



CONVENCIÓN SOBRE LAS ESPECIES MIGRATORIAS

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EL GRUPO CIENTÍFICO ESPECIAL SOBRE LA GRIPE AVIAR Y LAS AVES SILVESTRES

La respuesta de la CMS al subtipo altamente patógeno de la gripe aviar H5N1

Introducción

1. El subtipo altamente patógeno de la gripe aviar H5N1 (HPAI H5N1) es una enfermedad muy contagiosa que aflige a las aves silvestres, domésticas y en cautiverio en más de sesenta países desde que se la identificó en 1997. Más de 200 millones de aves domésticas han muerto de la enfermedad o han sido eliminadas en un intento de controlar la propagación de la enfermedad; que ha afectado más profundamente los países en el sudeste de Asia, cuya pérdida de ingresos equivale, según se estima, a más de diez mil millones de dólares de Estados Unidos, con serias consecuencias para la salud de los seres humanos. En junio de 2008, la Organización Mundial de la Salud (OMS) llevaba confirmados más de 380 casos, más del 60% de los cuales resultaron mortales. En abril de 2005 se informó de la aparición del primer brote de importancia, que afectó a más de 6,000 aves silvestres migratorias en el lago Qinghai en la China central. Desde entonces el virus ha infectado las aves silvestres en distintas partes de Asia central, Europa y África.

2. Antes de la aparición de HPAI H5N1, los informes sobre la existencia de HPAI en las aves silvestres eran muy escasos. La amplitud de la escala geográfica y la extensión de la enfermedad en las aves silvestres son ambas extraordinarias y sin precedentes y el impacto sobre la conservación, que resulta de la aparición de HPAI H5N1 ha sido significativo. Se estima que entre el 5 y el 10% de la población mundial de Anser indio *Anser indicus* murió en el lago Qinghai, en la China, en la primavera de 2005. Al menos dos especies, amenazadas a escala mundial, se vieron afectadas: Grulla cuellinegra *Grus nigricollis* en la China y Barnacla Cuelliroja *Branta ruficollis* en Grecia. Aproximadamente el 90% de la población mundial de Barnacla Cuelliroja está confinada en sólo cinco sitios en Rumania y Bulgaria, países que informaron sobre la aparición de brotes, tal como Rusia y Ucrania, donde hibernan.

3. La cifra total de las aves silvestres que se sabe que han sido afectadas es pequeño en comparación al número de las aves domésticas, y muchas más aves silvestres mueren de enfermedades aviares más comunes todos los años. Tal vez una amenaza mayor que la mortalidad directa reside en la aparición de temores públicos en relación con las aves acuáticas, lo que ha llevado a intentos descaminados de controlar la enfermedad molestando o destruyendo las aves silvestres y su hábitat. Tales reacciones se ven a menudo alentadas por los informes exagerados o incorrectos de los medios de difusión.

Por razones de economía, se ha impreso este documento en un tiraje limitado y no será distribuido en la reunión. Se ruega a los delegados traer sus copias a la reunión y a no solicitar copias adicionales.

4. Tras la preocupación expresada sobre el papel de las aves silvestres como vectores potenciales de HPAI H5N1, la Convención sobre las Especies Migratorias (CMS) del PNUMA, en cooperación estrecha con el Acuerdo sobre la Conservación de las Aves Acuáticas Migratorias de África y Eurasia (AEWA) estableció un grupo de trabajo especial sobre la gripe aviar y las aves silvestres (el grupo especial) en agosto de 2005. El mismo comprende 15 miembros y observadores, entre los cuales figuran organismos de las Naciones Unidas, acuerdos multilaterales ambientales, y organizaciones especialistas intergubernamentales y no-gubernamentales. Desde agosto de 2007, la Secretaría CMS y la FAO han suministrado coordinación conjunta para el grupo especial.

5. La lista actual de miembros del grupo especial incluye el Acuerdo para las aves acuáticas africano euroasiáticas del PNUMA, AEWA; BirdLife International; la Convención sobre la diversidad biológica del PNUMA, CDB; el Consejo Internacional para la conservación de la caza y de la vida silvestre, CIC; la Convención sobre las especies migratorias del PNUMA, CMS; la Organización de las Naciones Unidas para la alimentación y la agricultura, FAO; la Estrategia Internacional de las Naciones Unidas para la disminución de los desastres, ISDR; la Convención Ramsar sobre humedales; Wetlands Internacional; el Wildfowl & Wetlands Trust, WWT; la Wildlife Conservation Society, WCS; la Zoological Society of London, ZSL; el grupo especial de observadores de OIE, la World Organization for Animal Health; el Programa para el Medio Ambiente de las Naciones Unidas, PNUMA y la Organización Mundial de la Salud, OMS.

6. El grupo especial se propone obtener la mejor asesoría científica sobre el impacto de la conservación en la propagación de HPAI H5N1, así como evaluar el posible papel de las aves silvestres como vectores del virus. El mismo ha emitido información sobre las causas de la propagación de esta enfermedad y ha promovido el desarrollo de sistemas de alerta temprana internacional. El grupo especial promueve la difusión de información objetiva sobre el papel de las aves silvestres como vectores de HPAI H5N1 e intenta evitar los excesos reactivos de los decisores políticos, que podrían resultar nocivos para la conservación de las especies de aves acuáticas y su hábitat. Los miembros del grupo especial utilizan las teleconferencias, el contacto por correo electrónico y las reuniones de cuerpo presente.

7. El grupo especial es responsable, asimismo de una plataforma sobre la gripe aviar basada en la red Wildlife and the Environment (AIWE; www.aiweb.info), mediante la cual se facilita el intercambio de información y la comunicación entre expertos sobre tópicos corrientes y novedosos vinculados a HPAI H5N1, las aves silvestres y el medio ambiente.

8. La Resolución CMS 8.27 – ‘Las especies migratorias y la gripe aviar’ – hace un llamamiento para que se proporcionen respuestas integradas tanto a escala nacional como internacional, y exista una mayor capacidad de investigación, un cumplimiento con las normas de seguridad biológica y una mejora de las mismas, una cooperación por parte de la comunidad de la caza, programas de educación y concienciación pública sobre HPAI H5N1, y solicita a las Partes que apoyen el desarrollo de programas de vigilancia y monitoreo de larga duración para las aves silvestres. La resolución se opone resueltamente a la matanza de las aves silvestres acuáticas y a la destrucción de su hábitat en respuesta a HPAI H5N1, ya que tales medidas no corresponden a una utilización sensata, a la que invitan los artículos 1 y 8 de la CDB, y puede haber exacerbado el problema provocando una mayor dispersión de las aves infectadas. La resolución apoyó asimismo los resultados de los trabajos del grupo especial.

Novedades desde la octava Reunión de la Conferencia de las Partes a la CMS (COP 8)

9. Desde la COP 8, el grupo especial ha celebrado nueve teleconferencias, efectuado dos reuniones técnicas, organizado un evento sobre la gripe aviar como parte de la COP 9 de la CDB, suministrado asesoría a varios gobiernos sobre cómo responder a HPAI H5N1, producido muchos documentos y publicaciones en varios idiomas, mantenido al día un sitio en la red y asistido a reuniones internacionales sobre HPAI en todo el mundo, brindando información científica equilibrada sobre el papel de las aves silvestres en la propagación de HPAI H5N1.

10. La primera reunión técnica del grupo especial, un seminario científico sobre ‘la gripe aviar, el medio ambiente y las aves silvestres’ (Nairobi, Kenia; 10 y 11 de abril de 2006), contó con la presencia de más de 50 expertos en los campos de la virología, epidemiología, salud humana y animal, producción de aves de corral, ecología y conservación. En el seminario se examinaron los últimos estudios científicos relativos a la evolución y propagación del linaje asiático de HPAI H5N1, sus impactos sobre las aves silvestres y el medio ambiente en general y se debatieron temas vinculados con el riesgo de una transmisión ulterior, así como las estrategias eficaces de mitigación. Las recomendaciones del seminario figuran en el Anexo 1 al presente documento, y las actas completas en el documento de información PNUMA/CMS/Inf.9.17: el grupo científico sobre la gripe aviar y las aves silvestres. En el seminario se reconoció que el grupo especial será el principal encargado de la aplicación de las recomendaciones.

11. La segunda reunión técnica del grupo especial, un taller internacional sobre ‘La experiencia práctica adquirida’ (Aviemore, Escocia, 26 a 28 de junio de 2007), opinó que los brotes futuros deberán atacarse con rapidez, con la intervención de expertos en aves silvestres, así como de veterinarios y otros especialistas. Se consideró en la reunión que si bien las aves silvestres están afectadas por el virus, las aves domésticas, en especial la industria y el comercio de las aves de corral disponen de la llave para limitar una futura propagación internacional. Además, es necesario continuar desarrollando la capacidad nacional interministerial y la colaboración interdisciplinaria para estar a la altura de los retos suscitados por HPAI H5N1. Las conclusiones y recomendaciones del taller figuran en el Anexo 2 al presente documento, y las actas completas en el documento de información PNUMA/CMS/Inf.9.17: El Grupo científico sobre la gripe aviar y las aves silvestres.

12. En un seminario reunido conjuntamente por la CMS y el Museo Koenig, en mayo de 2008, sobre ‘Animales, personas y enfermedades: un tema transversal para la conservación de la diversidad biológica’ los participantes se ocuparon del tema de la gripe aviar en el contexto más amplio de la salud de la fauna silvestre y sugirieron adaptar los enfoques desarrollados para tratar HPAI H5N1 a otras enfermedades de la fauna silvestre. El seminario fue organizado en Bonn como un evento colateral a la COP 9 de la CDB. En dicho seminario se destacó una vez más la necesidad de aumentar las capacidades nacionales para responder a los retos que suscita HPAI H5N1. En particular se hizo hincapié en la preparación previa para luchar contra los brotes mediante una planificación adecuada y la evaluación de los riesgos. Durante el seminario se insistió también en la necesidad de adoptar perspectivas integradas y a largo plazo para responder a los desafíos suscitados por estas enfermedades. La respuesta global a HPAI H5N1 ofrece una importante ocasión para aprender y para mejorar la capacidad de vigilancia de la enfermedad en la fauna silvestre y en la gestión del hábitat, con el fin de reducir los riesgos asociados. Ello ayudará a controlar las enfermedades nuevas y repetidas de la fauna silvestre, que podrían tener un impacto de largo alcance sobre la agricultura, la economía, la vida y la salud humanas y la conservación de la fauna silvestre.

13. Los documentos preparados por el grupo especial, o con su colaboración, incluyen una edición corregida del folleto de información del grupo especial (disponible ya en siete idiomas); las actas del taller sobre la gripe aviar y la fauna silvestre sobre “las experiencias adquiridas” (Aviomore, Escocia; 26 a 28 de junio de 2007); un texto científico breve sobre la gripe aviar y sus efectos sobre la fauna silvestre y su conservación (véase el Anexo 3); proyectos de resoluciones y documentos de orientación para la COP 9 de la CMS, la MOP 4 de AEWA y la COP 10 de Ramsar. Otras publicaciones de la CMS relacionadas con la gripe aviar pueden encontrarse en <http://www.cms.int/avianflu/index.htm>.

14. El texto breve de índole científica (véase el Anexo 3) se preparó para presentar una visión sucinta de lo que se sabe al presente sobre la gripe aviar y sobre cómo la enfermedad afecta la fauna silvestre y su conservación. El documento define la gripe aviar, describe cómo surgen los virus HPAI, detalla la propagación de HPAI H5N1, incluyendo los principales brotes en las aves silvestres, y detalla las implicaciones para la conservación que resultan de HPAI H5N1. El documento brinda información científica contextual de interés para los decisores políticos, la prensa y el gran público. Así como la COP 9 de la CMS, la declaración científica se presentará a la COP 10 de Ramsar y la MOP 4 de AEWA, para su aprobación.

15. El sitio en la red para la gripe aviar, la fauna silvestre y el medio ambiente (AIWEb; www.aiweb.info) fue lanzado por el grupo especial en el otoño de 2006. Lo pone al día periódicamente y lo mantiene el coordinador del grupo especial. El sitio presenta información actualizada, documentos fundamentales, información sobre temas corrientes y muchos otros recursos. Además, ofrece una plataforma pública para el intercambio de datos sobre temas y novedades relativas a la gripe aviar y las aves silvestres y recibe a unos 5,000 visitantes por mes. Para que resulte una fuente activa, constante y fructuosa de información, se requiere la colaboración constante de los miembros del grupo especial y de otros expertos, a quienes se alienta a participar.

La coordinación del grupo especial y los proyectos futuros

16. Se requieren fondos para garantizar la continuación efectiva de las labores del grupo especial. Dicha financiación se utilizará primordialmente para mantener AIWEb, así como para las publicaciones y la organización de eventos. Se ha contratado al Wildfowl & Wetlands Trust (WWT) para que lleva a cabo varias tareas de coordinación efectuadas previamente por un coordinador basado en la CMS. El trabajo continuado del grupo especial ha recibido el apoyo de los proyectos de resolución presentados a la COP de Ramsar, la MOP 4 de AEWA y la COP 9 de la CMS.

17. Amén de las teleconferencias periódicas, el grupo especial proyecta organizar su tercera reunión técnica en 2009, tras las exitosas reuniones de Nairobi y Aviomore (véase PNUMA/CMS/Inf.9.17: El Grupo científico sobre la gripe aviar y las aves silvestres).

18. El grupo especial continuará brindando información y asesoría científicas sobre el papel de las aves silvestres en la propagación y presencia de HPAI H5N1, asistiendo a reuniones internacionales, produciendo documentos de información, publicando datos sobre AIWEb y comunicando por correo electrónico o mediante otro método idóneo.

Acción solicitada:

Se invita a la Conferencia de las Partes a:

- a) brindar, con el grupo científico especial sobre la gripe aviar y las aves silvestres, y mediante el mismo, información idónea sobre las medidas prácticas que conviene aplicar para disminuir el riesgo de la transmisión de la enfermedad entre las aves silvestres, en cautiverio y domésticas, a los organismos que desarrollan planes de gestión para humedales y de emergencias vinculadas a HPAI;
- b) colaborar con el Grupo de trabajo sobre las especies migratorias como vectores de enfermedades y con el Secretario Ejecutivo, para efectuar recomendaciones relativas a la índole y la importancia de los riesgos asociados con otras enfermedades en las especies migratorias y a las posibilidades de acción por las Partes para luchar contra ellos;
- c) reafirmar las disposiciones de la Resolución 8.27 sobre las especies migratorias y la gripe aviar altamente patógena, y en particular:
 - i. la necesidad de establecer enfoques plenamente integrados, tanto a escala nacional como internacional, para combatir HPAI y otras enfermedades de las que los animales son portadores, llevando los conocimientos sobre la gestión ornitológica, la fauna silvestre y los humedales a quienes son tradicionalmente responsables de la salud pública y las zoonosis, incluyendo la pericia veterinaria, agrícola, virológica, epidemiológica y médica;
 - ii. la necesidad de que los gobiernos apoyen los programas de monitoreo y vigilancia coordinados, estructurados correctamente, y a largo plazo, para las aves silvestres, con el fin de evaluar, *inter alia*, los riesgos de enfermedad corrientes y nuevos, haciendo el mejor uso posible de los sistemas existentes, incluyendo aquellos que se han desarrollado desde 2005;
- d) felicitar a los miembros del grupo especial por sus esfuerzos constantes y los resultados obtenidos durante el periodo 2005 – 2008, que han contribuido de manera significativa a mejorar nuestra comprensión de las causas y del papel de las aves silvestres en la propagación de HPAI así como de las respuestas a los mismos;
- e) requerir al Secretario Ejecutivo que continúe actuando como coordinador conjunto del grupo científico especial sobre la gripe aviar y las aves silvestres, en asociación con la FAO, y con la participación del Consejo Científico de la CMS;
- f) aprobar el informe científico sobre la gripe aviar altamente patógena H5N1: “Consideraciones sobre la fauna silvestre y la conservación”, preparadas por el grupo científico especial y adjuntadas como Anexo 3 a este documento; invitar a otros organismos idóneos, entre los cuales figuran la FAO, el PNUMA y los MEAs, a que respalden asimismo esta declaración, y solicitar a la Secretaría que asegure la mayor circulación y la comprensión más amplia que resulten posibles para la declaración;
- g) acordar suministrar financiación apropiada en el presupuesto de la CMS para 2009 – 2011, para la labor de la CMS en relación con el grupo especial y con otros aspectos que le están vinculados, sobre la gripe aviar, entre los que figuran la concienciación y las actividades de incremento de capacidades; y
- h) aprobar un proyecto de Resolución, que se presentará en la COP 9 de la CMS, sobre cómo responder a los desafíos que presentan las enfermedades nuevas y las que reaparecen en las especies migratorias.

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 zoonoses¹. 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 agencies with authority and expertise in wild bird science and management need to be included in contingency planning.

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

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 website. 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 asymptotically 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 21st century the incidence of HPAI outbreaks has already exceeded the total number of outbreaks recorded for the entire 20th 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 <i>Larus ichthyaetus</i> , Bar-headed Geese <i>Anser indicus</i> and Brown-headed Gulls <i>Larus brunnicephalus</i>
	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 <i>Anser indicus</i>
	May	Naqu, Tibet	Over 2,300 birds – species composition unclear but 300 infected Bar-headed Geese <i>Anser indicus</i> 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.

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