encouraged by exaggerated or misleading messages in the media.

Currently, wildlife health problems are being created or exacerbated by unsustainable activities such as habitat loss or degradation, which facilitates closer contact between domestic and wild animals. Many advocate that to reduce risk of avian influenza and other bird diseases, there is a need to move to markedly more sustainable systems of agriculture with significantly lower intensity systems of poultry production. These need to be more biosecure, separated from wild waterbirds and their natural wetland habitats resulting in far fewer opportunities for viral cross-infection and thus pathogenetic amplification (Greger 2006). There are major animal and human health consequences (in terms of the impact on economies, food security and potential implications of a human influenza pandemic) of not strategically addressing these issues. However, to deliver such an objective in a world with an ever-growing human population and with issues of food-security in many developing countries, will be a major policy challenge.

References:

BirdLife International 2007. BirdLife statement on avian influenza. Available from http://www.birdlife.org/action/science/species/avian_flu/index.html.

Brown, J.D., Stallknecht, D.E., Beck, J.R., Suarez, D.L. & Swayne, D.E. 2006. Susceptibility of North American ducks and gulls to H5N1 Highly Pathogenic Avian Influenza viruses. *Emerging Infectious Diseases* 12(11): 1663-1670.

Capua, I. & Mutinelli, F. 2001. Low pathogenicity (LPAI) and highly pathogenic (HPAI) avian influenza in turkeys and chicken. Pp. 13-20. In: Capua, I. & Mutinelli F. (eds.). *A Colour Atlas and Text on Avian Influenza.* Papi Editore, Bologna, Italy.

Center for Infectious Disease Research & Policy. 2007. Avian Influenza (Bird Flu): Agricultural and Wildlife Considerations. Available from http://www.cidrapforum.org/cidrap/content/influenza/avianflu/biofacts/avflu.html.

Chen, H., Smith, G.J.D., Zhang, S.Y., Oin, K., Wang, J., Li. K.S., Webster, R.G., Peiris, J.S.M. & Guan, Y. 2005. H5N1 virus outbreak in migratory waterfowl. *Nature Online*. Available from http://www.nature.com/nature/journal/vaop/ncurrent/full/nature03974.html.

Culliton, B.J. 1990. Emerging viruses, emerging threat. *Science* 247: 279-280.

Diouf, J. 2005. Address on Avian Influenza to 33rd FAO Conference. Available from http://www.fao.org/ag/againfo/subjects/avian/conf05-AI/J6651e-DG.pdf.

Ellis, T.M., Bousfield, R.B., Bisset, L.A., Dyrting, K.C., Luk, G., Tsim, S.T., Sturm-Ramirez, K., Webster, R.G., Guan, Y., & Peiris, J.S. 2004. Investigation of outbreaks of highly pathogenic H5N1 avian influenza in waterfowl and wild birds in Hong Kong in late 2002. *Avian Pathology* 33(5): 492-505.

Feare, C.J. & Yasué, M. 2006. Asymptomatic infection with highly pathogenic avian influenza H5N1 in wild birds: how sound is the evidence? *Virology Journal*. 3.96. doi:10.1186/1742-422X_3_96.

Fouchier, R.A.M., Munster, V., Wallensten, A., Bestebroer, T.M., Herfst, S., Smith, D, Rimmelzwaan, G.F., Olsen, B. & Osterhaus, D.M.E. 2005. Characterization of a novel influenza A virus hemagglutinin subtype (H16) obtained from Black-headed Gulls. *Journal of Virology* 79: 2814-2822.

Gilbert, M., Chaitaweesub, P., Parakamawongsa, T., Premashthira, S., Tiensin, T., Kalpravidh, W., Wagner, H. & Slingenbergh, J. 2006. Free-grazing ducks and highly pathogenic avian influenza, Thailand. *Emerging Infectious Diseases* 12(2): 227-234.

Gorman, O.T., Bean, W.J. & Webster, R.G. 1992. Evolutionary processes in influenza viruses: divergence, rapid evolution, and stasis. *Current Topics in Microbiology and Immunology* 176: 75-97.

GRAIN 2006. *Fowl play: The poultry industry's central role in the bird flu crisis.* GRAIN Briefing, February 2006. Available from http://www.grain.org/briefings/?id=194.

Greger, M. 2006. *Bird Flu: a virus of our own hatching.* Lantern Books, New York. 465 pp.

Guan Y, Peiris, J.S., Lipatov, A.S., Ellis, T.M., Dyrting, K.C. Krauss, S., Zhang, L.J., Webster, R.G. & Shortridge, K.F. 2002. Emergence of multiple genotypes of H5N1 avian influenza viruses in Hong Kong SAR. *Proceedings of the National Academy of Sciences* 99(13): 8950-8955.

Hesterberg, U., Harris, K., Cook A. & Brown, I. 2007. *Annual Report. Surveillance for avian influenza in wild birds carried out by Member States. February- December 2006.* Community Reference Laboratory for avian influenza and Newcastle disease. 53 pp. Available from http://ec.europa.eu/food/animal/diseases/controlmeasures/avian/annrepres_surv_wb_02-12-2006_en.pdf.

Hinshaw, V.S. & Webster, R.G. 1982. The natural history of influenza A viruses. In: *Basic and applied influenza research.* Beare, A.S. (ed.). CRC Press, Boca Raton, Florida. Pp. 79-104.

Hinshaw, V.S., Webster, R.G. & Turner, B. 1980. The perpetuation of orthomyxoviruses and paramyxoviruses in Canadian waterfowl. *Canadian Journal of Microbiology* 26: 622-629.

Hulse-Post, D.J., Sturm-Ramirez, K.M., Humberd, J., Seiler, P., Govorkova, E.A., Krauss, S., Scholtissek, C., Puthavathana, P., Buranathai, C., Nguyen, T.D., Long, H.T., Naipospos, T.S.P., Chen, H., Ellis, T.M., Guan, Y., Peiris, J.S.M. & Webster, R.G. 2005. Role of domestic ducks in the propagation and biological evolution of highly pathogenic H5N1 influenza viruses in Asia. *Proceedings of the National Academy of Sciences* 102: 10682-10687. Available from http://www.pnas.org/cgi/content/full/102/30/10682.

Ito, T., Okazaki, K., Kawaoka, Y., Takada, A., Webster, R.G. & Kida, H. 1995. Perpetuation of influenza A viruses in Alaskan waterfowl reservoirs. *Archives of Virology* 140: 1163-1172.

Kilbourne, E.D. 2006. Influenza pandemics of the 20th century. *Emerging Infectious Diseases* 12(1): 9-14.

Kilpatrick, M., Chmura, A.A., Gibbons, D.W., Fleischer, R.C., Marra, P.P. & Daszak, P. 2006. Predicting the global spread of H5N1 avian influenza. *Proceedings of the National Academy of Sciences* 103(15): 19368–19373. Available from http://www.pnas.org/cgi/reprint/103/51/19368.

Lee, R.. 2008. Unpublished review of wild bird species reported as infected with HPAI H5N1. WWT, Slimbridge, UK.

Li, K., Guan, S.Y., Wang, J., Smith, G.J., Xu K.M., Duan L., Rahardjo, A.P., Puthavathana, P., Buranathai, C., Nguyen, T.D., Estoepangestie, A.T., Chaisingh, A., Auewarakul, P., Long, H.T., Hanh, N.T., Webby, R.J., Poon, L.L., Chen, H., Shortridge, K.F., Yuen, K.Y., Webster, R.G. & Peiris, J.S. 2004. Genesis of a highly pathogenic and potentially pandemic H5N1 influenza virus in eastern Asia. *Nature* 430 (6996):209-213.

Liu, J., Xiao, H., Lei, F., Zhu, Q., Qin, K., Zhang, X., Zhang, X., Zhao, D., Wang, G., Feng, Y., Ma, J., Liu, W., Wang, J. & Gao, F. 2005. Highly pathogenic H5N1 influenza virus infection in migratory birds. *Science Online.* Available from http://www.sciencemag.org/cgi/content/abstract/309/5738/1206.

Lu, H., Castro, A.E., Pennick, K., Liu, J., Yang, Q., Dunn, P., Weinstock, D., & Henzler, D. 2003. Survival of avian influenza virus H7N2 in SPF chickens and their environments. *Avian Diseases* 47: 1015-1021.

Mase, M., Tsukamoto, K., Imada, T., Imai, K., Tanimura, N., Nakamura, K., Yamamoto, Y., Hitomi, T., Kira, T., Nakai, T., Kiso, M., Horimoto, T., Kawaoka, Y. & Yamaguchi, S. 2005. Characterization of H5N1 influenza A viruses isolated during the 2003-2004 influenza outbreaks in Japan. *Virology* 332(1): 167-176.

OIE 2007. Terrestrial Animal Health Code. Available from http://www.oie.int/eng/Normes/mcode/en_sommaire.htm.

OIE 2008. Update on highly pathogenic avian influenza in animals (type H5 and H7). Available from http://www.oie.int/downld/AVIAN%20INFLUENZA/A_AI-Asia.htm.

Okazaki, K., Takada, A., Ito, T., Imai, M., Takakuwa, H., Hatta, M., Ozaki, H., Tnizaki, T., Nagano, T., Ninomiya, A., Demenev, V.A., Tyaptirganov, M.M., Karatayeva, T.D., Yanmikova, S.S., Lvov, D.K. & Kida, H. 2000. Precursor genes of future pandemic influenza viruses are perpetuated in ducks nesting in Siberia. *Archives of Virology* 145: 885-893.

Olsen, B., Munster, V.J., Wallensten, A., Waldenstrom, J., Osterhaus, A.D.M.E. & Fouchier, R.A.M. 2006. Global patterns of influenza a virus in wild birds. *Science* 312: 384–388.

Rogers, S.O., Starmer, W.T., Castello, J.D. 2004. Recycling of pathogenic microbes through survival in ice. *Medical Hypotheses* 63: 773-777.

Rohm, C., Zhou, N., Suss, J., Mackenzie,,J. & Webster, R.G. 1996. Characterization of a novel influenza hemagglutinin, H15: criteria for determination of influenza A subtypes. *Virology* 217:508-516.

Sabirovic, M., Wilesmith, J., Hall, S., Coulson, N., Landeg, F. 2006. Situation Analysis – Outbreaks of HPAI H5N1 virus in Europe during 2005/2006 – An overview and commentary. DEFRA, International Animal Health Division, United Kingdom. 40 pp. Available from http://www.defra.gov.uk/animalh/diseases/monitoring/pdf/hpai-europe300606.pdf.

Senne, D.A., Panigrahy, B., Kawaoka, Y., Pearson, J.E., Suss, J., Lipkind, M., Kida, H. & Webster, R.G. 1996. Survey of the hemagglutinin (HA) cleavage site sequence of H5 and H7 avian influenza viruses: amino acid sequence at the HA cleavage site as a marker of pathogenicity potential. *Avian Diseases* 40(2): 425-437.

Shortridge, K.F. & Melville, D.S. 2006. Domestic poultry and migratory birds in the interspecies transmission of avian influenza viruses: a view from Hong Kong. In *Waterbirds around the world.* Eds. G.C. Boere, C.A. Galbraith & D.A. Stroud. The Stationery Office, Edinburgh, UK. Pp. 427-431.

Shortridge, K.F. 1997. Is China an influenza epicentre? *Chinese Medical Journal* 110: 637-641.

Shortridge, K.F., Webster, R.G., Butterfield, W.K. & Campbell, C.H. 1977. Persistence of Hong Kong influenza virus variants in pigs. *Science* 196: 1454-1455.

Sims, L.D. 2007. Lessons learned from Asian H5N1 outbreak control. *Avian Diseases* 50: 174-181.

Smith, A.W., Skilling, D.E., Castello, J.D., Rogers, S.O. 2004. Ice as a reservoir for pathogenic human viruses: specifically, caliciviruses, influenza viruses, and enteroviruses. *Medical Hypotheses* 63: 560-566.

Snacken, R., Kendal, A.P., Haaheim, L.R. & Wood, J.M.. 1999. The next influenza pandemic: lessons from Hong Kong, 1997. *Emerging Infectious Diseases* 5:195-203.

Songserm, T., Jam-on, R., Sae-Heng, N., Meemak, N., Hulse-Post, D.J., Sturm-Ramirez, K.M., & Webster, R.J. 2006. Domestic ducks and H5N1 Influenza Epidemic, Thailand. *Emerging Infectious Diseases* 12(4): 575-581.

Stallknecht, D.E. & Shane, S.M. 1988. Host range of avian influenza virus in free-living birds. *Veterinary Research Communications* 12: 125-141.

Stallknecht, D.E. & Brown, J.D. 2007. Wild birds and the epidemiology of avian influenza. *Journal of Wildlife Diseases* 43(3) Supplement: S15-20.

Stallknecht, D.E., Shane, S.M., Kearney, M.T., Zwank, P.J. 1990. Persistence of avian influenza viruses in water. *Avian Diseases* 34: 406-411.

Sturm-Ramirez, K.M., Ellis, T., Bousfield, B., Bissett, L., Dyrting, K., Rehg, J.E., Poon, L., Guan, Y, Peiris, M. & Webster, R.G. 2004. Re-emerging H5N1 influenza viruses in Hong Kong in 2002 are highly pathogenic to ducks. *Journal of Virology* 78: 4892-4901.

Taubenberger, J.K., Reid, A.H., Lourens, R.M., Wang, R.., Jin, G. & Fanning, T.G. 2005. Characterization of the 1918 influenza virus polymerase genes. *Nature* 437(7060):889-93.

UN System Influenza Coordinator & World Bank 2007. Third global progress report on responses to avian influenza and state of pandemic readiness. Available from http://siteresources.worldbank.org/INTTOPAVIFLU/Resources/UN_WB_AHI_ProgressReportFinal.pdf.

USGS National Wildlife Health Center 2008. List of species affected by H5N1. Available from http://www.nwhc.usgs.gov/disease_information/avian_influenza/affected_species_chart.jsp.

van Gils, J.A., Munster, V.J., Radersma, R., Liefhebber, D., Fouchier, R.A., *et al*. 2007. Hampered Foraging and Migratory Performance in Swans Infected with Low-Pathogenic Avian Influenza A Virus. *PLoS ONE* 2(1): e184. doi:10.1371/journal.pone.0000184.

Weber, T.P. & Stilianakis, N.I. 2007. Ecologic immunity of avian influenza (H5N1) in migratory birds. *Emerging Infectious Diseases* 13: 1139-1143.

Webster, R.G., Peiris, M., Chen, H. & Guan, Y. 2006. H5N1 outbreaks and enzootic influenza. *Emerging Infectious Diseases* 12(1): 3-8.

Webster, R.G., Bean, W.J., Gorman, O.T., Chambers, T.M. & Kawaoka, Y. 1992. Evolution and ecology of Influenza A viruses. *Microbiological Reviews* 56(1): 152-179.

World Health Organisation 2008. Cumulative Number of Confirmed Human Cases of Avian Influenza A/(H5N1) Reported to WHO. Available from http://www.who.int/csr/disease/avian_influenza/country/cases_table_2008_03_11/en/index.html Accessed 11 March 2008.