Investigation of the role of wild birds in Highly Pathogenic Avian Influenza Outbreaks in Turkey between January and February 2008

MISSION REPORT

19 February to 12 March 2008

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
# MISSION REPORT

CRISIS MANAGEMENT CENTRE – ANIMAL HEALTH

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ACRONYMS AND ABBREVIATIONS

CMC-AH  Crisis Management Centre – Animal Health
CVO     Chief Veterinary Officer
ECTAD   Emergency Centre for Transboundary Animal Disease
EMPRES  Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases
EU      European Union
FAO     Food and Agriculture Organization of the United Nations
HPAI    Highly pathogenic avian influenza
KAD     Turkish Bird Research Society
OIE     World Organisation for Animal Health
OMU ORC Ondokuz Mayıs University Ornithological Research Centre
RDT     Rapid deployment team
TAD     Transboundary animal disease
TOR     Term of reference
UN      United Nations
WHO     World Health Organization

It is suggested that should this report be referenced, the following citation should be used:

EXECUTIVE SUMMARY

Turkey has experienced outbreaks of H5N1 HPAI in domestic poultry every year since October 2005. The initial case was in the northeast of the country in October 2005, affecting a single free range flock of turkeys. From December 2005 to March 2006, an extensive epidemic occurred, starting in the east and then spreading over the whole country, which resulted in 230 outbreaks and 12 human cases, including four fatalities. In February 2007, 19 outbreaks were confined to southeast Turkey. In January and February 2008, six outbreaks occurred along the Black Sea coast of Turkey. In response to these outbreaks, the Chief Veterinary Officer (CVO) of FAO contacted the CVO of Turkey; and on 6 February 2008, FAO received an official acceptance of the mission (see Annex 1).

In response to this, the Crisis Management Centre – Animal Health (CMC-AH) and Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases (EMPRES) fielded a rapid deployment team consisting of two wildlife experts (Scott Newman and Javier Sanz-Alvarez) and one epidemiologist (Nick Honhold), to Ankara, Turkey on 17 and 18 February 2008 (see Annex 2 for ToRs).

The mission objectives were to:
- Conduct species censuses at and near infected sites
- Capture and sample healthy wild birds at and near infected farms.
- Assist with assessment of wild bird - domestic bird interface.
- Radio mark birds that are captured to evaluate migration.

This was the first time globally, that a Mission attempted to conduct concurrent poultry outbreak investigations coupled with wild bird census activities, monitoring for dead wild birds, and wild bird capture and sampling. The Mission team conducted outbreak investigations [with the European Union (EU) team] and wild bird censuses including transects and point counts (with national ornithologists) at five of six outbreak sites (Yörükler and Aybeder in Samsun Province, Yenicam and Konacik in Sakarya Province and Tasmanli in Sinop Province). The initial outbreak at Sazkoy in Zonguldak Province was not evaluated directly by the Mission team as it had been fully investigated previously and had occurred well before the Mission was mobilised.

Results of the outbreak investigations closely link three of five outbreaks to introduction of infectious materials (feathers and viscera) from hunted wild birds (Coot and Mallard) into back-yard poultry. In the one outbreak not directly investigated by the Mission, a similar hunting history was described meaning that four of six of the 2008 outbreaks were linked to wild bird introductions via hunting. In these cases, there was a history of hunting three to five days prior to the outbreak, and in each case, hunted birds were brought home and cleaned on the premise where the outbreaks occurred. Investigations also indicated that there were no possible sources of poultry based disease introduction. For the remaining two sites, no sources of virus introduction through poultry practices (production, trade, etc.) could be identified, and no direct link to hunting could be made although recently used hunting cartridges were observed at one of the two outbreak sites.

Census work at these sites demonstrated that many bridge species could have come into direct contact with infectious materials discarded from hunted birds, or directly contacted infected poultry.
At four of five outbreak sites investigated during the Mission, census activities were conducted at nearby wetlands. At three of five sites, census activities were conducted at the wetlands identified as the sources of hunted birds linked to disease introduction. A total of 3,235 birds comprising 83 species were counted at outbreak sites. Blackbird, robin, goldfinch, and hooded crow were present at all five outbreak sites investigated with coot, pochard, teal and rook being counted in the greatest abundance despite not being present at all outbreak sites or areas associated with hunted positive birds. At the Yörükler site, national and international biologists captured and sampled 177 healthy free-ranging birds (mostly bridge species), collected samples from 43 dead birds (four hunted and 39 recovered by shoreline monitoring), and collected 75 fresh faecal samples for AI testing.

A buzzard (*Buteo buteo*), found moribund and euthanized, near the Yörükler site on 5 March 2008 was positive for H5N1 HPAI based on diagnostics at the Padova FAO-OIE reference lab. Poultry culling had been completed on 2 February 2008 therefore, infection most likely took place by ingestion of a sick live (moribund) or fresh dead bird carcass, with the greatest likelihood being a dead wild bird. This suggests that virus continued to be circulating (most likely in wild birds) a month after the poultry outbreak had ended. A less likely explanation is that this buzzard could have become infected when infected domestic poultry were present, but succumbed to infection a month later. However, no large scale wild bird mortality event was observed, and surveillance from bridge species (birds that move between homes or farms where domestic birds are kept, and wild bird habitats) at the infected site showed negative results.

**Recommendations based on the findings of this Mission include:**

1) Develop literature related to best practices for hunters and their wives/partners to prevent spread of HPAI to poultry and wild birds, and to safeguard themselves and their families;

2) Conduct training exercises for ornithologists, hunting clubs and hunters, and laboratory staff to increase their respective technical capacities and knowledge about HPAI;

3) Conduct a debrief/workshop in Turkey with MOA, MOE, ornithologists, laboratories, hunting clubs, and EU team to modify the national contingency plan and establish a mechanism to ensure that future outbreak responses include concurrent, coordinated outbreak investigations, wild bird census activities, monitoring for dead wild birds, and capture/sampling of wild birds at outbreak sites or adjacent wetlands;

4) Help implement a long-term wild bird monitoring and disease surveillance programme requiring coordination amongst MOA, MOE, ornithologists, and hunters; and

5) Implement a Black Sea Basin HPAI project to include multiple countries bordering the Black Sea that includes census, monitoring, surveillance, and habitat use/migration studies to better understand the livestock-wildlife interface in the region and any ecological drivers of wild bird movements from the northern Black Sea to the southern coastline that encompasses Turkey.

The above-mentioned recommendations will be implemented through some or all of the following: collaboration with the EU Project, an emergency FAO Technical Cooperation Project (TCP), and the FAO Regional Programme.

**Please note that destruction of wild bird habitats or indiscriminate culling of wildlife is scientifically unjustified as a method to prevent disease transmission, as a response to an
HPAI H5N1 outbreak, or as a control strategy. This is the position of FAO, as stated in the Recommendations from the FAO & OIE International Scientific Conference on Avian Influenza and Wild Birds (Rome, Italy 30-31 May 2006) and in concurrence with Resolutions Resolution 3.18, Resolution IX.23, and Resolution 8.27 from UNEP’s Convention on the Conservation of Migratory Species and the African Eurasian Waterbird Agreement which has been endorsed by 119 countries from Europe, Asia, the Americas, Middle East and Africa.
1. **INTRODUCTION**

1.1 **Background- H5N1 HPAI**

H5N1 HPAI is a disease of domestic poultry and wild birds caused by Influenza A virus. Avian pathogenicity is due to a structural change in the haemaglutinin (HA) protein which has only been seen for some types of H5 and H7 viruses. The present H5N1 virus has caused a pandemic affecting many parts of Eurasia and Africa. Domestic chickens are the most susceptible species. Domestic turkeys are also highly susceptible, domestic geese less so and domestic ducks variably so. Over 90 species of wild birds have died from exposure to this virus, which is an unusual feature of this virus. Certain species of ducks, swans, geese, and grebes appear to be more sensitive to the virus usually resulting in mortality within several days of virus exposure. Experimental exposure trials have also demonstrated that other species of duck appear to be more resilient to virus exposure and can even survive. This is also true of some species of terrestrial bird’s e.g. wild pigeons. Wild bird surveillance of more than 350 000 samples to date has not identified a definitive wild bird reservoir. Illness due to infection with the virus has been detected in over 300 people, resulting in over 200 deaths. With the exception of one suspected human to human case in Indonesia (and possibly also in Vietnam), and the case in Azerbaijan where people were infected by plucking feathers from apparently infected geese, human infections have resulted from direct contact with domestic poultry.

To be added: wild bird migrations have proven to be a mechanism for spread (Europe 2006) but much remains unknown and illegal trade of domestic and wild birds remains the main cause of spread.

Turkey has experienced outbreaks of H5N1 HPAI in domestic poultry every year since 2005. In October 2005 there was a single case recorded in the north west of the country. In December 2005, further cases were discovered in the far east of the country which resulted in four human deaths in that region and 230 outbreaks in poultry and wild birds spread over the whole country. The last outbreak in that epidemic was reported at the end of March 2006. In February 2007, outbreaks were reported in the south east of the country. In contrast to 2006, the overall epidemic was kept to 19 outbreaks confined to a limited area. In January 2008, a further outbreak was reported. By 5 March 2008, there had been five more cases reported along the Black Sea coast of Turkey.

From January 2006 to March 2007, FAO had a permanent presence in Turkey to provide technical assistance on the control of HPAI. This was replaced by an EU project which started in February 2007 and will run until November 2008.

**Background - Epidemiological investigation to establish the likely source of infection in domestic poultry**

There is an established methodology for conducting outbreak investigations which utilises a semi-structured interview technique and a standard data collection format. This ensures that both a standard set of data is collected at each outbreak but that non-standard information can also be captured. These investigations build up a picture of the major routes of introduction and spread of an epidemic as well as indicating high risk locations where further investigations should be carried out.
Background - Temporo-spatial analysis to establish the characteristics of an epidemic

Temporo-spatial analysis of epidemics involves:
1) creating timelines showing active outbreak foci and potential sources for environmental contamination; likely timing of infected or introduction; and possible relationships and transmission between outbreaks;
2) epidemic curves to examine the progress and type of the epidemic (propagating, point sources, etc.); and
3) spatial analysis using mapping and basic geometric calculations. This again helps to characterise the type of epidemic being dealt with.

These tools (as well as being useful management systems) characterise the type of epidemic, how it is being spread and so guide the type of control measures required.

Background - Assessing the role of wild birds in the introduction of H5N1 HPAI to poultry or the potential transmission from infected poultry to wild birds

An understanding of the role that wild birds play in the ecology of diseases requires assessments of species likely to either host, transmit, or spread pathogens. Specifically related to H5N1 HPAI, it is essential to evaluate species that have direct contact with poultry at the outbreak site, and ideally, at the same time when an outbreak is happening. To properly assess the role of wild birds at a poultry outbreak, it is recommended that concurrently with the epidemiological outbreak investigation the following activities be conducted:

1) baseline wild bird species and population assessments;
2) monitoring for and collection of fresh dead wild birds for virus detection and isolation;
3) capture of live birds at the outbreak site and near the outbreak site when wetland habitat is concurrently utilized by waterfowl, geese, swan, grebe, cormorant, or other higher risk species for oropharyngeal/tracheal and cloacal swabbing for virus detection and isolation.

Although no reliable or validated methods exist for conducting serology (ELISA or HI) testing specifically for H5N1 HPAI in wild bird species, blood collection should be considered if analytical capacity and financial support exists for other disease testing, contaminants screening, genetics or isotope analyses. When there is a reliable history linking poultry outbreaks to exposure to hunted wild birds, it is important that this source i.e. the hunted bird habitat should be added to the locations for the wild bird investigation activities detailed above.

Background - Baseline Wild Bird Species and Population Assessments

Baseline studies of wild bird populations generally fall into three categories: inventory and monitoring, movement patterns and behavioural studies. Inventory and monitoring activities focus specific objectives that include: 1) an inventory of all the bird species in an area of interest; 2) determining the abundance or density of the species present; and 3) monitoring seasonal changes in species composition and numbers. When applied to understanding the emergence of infectious diseases such as H5N1 HPAI, these techniques serve to provide an early warning system for detection of higher than expected mortality rates in wild bird populations and can also provide insight into whether wild birds played a role in virus
introduction, or alternatively, if virus can be moved from domestic birds into wild bird populations via direct contact with infected poultry.

Species inventories and population monitoring are common tasks of biologists, and a variety of avian survey and monitoring techniques are available. While each technique has unique advantages, the most appropriate technique will depend on the specific objectives of the study, the size of the study area, characteristics of the species and habitat of interest, and the logistic and financial feasibility of implementing activities. One important precept applies regardless of the technique employed: it is essential that all techniques are properly described and surveys are conducted by qualified personnel using standard methods that are consistent over time. Observers will undoubtedly encounter a variety of species, conditions and habitats during surveys, but counts are of little use if the species identification is dubious and the survey methodology varies from one day to the next or among sites. Thus, observers should be able to identify most, if not all, of the species likely to be encountered during a survey, including closely-related species that may be nearly identical, and different sexes and age groups within a species.

The goal of a complete census is to conduct a total count of all the animals present over a specified area to obtain an unbiased estimate of abundance without statistical inferences or underlying assumptions. A reliable census is conditional on the assumption that all individuals present in an area can be recorded; therefore, censuses are most useful for conspicuous species occupying discrete and well-defined habitats. However, in many situations, such as where waterbirds are very numerous or tightly grouped, or where time is limited, it may be necessary to either estimate the number of individuals rather than to count every individual. In other situations such as very large expansive habitats too large to see from accessible observation points, when it is not possible to gain access to inlets, waterways, streams/rivers feeding larger wetland systems, or in heavily vegetated wetlands, it may be necessary to decide that an accurate census is not feasible. Achieving the ambitious goals of a conventional census count will often involve considerable logistic preparations. A large census area will usually need to be divided into smaller units that can be conveniently surveyed over time or by multiple field personnel at the same time.

Background - Techniques For Capture of Wild Birds

Capture techniques specifically designed for wild birds such as waterfowl, shorebirds and other wetland species are of primary interest because current knowledge indicates these are the species that serve as the primary reservoirs of low pathogenic AI viruses. While their mobility, wariness of humans and diverse habitats often make live capture a challenge, a multitude of trapping techniques and devices have been developed over time. Most of the live capture techniques utilise bait, decoys, recorded calls or lures to attract birds to trapping sites, but a few active techniques in which the trapper actually pursues the bird have been developed and may be useful in some situations. Thus, there are few, if any, bird species which cannot be captured but the effectiveness and ease of capture is often determined by the species, habitat, season, time available, techniques available, disturbance at the capture locations, and a bit of luck.

In most waterfowl capture efforts, the most successful captures occur when sites have been baited for weeks to months ahead of the desired capture date, when all capture techniques (cannon nets, rocket nets, whoosh nets, drop nets, walk-in and swim-in traps, and nooses) are available for use, and when there are no seasonal or avian biology dynamics are potentially
playing a role in the behaviour of birds. Since this was an emergency mission and the
dates/season were not pre-planned, and there was no history of conducting waterfowl captures
near the outbreak sites, and all capture techniques were not available for use, the opportunity
to catch waterfowl would be based on the response of birds to being baited over the duration
of the 2-3 week long Mission, and the capture techniques that could be employed on an
emergency basis.

Capture techniques specifically designed for wild birds such as passerines are of importance
because these species comprise the potential bridge species which may play a crucial role in
transmitting disease among poultry and wetland habitats, in one or both directions. The most
versatile and widely used method for catching these species is the mist netting which entails
erecting an inconspicuous mesh net on vertically placed poles in locations of high passerine
bird activity.

Background - Techniques Employed During the Mission in Turkey

During this Mission, we employed census techniques (strip transects and point counts) for
determining the density and species present at outbreak sites and nearby wetlands when
possible, including locations where outbreak investigation information provided the locations
of hunted birds thought to be the source of H5N1 HPAI introduction. Strip transects are
performed by an observer who counts species composition and abundance while travelling
along a fixed transect using binoculars. Point counts are performed by an observer counting
species composition and abundance in a 360 degree arc around a fixed survey station using
either binoculars for small spatial habitats, or a spotting scope for larger spatial habitats.

Specifically related to the Mission, swim-in and walk-in trap, nooses, and whoosh nets were
used to attempt to capture waterfowl on the wetland site near the Yörükler outbreak location.
Mist nets were placed on the property where the Yörükler outbreak occurred to intercept birds
visiting the actual property where the poultry outbreak occurred.

As well, we conducted intensive and daily shoreline monitoring and collection of carcasses at
the outbreak site in Yörükler and the nearby associated lakes and wetland. During census
work at other sites, census activities included shoreline scans for dead birds but continuous
dead bird monitoring was not possible because we did not have daily activities at all outbreak
sites.

Fortuitously, the Ondokuz Mayıs University Ornithological Research Centre had previously
conducted census activities through other funding sources at the Yörükler Wetland Complex
and we were able to repeat a portion of their census work during our Mission providing us
with the opportunity to evaluate seasonal changes in species composition concurrent with the
onset of the H5N1 HPAI outbreak in Yörükler.

1.2 Mission request, composition and duration

A. Haluk (CVO-Turkey) contacted by J. Domenech (CVO-FAO) regarding the HPAI
outbreaks in Turkey on 4 February 2008 and on 6 February 2008 FAO received an official
request (see Annex 1, Official request) for assistance. In response to this request, the Crisis
Management Centre – Animal Health (CMC-AH) and Emergency Prevention System for
Transboundary Animal and Plant Pests and Diseases (EMPRES), Animal Health Service
(AGAH) fielded a rapid deployment team (RDT) consisting of two wildlife experts and one
epidemiologist (see Annex 2, TORs) to Ankara, Turkey from 17 February to 12 March 2008. This mission was supported by funds from the Government of Canada, the Government of the United Kingdom, the United States Department of Agriculture (USDA), and the United States Agency for International Development (USAID).

1.3 Mission objectives

The overall objective of the mission was to support the Government’s response to H5N1 highly pathogenic avian influenza outbreaks.

The specific objectives of the mission were:

- Conduct species censuses and surveys at and near infected farms. Sick and dead birds will be collected and sampled.
- Capture and sample healthy wild birds at and near infected farms.
- Assist with assessment of wild bird - domestic bird interface.
- Radio mark birds that are captured to evaluate migration.

The outcome of these activities was intended to help provide knowledge about the role that wild birds may have played in the introduction of disease to the outbreak sites, and the potential spill over from infected poultry at the outbreak sites into local wild bird populations.

2 FINDINGS AND ANALYSIS

2.1 Mission activities

Members of the Mission team (Newman, Honhold, Sanz-Alvarez) met with the FAO-Turkey, Ministry of Agriculture and Rural Affairs, European Union Project, both diagnostic laboratories in Samsun and Ankara, Veterinary Directorate offices near each outbreak site investigated, Ministry of Environment (Samsun), Samsun hunting club, Turkish Bird Research Society (KAD), and Ondokuz Mayis University Ornithological Research Centre (OMUORC).

Five of the (up to then) six outbreak sites were included in the FAO Mission. Table 1 summarises the outbreaks, timelines, and field activities conducted at each outbreak investigated by the FAO team. The outbreak at Sazkoy in Zonguldak Province on 19 January 2008 was not evaluated directly by the Mission team.

Table 1: Outbreaks investigated, timelines and field activities

<table>
<thead>
<tr>
<th>Outbreak code</th>
<th>08002</th>
<th>08003</th>
<th>08004</th>
<th>08005</th>
<th>08006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Village</td>
<td>Yörükluer</td>
<td>Yenicam</td>
<td>Konacik</td>
<td>Aybeder</td>
<td>Tasmanli</td>
</tr>
<tr>
<td>Province</td>
<td>Samsun</td>
<td>Sakarya</td>
<td>Sakarya</td>
<td>Samsun</td>
<td>Sinop</td>
</tr>
<tr>
<td>Date of start of likely infection</td>
<td>19-Jan-08</td>
<td>21-Jan-08</td>
<td>21-Jan-08</td>
<td>29-Jan-08</td>
<td>04-Feb-08</td>
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<tr>
<td>End date of likely infection</td>
<td>24-Jan-08</td>
<td>26-Jan-08</td>
<td>26-Jan-08</td>
<td>03-Feb-08</td>
<td>09-Feb-08</td>
</tr>
<tr>
<td>Date of epidemiological investigation</td>
<td>21-Feb-08</td>
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<td>26-Feb-08</td>
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<td>28-Feb-08</td>
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<tr>
<td>Days from infection to</td>
<td>28</td>
<td>31</td>
<td>31</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>Outbreak code</td>
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<td>08004</td>
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<td>-------</td>
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</tr>
<tr>
<td>investigation</td>
<td></td>
<td></td>
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<td>Outbreak investigation carried out</td>
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<td>Y</td>
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<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y/N</td>
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<tr>
<td>Likely source wild bird</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Un-determined</td>
</tr>
<tr>
<td>Likely source hunting away from household</td>
<td>Stated “No” but possible</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Stated “No” but possible</td>
</tr>
<tr>
<td>Census around outbreak site</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Census of water birds at hunting sites</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Collection of dead birds at hunting sites</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Capture of healthy wild birds at hunting sites</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>

Outbreak investigations, wild bird transects, and point were conducted at the 5 outbreak sites at Yörükler in Samsun Province, Yenicam in Sakarya Province, Konacik in Sakarya Province, Aybeder in Samsun Province, and Tasmanli in Sinop Province. At Yörükler, Yenicam, and Sinop, census work was also conducted at adjacent wetlands identified as the source of the hunted apparently infected birds. At Aybeder, census work was conducted at adjacent wetlands but not at the hunting site. Associated with the Konacik outbreak, information was collected about the location where birds had been hunted prior to the outbreak, but census activities were not possible at this large wetland.

Daily shoreline monitoring and collection of carcasses was conducted at the Yörükler outbreak site and adjacent wetland. During census work at other sites, census activities included shoreline scans for dead birds but continuous dead bird monitoring was not possible. Capture and sampling of wild birds was conducted at the Yörükler site and in adjacent wetlands.

A mid-Mission briefing was given by Honhold in Ankara on 27 February 2008 and attendance included FAO-Turkey, EU, USDA, WHO, MOA, MOE, and KAD. A final debrief was provided by Newman and Honhold in Rome on 10 March and was attended by FAO-SEC, FAO-Turkey, EC delegation in Turkey, Biology Department of the Middle East Technical University, Bird Research Association, Bird Research Association, General Director of Protection & Control, Ministry of Agriculture, UNDSS, FAO-Rome (CMC, AGAH, and TCEO).

Annex 3 shows the details of the mission agenda and activities.

### 2.2 Current disease situation

Turkey has a passive surveillance system that since April 2006 has resulted in the submission, on average, of two samples per day for investigation as suspect cases of HPAI. This has been
divided roughly 2:1 between domestic backyard poultry and wild birds. All commercial flocks are inspected at the time of slaughter by official veterinarians. Additionally, all broiler flocks have mortality records examined before a movement licence is issued and most are tested with rapid antigen detection kits. The functioning of these passive surveillance systems is assessed to be good. The repeated discovery of small outbreaks in relatively remote locations indicates that passive surveillance is functioning in backyard poultry. The system in commercial poultry is extensive and would need an improbable amount of collusion for disease to be hidden in this sector.

There had been six reported outbreaks in the period 19 January to 18 February 2008, with all culling operations completed by 20 February 2008. Symptoms have been classically those of HPAI (swollen head, darkened wattles, respiratory signs, nervous signs, death in 1-2 days). To date, 345 birds have died of the disease and a further 6,187 have been culled, an average of around 1,000 birds per confirmed outbreak. Of those culled, over 4,000 were associated with a single outbreak, most of which were culled outside the 3km protection zone. (Source: GDPC database).

Initial outbreak investigations attributed the source of all infections to hunted wild birds.

See section 2.3.2 for details of epidemiological findings during the mission.

2.3 Epidemiology and surveillance

The following maps show the location of the outbreaks:

Analysis showed that the median distance of the outbreaks from the coast was 3km and the median distance between outbreaks was 97 km. The shape of the epidemic curve indicated that there was no evidence of spread between outbreaks. Though the information included in the time line suggests that spread would be possible, it is unlikely that this had taken place between the two closest outbreaks – since clinical signs at both sites first appeared on the same date. The temporal analytical epidemiology clearly indicated that this was not a propagating epidemic, but a series of separate introductions, while the spatial epidemiology suggests that outbreaks have a spatial relationship along the southern shore of the Black Sea. Field outbreak investigations substantiate this and added that no credible domestic poultry source could be found at any of the outbreaks investigated. Investigations clearly pointed to the
source of the outbreaks being introductions via wild birds in three of the five outbreaks and the probable source in one other. At the fifth site, direct contact between domestic poultry and wild birds was the most likely source, although hunting could not be ruled in or out.

This epidemiological investigation provides one of the clearest and most direct examples to date, of introduction of infection to domestic poultry from wild birds. This was also the finding of the EU team investigation of the first outbreak (not investigated by the Mission), also involving hunted birds. It is notable that in at least four of the six cases to date, there is a strong link to hunters bringing hunted wild birds back to the first affected households a few days before the onset of signs in their poultry.

*Details of the results of epidemiological investigation and analysis are given in Annex 4.*

### 2.3a Wild Bird Census Findings

The census activities associated with this Mission resulted in the counting of 3,235 birds comprising 83 species. Coot, pochard, teal and rook were the species in counted in the greatest abundance and these species were present at 4, 2, 1, and 4 of the 5 outbreak sites or associated hunting sites respectively.

Census information demonstrates that at every outbreak site investigated, there were large numbers of bridge species which would likely have exposure to feathers and viscera of infected hunted ducks. Although the species lists vary for each outbreak site investigated, based on the type of habitat, physical features of the habitat, other species, present (biodiversity), food availability, and predator pressure, there are some species that were present at all 5 outbreak sites investigated including Blackbird, Robin, Goldfinch, and Hooded Crow.

A brief summary of census findings at each site are below.

**Aybeder Samsun Census**: transects extending of 500 m around the outbreak site (house)
- Date of census: 21 February 2008
- Team: Javier Sanz-Alvarez, Kiraz Erciyas, Ozge Kesapli Can, Okan Can, Yakup Sancar Baris, Cemal Ozsemir
- Observed 36 species and 254 birds based on point counts and line transects.

**Yörükler Samsun Census**: transects extending of 500 m circumference around the outbreak site (house)
- Date of census: 22 February 2008
- Team: Javier Sanz-Alvarez, Kiraz Erciyas, Ozge Kesapli Can, Okan Can, Yakup Sancar Baris, Cemal Ozsemir
- Observed 38 species and 529 birds based on point counts and line transects.

**Konacik Sakarya Census**: circumference of 500 m around the outbreak site (house)
- Date of census: 2 March 2008
- Team: Bahar Bilgen, Murat Bozdoğan
- Observed 20 species and 137 birds based on point counts and line transects.

**Yeniçam Sakarya Census**: circumference of 500 m around the outbreak site (house)
- Date of census: 2 March 2008
- Team: Bahar Bilgen, Murat Bozdoğan, Scott Newman
Observed 11 species and 96 birds based on point counts and line transects. In addition, a point survey of non-passerine species at Arikler Lake where the hunted bird(s) were reportedly taken included 4 species and 1,589 birds.

**Taşmanlı Village Sinop Census:** circumference of 1,000 m around the outbreak site (house) that included Taşmanlı Pond
- Date of census: 1 March 2008
- Team: Okan Can, Cemal Özsemir
- Observed 42 species and 650 birds based on point counts and line transects

The abundance of bridge species at outbreak sites demonstrates the risk of disease transmission from tissues (feathers and viscera) of hunted infected birds to other wild birds by bringing hunted carcasses home, cleaning them, and disposing of infectious materials into the environment. Furthermore, these same bridge species could have had direct contact with poultry that became infected, and again, the risk for disease movement from poultry into wildlife has been clearly demonstrated through census activities. Although the Mission did not observe or receive reports of wild bird mortalities away from the outbreak sites, local movements of bridge species from infected outbreak sites demonstrates that once exposed, bridge species can potentially move disease short distances either by serving as flying fomites or by becoming infected and shedding virus in other locations.

At wetlands sites, the transmission route of virus among wild birds is most often assumed to be through faecal-oral, or possibly oral-oral for H5N1 HPAI. However, if HPAI H5N1 infected wild birds are shot and cleaned in wetlands and infectious materials are left in the environment, there are a large number of species including waterfowl, geese, swan, raptors and other mammalian scavengers that could be exposed. Furthermore, moribund HPAI H5N1 infected wild birds that die also pose great risk for virus transmission emphasizing the importance of secondary routes of exposure which may be equally as important as direct inter-animal transmission, in sustaining virus in ecological systems.

*Details of the results and analyses of wild bird census findings are given in Annex 5.*

### 2.3b Wild Bird Monitoring

We collected samples from 43 dead birds that included 4 birds that we sampled after the Samsun hunting club provided them, and 39 birds that the wildlife team recovered by monitoring shoreline of the canal near the Yörükler site, and also the nearby wetlands. These samples include some birds that were injured by hunters, and others that had no visible hunting injuries. Of particular interest are two cats (one adult and one kitten) found dead near the Yörükler outbreak site.

From all dead birds, duplicate oropharyngeal/tracheal and cloacal swabs were collected for testing, and necropsies were performed on 37 carcasses as two were determined to be autolyzed beyond diagnostic value. From the necropsied birds, a tissue homogenate was made from liver, kidney, CNS, spleen, pancreas, oesophagus, stomach, small and large intestine.

*Details of the results of dead birds collected are given in Annex 6*
2.3c **Wild Bird Captures**

A total of 177 live birds were captured and sampled for diagnostic testing from the Yörükler site and the adjacent wetlands. For each bird, duplicate oropharyngeal/tracheal and cloacal swabs were collected. In addition to sampling, birds were weighed, ringed, and the species identified prior to release.

*Details of the results of live bird capture information are given in Annex 7*

2.3d **Environmental Sampling**

A total of 75 fresh faecal samples were collected for analyses from coots, ducks and corvids.

2.3e **Sample Collection and Laboratory Analyses**

All samples were collected in viral transport media supplied by the laboratory and cold chain was maintained using ice packs, snow, and coolers. Samples were transported to the lab in Samsun and stored at -70°C until being transferred to the lab in Ankara where samples were placed back into a -70°C freezer. Duplicate samples were separated out and 1 sample of each duplicate was sent to the FAO-OIE reference lab in Padova Italy. At both the Padova and Etilk lab (Ankara), samples will be analysed using PCR and virus isolation techniques. At the Yörükler site, national and international biologists captured and sampled 177 healthy free-ranging birds, collected samples from 43 dead birds (four hunted and 39 recovered by shoreline monitoring), and 75 fresh faecal samples for AI testing.

One moribund buzzard (*Buteo buteo*) collected and euthanized on 5 March 2008 from the wetlands (N 41 39 09,62 E 36 04 18,29) adjacent to the Yörükler outbreak site, was positive for H5N1 HPAI. This finding is of significance because it demonstrates that 3-4 weeks after depopulation of domestic poultry surrounding the outbreak site, the virus persisted, most likely circulating in one or more wild birds. Based on the foraging behaviour of the buzzard, infection most likely took place by ingestion of a sick live (moribund) or fresh dead bird carcass, with the greatest likelihood being a dead wild bird since infected poultry had been culled 3-4 weeks prior to this bird becoming infected. There is also a possibility that the buzzard was infected a few weeks prior, when there were both infected wild and domestic poultry, but only succumbed much later.

2.3f **Integrating Ornithology Into Outbreak Investigation Activities**

As this was the first time globally, that a Mission attempted to conduct concurrent outbreak investigations at poultry outbreak sites, coupled with census activities, monitoring for dead wild birds, and wild bird capture and sampling, we have gained great insight into the best ways to conduct these activities in the future.

Since most ornithologists are not trained on epidemiological principles related to understanding the role that wild birds may play in disease introduction at poultry farms or into backyard poultry flocks, nor do they have training to look at how disease may spill over from poultry into wild bird populations at outbreak sites, jointly combined poultry outbreak
investigations and wild bird activities provided an excellent training opportunity as well as real time experience for ornithologists in Turkey.

The Mission was successful at accomplishing most of the stated objectives. We conducted census work at all five sites, captured and sampled 177 healthy free-ranging birds, collected 43 dead birds (4 hunted and 39 from shoreline monitoring) and 2 cats as well as 75 fresh faecal samples for HPAI analyses with one moribund and euthanized bird being positive for H5N1 HPAI. Radio marking was not accomplished because the desired species were not captured.

At the onset of the Mission, it was recognized that the greatest challenge of the Mission would be to capture waterfowl due to: 1) the lack of waterfowl capture experience of national biologists, 2) the inherent challenges associated with capturing flighted waterfowl, 3) the timing of the attempted captures that coincided with late February, a time during the season when behaviour and activity patterns are associated with pre-spring migration staging, 4) the abundance of food available due to onset of spring vegetation blooms, 5) a high level of disturbance and high sensitivity to human activity associated with high hunting pressure in the wetland and surrounding area, 6) the limited time available for pre-baiting before traps were placed and captures attempted, 7) the limited time available to have a response to baiting (limited to 2-3 weeks maximum), and the limitation of capture techniques that could be employed during the Mission (i.e. not able to use cannon or rocket nets due to lack of equipment in-country, lack of trained personnel, and inability to mobilise this equipment on short notice (1 week prior to the onset of the Mission) from trained, licensed personnel).

Despite the lack of success in capturing waterfowl, extensive duck capture training was provided including evaluating habitats appropriate for capture, understanding behaviour of ducks, techniques for monitoring daily movements and habitat use, principles and methods for conducting appropriate baiting, identifying types of duck traps that can work in different situations, use of decoys, as well as construction and use of nooses, walk-in or swim-in traps, and whoosh nets. National ornithologists also have a clear understanding of what activities to undertake, and how best to perform these activities to gain insight into the role that wild birds may play in disease introductions at poultry sites. As well, there is increased understanding of how bridge species or secondary infections from predation may play a role in the sustaining and transmitting H5N1 HPAI.

2.4 Disease prevention and control

2.4.1 Institutional setup

Turkey has a central veterinary authority (GDPC /KKGM) and each province has a veterinary department. The system in Turkey is fairly devolved, with each province having a degree of independence but under the overall control of the GDPC. In practice, this works well for the most part. At province level, cross Ministerial working is relatively easy and common, which enable resources to be easily mobilised. Provincial governors have substantial powers to direct control activities.

2.4.2 National contingency plans

Turkey has a fully developed (and tested) preparedness plan and contingency plan. Both have been revised in the light of experience and developments. They can be found at [www.kkgm.gov.tr](http://www.kkgm.gov.tr) Given the new capacity that exists amongst ornithologists in Turkey, the importance of concurrent, real time poultry outbreak investigations coupled with wildlife
census activities, monitoring and collection of dead wild birds, and capture/sampling of wild birds, it may be valuable to revisit the current national contingency plan and revise it to reflect the increased capacity that exists in Turkey to gain better insight into the role that wild birds play in future outbreaks.

2.4.3 Diagnostic activities and facilities
Turkey has a system of eight regional diagnostic labs. All have been recently equipped with real time RT-PCR thermocyclers and computers. They can all also undertake egg inoculation and differentiate between Newcastle disease and HPAI. There are three reference labs for AI in Turkey which can undertake typing and one lab performs sequencing (Pendik). These three labs participated to the EU inter-laboratory ring trials of molecular detection/characterisation methods of AI in the years 2007 and 2008 (conducted by the EU community reference laboratory, VLA). They have also been trained for molecular testing through EU projects. One lab provided very good results with the 2008 panel, which included AI, H5 and H7 detection by real-time and correct pathotyping of the H5 and H7.

2.4.4 Response and control activities and capacity
Each outbreak has been handled differently, depending on the situation. Area culling has not been used in any case to date, with all culling based on veterinary risk assessment. This has varied from culling the poultry in the affected village and several nearby villages to only culling the birds in a few isolated houses. Biosecurity has improved year on year. This year there is more use of high pressure washing followed by disinfection as opposed to the use of medium pressure washer/disinfectors. All affected sites are placed under quarantine for 21 days although enforcement can be difficult and incomplete in relatively remote locations.

At only one outbreak investigation site (Konacik Sakarya) did the Mission team observe a flock of backyard duck (approximately 10) being maintained within the cull zone and before the site was declared HPAI free.

2.4.5 Communication
Turkey has a good system for communications with most places receiving mobile phone coverage.

3. RECOMMENDATIONS AND NEXT STEPS
The CMC-AH mission has provided the below-mentioned recommendations for Government implementation to prevent/control the disease.

3.1 Immediate and short-term recommendations
3.1.1 Institutional setup
This was not specifically examined as part of the Mission, however, Mission activities overlapped with the Institutional setup from the standpoint of needing to establish collaborations amongst Ministries, laboratories, and ornithologists, as well as the mechanisms by which permits were obtained to conduct the Mission activities. Revision of the national contingency plan to reflect new national ornithological capacities is appropriate and would provide a clear understanding of the mechanisms for future collaboration amongst Ministries, NGO’s, ornithologists, and other fields of expertise that have not been previously included in
the institutional structure, chain of command, or standard AI outbreak response and activities to date.

3.1.2 Control
Based on the epidemiological investigations conducted during the Mission, this appears to be good. The decision to cull based on the combination of clinical signs and a positive rapid test result i.e. without waiting for a "confirmatory" lab result has led to significant savings in time and has allowed control at an earlier stage before spread and resulted in more focused limited culling.

During outbreak responses, it may also be beneficial to collect sick or dead wild birds in surrounding wetlands near outbreak sites and dispose of them properly. These moribund or dead wild birds would not only provide additional virus surveillance information, but as has been demonstrated, they may also be a source of virus that can sustain virus in the region of facilitate further virus transmission. Removing them from the environment would prevent secondary exposure through contact or predation.

Conducting an educational programme that effectively reaches both legal and illegal hunters would be beneficial. It would be important to emphasize that bringing hunted birds home and cleaning them poses a health risk to humans cleaning the birds, as well as poultry and wild birds exposed to potentially infectious materials (feathers and viscera). As well, if potentially infected materials could be buried (>15cm below the ground), and covered with dirt, this would be one simple way to prevent potential spread of HPAI if an infected bird happens to have been hunted. These same actions would also minimize disease transmission that could take place in wetlands if hunted birds are cleaned there and infectious materials are not disposed of properly.

A more consistent application of strict biosecurity measures is recommended.

3.1.3 Compensation
None. Compensation is paid at full market value for backyard birds, directly and rapidly to the owners

3.1.4 Vaccination
Turkey has a policy of non-vaccination against AI. This should be maintained.

3.1.5 Epidemiology and surveillance
The systems put in place in the last few years are functioning well however additional surveillance on wild birds, including both samples from live captured birds at/near outbreak sites, and sanctioned hunters would compliment the ongoing poultry surveillance programme.

It would be valuable to conduct future outbreak investigations that included trained ornithologists that have experience identifying species present at outbreak sites or nearby wetlands, as well as conducting shoreline collection of dead birds for diagnostic purposes. This combined approach would greatly enhance our understanding of the role that wild birds play in the epidemiology of this disease, better clarify the cause of disease introductions at each future outbreak, identify potential sources of disease persistence, and provide insight on how virus may spill over from the domestic to wild bird sector.
3.1.6 Laboratory

The need for on-site laboratory training or adjustments for Etlik/Bornova and other laboratories should be considered. Though some staff have been trained in other laboratories outside Turkey, the implementation of such training is recommended and is to be validated (i.e., real-time PCR protocols as recommended by the EU Diagnostic Manual). Furthermore, laboratories must adapt protocols to the existing Roche real-time thermocyclers which will require specific adjustments (Etlik/Bornova). This could include, but not be limited to: a) development and revision of protocols and SOPs (with experts that use the Roche instrument on a routine basis, i.e., the Croatian laboratory), b) understanding reasons for PCR negative and egg inoculation positive results, and c) interpretation of phylogenetic results (i.e. genetic clades in relation to the global spread of HPAI). The FAO OFFLU bioinformatician could be available for such training/support subsequently, after effective diagnostic methods have been implemented.

3.1.7 Personal protective equipment

PPE recommendations for ornithologists working in the field or at outbreak sites have been refined. Please refer to technical specification provided in Annex 8 related to proper levels of biosafety and PPE necessary for reducing the risk of pathogen spread.

3.1.8 Communication and public awareness

There is a high level of public awareness of the disease in Turkey in domestic poultry and how to respond to it. The potential role of wild birds is also known (perhaps overstressed as in many countries). Messages should be developed targeted at hunters to encourage practices that prevent their domestic poultry, other wild birds, and humans from being exposed to the internal organs and feathers of hunted wild birds.

Be careful: make a strong statement on the need to avoid wild bird destruction...

3.1.9 Coordination

Additional coordination amongst the MOA, MOE, ornithologists, hunting clubs, and laboratories is needed to ensure the best possible outbreak investigations, surveillance programme, and disease prevention.

3.2 Recommendations for FAO next steps

1) Conduct a debrief/workshop in Turkey with MOA, MOE, ornithologists, laboratory entities, hunting clubs, and EU team to develop an agreed upon strategy for ensuring that future outbreaks are conducted in such a way that outbreak investigations, stamping out, and wild bird assessment activities are mobilised at the same time and conducted concurrently

2) Participate in planned EU wildlife cannon netting and duck capture training: Oct 08

3) Develop literature related to best practices for hunters to prevent spread of HPAI to poultry and wild birds, and to safeguard themselves and their families. This has clear implications for Turkey but lessons learned apply globally.
   a) in partnership with the EU project
   b) in partnership with FAO-communications programme (Rome)
   c) in partnership with FAO Forestry Division (Rome)
4) Implement long-term census, monitoring, and disease surveillance activities in Turkey-needs to be in place by Sept 08 to allow sampling this fall when migratory birds arrive back in Turkey
   a) consider through emergency TCP
   b) Consider through FAO Regional Program
   c) Consider through EU funded NewFlu Program
   d) combination of the above programs

5) Implement a Black Sea Basin HPAI project to include multiple countries bordering the Black Sea that includes census, monitoring, surveillance, and habitat use/migration studies to better understand the livestock-wildlife interface in the region and any ecological drivers of wild bird movements from the northern Black Sea to the southern coast line that encompasses Turkey.

6) Capacity building and training for the MOA, MOE, ornithologists, diagnostic laboratories, and hunting clubs (from all provinces) in order to establish an ongoing disease surveillance programme through the sanctioned hunting programme.

7) Laboratory training for Etlik and other laboratories to include: a) protocols and SOPs, b) conventional versus real time PCR analyses, c) understanding reasons for PCR negative and egg inoculation positive results, and d) interpretation of clades of virus in relation to the global spread of HPAI
MISSION REPORT  CRISIS MANAGEMENT CENTRE – ANIMAL HEALTH

4. ANNEXES

Annex 1: Official request

----- Original Message ----- 

From: Domenech, Joseph (AGAH)
To: haluka@kkgm.gov.tr
Cc: Honhold, Nick (AGAH); Ferrari, Giancarlo (AGAH); Lubroth, Juan (AGAH); Newman, Scott (AGAH); Burgeon, Dominique (TCEO); Farina, Tiziana (AGAH)

Sent: Monday, February 04, 2008 6:38 PM

Subject: HPAI Turkey

Dear Dr Aşkaroğlu

We are sorry to see that Turkey is suffering outbreaks of H5N1 HPAI in domestic poultry and note that the two cases reported in 2008 are both thought to have been due to infection passing from wild water birds to domestic poultry. FAO has worked extensively together with collaborating centres in order to understand the role of wild birds in H5N1 HPAI and their interactions with domestic poultry. Although it is clear that wild birds play a role in transmitting the disease, widespread sampling of live birds has yet to show a significant amount of infection. However, this sampling has not, so far, been targeted around recent confirmed outbreaks in domestic poultry.

FAO recommends the sampling of healthy wild birds around known recent outbreaks of the disease in domestic poultry. This sampling should be directed at wild water birds, specifically ducks and preferably at juvenile animals. In order to be of relevance, such sampling should be undertaken within a short time of the commencement of the outbreak. FAO would be very much interested in participating in such investigations as a matter of general information as well as regular collaboration and support to Turkey as an FAO member country. FAO would also be very pleased to provide details on the protocols to be used such as types of birds and numbers to be caught and assist in providing both specialist equipment and trained personnel to capture the birds.

FAO would like to send a short term mission of around one week with the necessary personnel and equipment to undertake such sampling. This mission would of course work closely with the Government of Turkey including full sharing of data. Indeed, it would be ideal if samples could be processed in the laboratory facilities in Turkey.

Looking forward to receiving if possible a rapid answer.

Yours sincerely

J. Domenech
Chief Animal Health Service- FAO, CVO

-----Original Message----- 

From: H. Haluk ASKAROGLU [mailto:haluka@kkgm.gov.tr]
Sent: 06 February 2008 10:30
To: Domenech, Joseph (AGAH)  
Cc: Honhold, Nick (AGAH); Ferrari, Giancarlo (AGAH); Lubroth, Juan (AGAH); Newman, Scott (AGAH); Burgeon, Dominique (TCEO); Farina, Tiziana (AGAH); Doç.Dr.Muzaffer AYDEMIR; beytullaho@kkgm.gov.tr  
Subject: Re: HPAI Turkey

Dear Dr. Domenech,

I acknowledge with thanks the receipt of your e-mail regarding a short term mission in Turkey to elucidate the role of wild birds in H5N1 HPAI and their interactions with domestic poultry.

We highly appreciate FAO proposal to undertake such a mission with necessary personnel and equipment for sampling wild birds. I agree with the proposal. The mission team will work closely with the Government of Turkey, including full sharing of data and the samples will be processed in the laboratory facilities in Turkey. During the mission the FAO team will be supported and will work in close collaboration also with the EU Technical assistance to Avian Influenza Preparedness and Response project team.

I am looking forward to receive details about the mission.

Yours sincerely

H.Haluk Askaroglu
Annex 2: Terms of reference

Terms of Reference
CMC-AH/EMPRES Mission: Turkey
International Consultant
Team Leader and Investigation Coordinator

Under the overall guidance of the Chief, Emergency Centre for Transboundary Animal Diseases (ECTAD) and the supervision of the Manager of the Crisis Management Centre-Animal Health and the Head of EMPRES, and in close collaboration with the other mission team member(s) and the FAO representation, the incumbent will:

1. Coordinate and oversee surveys to determine the species diversity and densities of wild birds that have high potential for contact with domestic birds at the outbreak locations
2. Assess the role of wild birds (migratory and resident species) in the introduction and spread of the highly pathogenic avian influenza virus at [January 2008] outbreak sites in Turkey
3. Provide information on traps and capture equipment necessary to capture the wild bird species at and near the outbreak sites
4. Assist with building, deploying and implementing capture of wild birds
5. Oversee sampling, labelling, storage, and packaging of diagnostic samples
6. Provide daily updates on mission progress to CMC-AH and GLEWS
7. Conduct a debriefing with CVO Turkey, MOA, etc. at conclusion of Mission, or provide a progress report as of the day of departure from Turkey
8. Prepare Final Report within 1-week of the conclusion of the Mission

Duty Station: Turkey
Duration: 3 weeks

Qualifications:

The consultant will have a doctorate of veterinary medicine with advance study in epidemiology and expertise (at least 5 years) in disease risk assessment. It is preferred that the consultant have training in the Incident Command System. The consultant will be able to write and speak in English.

Security

Before starting the mission/travel, the mission member must determine the security phase of the country of assignment and what this implies for his/her own security. As soon as s/he arrives at the duty station, through the FAO Representation or directly s/he must contact the designated UN security officer to be briefed on all the recommended security measures. In case this procedure is not properly applied, the consultant/PSA/staff member holder may not be covered under the Malicious Acts Insurance Policy.

Health

All Consultants and Staff Members, on duty travel, must accept responsibility for their health and well being as part of their official duties and also on their return.
The following are the main responsibilities of the traveller:

- Seek health advice prior to travel.
- Compliance with recommended vaccinations and other prescribed medication and health measures.
- Ensure health precautions are taken before, during and after travel.
- Obtain a physician's letter pertaining to any prescription medicines, syringes, etc., being carried.
- Precautions to avoid transmitting any infectious disease to others during and after travel.
- Report any illness on return, including information about all recent travel.
- Respect the host country and its population.

Mission Focal Points:

- Primary: Gary Brickler, Mission Coordinator (Back-Up Barbara Corso)
- Secondary: Syrine Chaalala, Mission Operations Coordinator (Back-Up Elizabeth Christy)
Terms of Reference
CMC-AH/EMPRES Mission: Turkey
International Consultant
Epidemiologist

Under the overall guidance of the Chief, Emergency Centre for Transboundary Animal Diseases (ECTAD) and the technical supervision of the Manager of the Crisis Management Centre Animal Health and the head of EMPRES, and guidance of the Team Leader, and in close collaboration with the other mission team member(s) and the FAO representation, the incumbent will:

1. Undertake epidemiological analysis of data from outbreaks
2. Collect and collate disease outbreak investigation reports
3. Investigate any reports of significant morbidity or mortality in backyard poultry near the outbreak sites or in adjacent villages/towns/cities
4. Undertake and/or arrange for epidemiological investigations in randomly selected villages/towns/cities in which no outbreak has been detected in the area close to confirmed outbreak sites
5. Visit outbreak sites and assist ornithologists in defining trapping sites, species to be trapped, building traps, and trapping
6. Assist with sampling captured wild birds
7. Assist in the investigation any wild bird die offs and assist with necropsies/sampling
8. Perform other duties as required.

Duty Station: Turkey
Duration: 3 weeks
Qualifications:

The consultant will have a doctorate of veterinary medicine with advance study in epidemiology and expertise (at least 5 years) in disease risk assessment. It is preferred that the consultant have training in the Incident Command System. The consultant will be able to write and speak in English.

Security

Before starting the mission/travel, the mission member must determine the security phase of the country of assignment and what this implies for his/her own security. As soon as s/he arrives at the duty station, through the FAO Representation or directly s/he must contact the designated UN security officer to be briefed on all the recommended security measures. In case this procedure is not properly applied, the consultant/PSA/staff member holder may not be covered under the Malicious Acts Insurance Policy.

Health

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The following are the main responsibilities of the traveller:

- Seek health advice, prior to travel.
• Compliance with recommended vaccinations and other prescribed medication and health measures.
• Ensure health precautions are taken before, during and after travel.
• Obtain a physician's letter pertaining to any prescription medicines, syringes, etc., being carried.
• Precautions to avoid transmitting any infectious disease to others during and after travel.
• Report any illness on return, including information about all recent travel.
• Respect the host country and its population.

Mission Focal Points:

- Primary: Gary Brickler, Mission Coordinator (Back-Up Claudia Cartwright or Barbara Corso)
- Secondary: Syrine Chaalala, Mission Operations Coordinator (Back-Up Elizabeth Christy)
Terms of Reference
CMC-AH/EMPRES Mission: Turkey
International Consultant
Wild bird specialist/ornithologist

Under the overall guidance of the Chief, Emergency Centre for Transboundary Animal Diseases (ECTAD) and the technical supervision of the Manager of the Crisis Management Centre Animal Health and the head of EMPRES, and guidance of the Team Leader, and in close collaboration with the other mission team member(s) and the FAO representation, the incumbent will:

1. Conduct surveys to determine the species diversity and densities of wild birds that have high potential for contact with domestic birds at the outbreak locations
2. Collect GPS data on locations of infected sites and important wildlife habitats around the outbreaks locations
3. Create an inventory (Excel spreadsheet) of on the species of birds (migratory and resident) present in and near outbreak areas based on surveys
4. Evaluate habitats and determine which locations would be best for bird trapping
5. Construct bird traps
6. Assist in the capture wild birds (waterfowl, coots, passerines/other bridge species) with waterfowl being the primary species targeted
7. Sample (blood, cloacal and oropharyngeal swabs, or fresh faeces) captured live wild birds
8. Assist with proper labelling, storing, packing and shipping diagnostic samples to laboratories identified by FAO for laboratory analyses
9. Perform other duties as required

Duty Station: Turkey
Duration: 3 weeks

Qualifications:
The consultant will have; expertise in ornithological issues including bird capture/handling, and an undergraduate or masters degree in ornithology or a related biological degree, or at least 5 years of experience working in the ornithological field. It is preferred that the consultant have training in duck trapping and the Incident Command System. The consultant will be able to write and speak in English.

Security
Before starting the mission/travel, the mission member must determine the security phase of the country of assignment and what this implies for his/her own security. As soon as s/he arrives at the duty station, through the FAO Representation or directly s/he must contact the designated UN security officer to be briefed on all the recommended security measures. In case this procedure is not properly applied, the consultant/PSA/staff member holder may not be covered under the Malicious Acts Insurance Policy.

Health
All Consultants and Staff Members, on duty travel, must accept responsibility for their health and well being as part of their official duties and also on their return.
The following are the main responsibilities of the traveller:

- Seek health advice, prior to travel.
- Compliance with recommended vaccinations and other prescribed medication and health measures.
- Ensure health precautions are taken before, during and after travel.
- Obtain a physician's letter pertaining to any prescription medicines, syringes, etc., being carried.
- Precautions to avoid transmitting any infectious disease to others during and after travel.
- Report any illness on return, including information about all recent travel.
- Respect the host country and its population.

Mission Focal Points:

- Primary: Gary Brickler, Mission Coordinator (Back-Up Claudia Cartwright or Barbara Corso)
- Secondary: Syrine Chaalala, Mission Operations Coordinator (Back-Up Elizabeth Christy)
Terms of Reference
CMC-AH/EMPRES Mission: Turkey
National Consultant
Wild Bird Specialist/Ornithologist

Under the overall guidance of the Chief, Emergency Centre for Transboundary Animal Diseases (ECTAD), the supervision of the Manager of the Crisis Management Centre-Animal Health and the head of EMPRES, and technical guidance of the Team Leader, and in close collaboration with the other mission team member(s) and the FAO representation, the incumbent will:

1. Conduct surveys to determine the species diversity and densities of wild birds that have high potential for contact with domestic birds at the outbreak locations
2. Collect GPS data on locations of infected sites and important wildlife habitats around the HPAI outbreak locations
3. Create an inventory (Excel spreadsheet) and map of on the species of birds (migratory and resident) present in and near outbreak areas based on surveys
4. Conduct observations/surveys at wetlands, lakes, or other wild bird habitat within 5 km of the outbreak sites to determine if additional dead wild birds can be found and recovered in the outbreak areas
5. Assess the role of wild birds (migratory and resident species) in the introduction and spread of the highly pathogenic avian influenza virus in the Turkey
6. Provide information on traps and capture equipment available for use in Turkey to capture wild birds
7. Assist in the capture wild birds targeting the following birds (waterfowl, coots, passerines/other bridge species, shorebirds, grebes, cormorants)
8. Assist in the sampling (full necropsy and appropriate samples) of any dead wild birds around outbreak sites and attempt to capture and sample (blood, cloacal and oropharyngeal swabs, or fresh faeces) live wild birds at farms that were infected or alternatively, collect fresh wild bird fecal material if possible
9. Assist with proper labelling, storing, packing and shipping diagnostic samples to laboratories identified by FAO for laboratory analyses
10. Perform other duties as required

Duty Station: Turkey

Duration: 3-4 weeks

Qualifications:

The consultant will have; expertise in ornithological issues including bird capture/handling, and an undergraduate or masters degree in ornithology or a related biological degree, or at least 5 years of experience working in the ornithological field. It is preferred that the consultant have training in the Incident Command System. The consultant will be able to write and speak in English.

Security

Before starting the mission/travel, the mission member must determine the security phase of the country of assignment and what this implies for his/her own security. As soon as s/he arrives at the duty station, through the FAO Representation or directly s/he must contact the designated UN security officer to be briefed on all the recommended security measures. In case this procedure is
not properly applied, the consultant/PSA/staff member holder may not be covered under the Malicious Acts Insurance Policy.

Health

All Consultants and Staff Members, on duty travel, must accept responsibility for their health and well being as part of their official duties and also on their return. The following are the main responsibilities of the traveller:

- Seek health advice, prior to travel.
- Compliance with recommended vaccinations and other prescribed medication and health measures.
- Ensure health precautions are taken before, during and after travel.
- Obtain a physician's letter pertaining to any prescription medicines, syringes, etc., being carried.
- Precautions to avoid transmitting any infectious disease to others during and after travel.
- Report any illness on return, including information about all recent travel.
- Respect the host country and its population.

Mission Focal Points:

- Primary: Gary Brickler, Mission Coordinator (Back-Up Claudia Cartwright or Barbara Corso)
- Secondary: Syrine Chaalala, Mission Operations Coordinator (Back-Up Elizabeth Christy)
### Annex 3: Revised mission agenda

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Activity</th>
<th>Team</th>
</tr>
</thead>
<tbody>
<tr>
<td>17 February</td>
<td>Ankara</td>
<td>N Honhold Arrival</td>
<td>NH</td>
</tr>
<tr>
<td>18 February</td>
<td>Ankara</td>
<td>N Newman &amp; J Sanz-Alvarez Arrival</td>
<td>SN, NH, JS</td>
</tr>
<tr>
<td>19 February</td>
<td>Ankara</td>
<td>FAO Turkey, Ministry of Agriculture, local procurement</td>
<td>SN, NH, JS</td>
</tr>
<tr>
<td>20 February</td>
<td>Samsun</td>
<td>Meet up with national consultants</td>
<td>SN, NH, JS + 2 national consultants</td>
</tr>
<tr>
<td>21 February</td>
<td>Samsun</td>
<td>Visit 2 outbreak sites and assess situation; if possible, start baiting sites</td>
<td>SN, NH, JS + 2 national consultants</td>
</tr>
<tr>
<td>22 – 23 February</td>
<td>Samsun</td>
<td>Wild bird surveys; mist/net samples for passerines; bait duck capture site</td>
<td>SN, NH, JS + 2 national consultants</td>
</tr>
<tr>
<td>24 February</td>
<td>Ankara</td>
<td>Travel</td>
<td>SN, NH, JS + 1-2 national consultants</td>
</tr>
<tr>
<td>25 February</td>
<td>Sakarya ***Ankara</td>
<td>***Arrival of Dr Leader</td>
<td>SN, NH, JS + 1-2 national consultants Dr Leader (PL)</td>
</tr>
<tr>
<td>26 February</td>
<td>Sakarya</td>
<td>Visit outbreak sites; assess</td>
<td>SN, NH, JS + 1-2 national consultants</td>
</tr>
<tr>
<td></td>
<td>Samsun and Sakarya</td>
<td>Wild bird surveys;</td>
<td>SN, NH, JS + 2-4 national consultants, 1-2 int experts</td>
</tr>
<tr>
<td>27 February</td>
<td>Ankara</td>
<td>Presentation to GDPC, WB, EU Delegation, WHO, MoEF, USDA &amp; Travel to Sinop: Wild bird work</td>
<td>NH SN JS</td>
</tr>
<tr>
<td>28 February</td>
<td>Sinop Samsun</td>
<td>Outbreak site investigation &amp; travel to Ankara Wild bird work: SN, JS</td>
<td>NH 1-2 int experts, 2-4 national consultants</td>
</tr>
<tr>
<td>29 February</td>
<td>Ankara</td>
<td>N Honhold departure Wild bird work: SN, JS</td>
<td>1-2 int experts, 2-4 national consultants, SN, JS</td>
</tr>
<tr>
<td>1 March</td>
<td></td>
<td>Arrival Dr. Eldridge Wild bird work: SN, JS</td>
<td>1-2 int experts, 2-4 national consultants,</td>
</tr>
<tr>
<td>2 March</td>
<td></td>
<td>Travel to Ankara: SN Wild bird work: JS</td>
<td>1-2 int experts, 2-4 national consultants,</td>
</tr>
<tr>
<td>3 March</td>
<td></td>
<td>SN departure Wild bird work: JS</td>
<td>1-2 int experts, 2-4 national consultants,</td>
</tr>
<tr>
<td>4 March – 9 March</td>
<td></td>
<td>Wild bird work: JS</td>
<td>1-2 int experts, 2-4 national consultants</td>
</tr>
<tr>
<td>10 March</td>
<td></td>
<td>Mission ended JS departure</td>
<td></td>
</tr>
</tbody>
</table>
Annex 4: Epidemiological investigation

Investigation into the source of H5N1 HPAI (general principles)

**Basic principles of HPAI H5N1 investigation**
(or for conducting investigations of high mortality in avian species)

The following are the general principles that underlie the investigations, the epidemiological "philosophy" used.

- It is important that identification of source of infection be based on available evidence;
- Incorrect assumptions lead to incorrect control measures and can damage trade; such assumptions need to be stated;
- Absence of evidence is not evidence of absence;
- Absence of evidence is not evidence of presence;
- Incubation period usually 3-5 days, but in certain species it may be 2-14 days;
- Spread is by direct contact between an infected and susceptible animal or exposure to contaminated material;
- There must be a spatially and temporally consistent link to identify a credible route of infection;
- HPAI spreads between domestic poultry more easily than from wild birds to domestic poultry;
- Most (>95%) spread is from domestic poultry to domestic poultry;
- Between sites, this spread is mostly human mediated
- A minority of spread is from wild birds to domestic poultry
- If a credible domestic poultry source can be found, it would be the likely source over any possible wild bird source;
- Identification of a wild bird source depends on having a lack of a credible domestic poultry source, and the presence of a credible wild bird source;

**Ongoing inter-outbreak surveillance in Turkey**

Surveillance in backyard poultry and wild birds has depended on passive surveillance. Records show that

- In 2006 and 2007, around 2 samples a day had been submitted from suspect cases for lab testing in the periods between outbreaks
- Mostly backyard poultry, some wild birds (ratio 2 to 1)
- All samples negative during spring summer and autumn in each year
- In each year initial positives found during winter
- This pattern indicates a seasonal risk
- Initial outbreaks are often in relatively remote and isolated areas

The consistency of this surveillance effort over an extended period is commendable and indicates the successful nature of the ongoing public awareness campaigns. That the disease is frequently first found in relatively isolated locations and when there has been little or no spread of the disease indicates the sensitivity of the system.

In commercial poultry, there are differing surveillance systems in commercial broiler and egg layer systems.

In broiler flocks, there is on farm and slaughterhouse ante-mortem inspection. the issuing of the required movement certificate

**Analytical epidemiology**
This section looks at the location and time data for each outbreak separately and together to determine the pattern of disease. It should be noted that although reported first here, the analysis was undertaken after the field outbreak analysis in order not to prejudice that part of the work.

**Spatial pattern of disease**
Propagating epidemics of HPAI H5N1 are clustered both spatially and temporally

Figure 1 shows the location of the outbreaks.

**Figure 1: Location of HPAI outbreaks in Turkey Jan-Feb 2008**

All six outbreaks were along the southern shore on the Black Sea. Table 1 shows the distances from the coast, between outbreaks and from significant waterbodies.

The outbreaks were spread over more than 500km of the coast line with a median distance between outbreaks of nearly 100km. They have also been close to waterbodies (median distance 1km).

Whilst widespread outbreaks are not in themselves unlikely when spread of domestic poultry is involved e.g. spread along bus routes it is very unlikely that they would occur in the absence of significant local spread.
**Table 1: Distance of outbreaks from nearest outbreak, coast and waterbodies**

<table>
<thead>
<tr>
<th></th>
<th>Distance of outbreaks from coast (km)</th>
<th>Distance between outbreaks (km)</th>
<th>Distance of outbreaks from waterbody (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
<td>3</td>
<td>97</td>
<td>1</td>
</tr>
<tr>
<td>Minimum</td>
<td>2</td>
<td>31</td>
<td>0.01</td>
</tr>
<tr>
<td>Maximum</td>
<td>18</td>
<td>250</td>
<td>4</td>
</tr>
<tr>
<td>Mean</td>
<td>117</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>S.D.</td>
<td>75</td>
<td>6</td>
<td>1</td>
</tr>
</tbody>
</table>

The spatial distribution shows a clear linkage to the coast line in comparison with all possible locations and in comparison with other outbreaks.

**Temporal pattern of disease**

Figures 2 and 3 show the timelines of the outbreaks, ordered by onset date in Fig 2 and grouped by province and ordered by onset date in Fig 3.

The dates of onset range from 19-Jan-08 to 10-Feb-08, a period of 22 days.

The two outbreaks on Sakarya (08003 and 08004) have the same day of onset. This indicates that despite their relative proximity (around 30km) they were infected separately, not by transmission from one to the other. The timeline shows that either outbreak 08001 in Zonguldak or 08002 in Samsun could have been the source for both. However, the distances involved (around 140km and 460km respectively) make these unlikely sources. This was further investigated in field outbreak investigations (see below).

Outbreak 08005 could have 08002, 08003 or 08004 as a potential source. The distance to the first two is around 530km and to the latter, 72km in a straight line, but further overland. The former distance makes the Sakarya outbreaks an unlikely source, but the latter possible in both space and time.

Outbreak 08006 could have had 08003, 08004 or 08005 as the source. Distance to 08003 and 08004 (around 380km) makes these unlikely sources. Outbreak 08005 is around 170km in a straight line, but much further across land, and this distance is again an unlikely length of spread with no known evidence of disease intervening.

Fig 4 shows the epidemic curves for the outbreak as seven day retrospective rolling averages (necessary to give something approximating a curve when numbers per day are low and often zero). The graph does not show the initial climb them fall associated with a propagating epidemic. Instead it shows, even when smoothed, a series of rises and falls and low overall numbers. This is not indicative of a spreading epidemic, rather of a series of sporadic introductions that are clustered in time but are not caused/affected by each other.

**Conclusion of the temporo-spatial analysis**

This epidemic has the characteristics of a series of separate introductions clustered in time but not space. There is a heavy bias towards the coast line and perhaps towards nearby waterbodies.

There is no indication of a propagating epidemic which would be expected if poultry to poultry spread were occurring.
Fig 2: Timeline for HPAI H5N1 outbreaks in Turkey in January and February 2008:
Ordered by date of onset

<table>
<thead>
<tr>
<th>Case No</th>
<th>Village</th>
<th>Province</th>
<th>Days shedding</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>8001</td>
<td>Sazkoy</td>
<td>Zonguldak</td>
<td>4</td>
<td>05-Jan-08</td>
</tr>
<tr>
<td>8002</td>
<td>Yorukler</td>
<td>Samsun</td>
<td>9</td>
<td>06-Jan-08</td>
</tr>
<tr>
<td>8003</td>
<td>Yenicam</td>
<td>Sakarya</td>
<td>10</td>
<td>07-Jan-08</td>
</tr>
<tr>
<td>8004</td>
<td>Konacik</td>
<td>Sakarya</td>
<td>14</td>
<td>08-Jan-08</td>
</tr>
<tr>
<td>8005</td>
<td>Aybeder</td>
<td>Samsun</td>
<td>5</td>
<td>10-Jan-08</td>
</tr>
<tr>
<td>8006</td>
<td>Tasmanli</td>
<td>Sinop</td>
<td>11</td>
<td>11-Jan-08</td>
</tr>
</tbody>
</table>

Fig 3: Timeline for HPAI H5N1 outbreaks in Turkey in January and February 2008:
Grouped by province and ordered by date of onset

<table>
<thead>
<tr>
<th>Case No</th>
<th>Village</th>
<th>Province</th>
<th>Days shedding</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>8001</td>
<td>Sazkoy</td>
<td>Zonguldak</td>
<td>4</td>
<td>05-Jan-08</td>
</tr>
<tr>
<td>8002</td>
<td>Yorukler</td>
<td>Samsun</td>
<td>9</td>
<td>06-Jan-08</td>
</tr>
<tr>
<td>8003</td>
<td>Yenicam</td>
<td>Sakarya</td>
<td>10</td>
<td>07-Jan-08</td>
</tr>
<tr>
<td>8004</td>
<td>Konacik</td>
<td>Sakarya</td>
<td>14</td>
<td>08-Jan-08</td>
</tr>
<tr>
<td>8005</td>
<td>Aybeder</td>
<td>Samsun</td>
<td>5</td>
<td>10-Jan-08</td>
</tr>
<tr>
<td>8006</td>
<td>Tasmanli</td>
<td>Sinop</td>
<td>11</td>
<td>11-Jan-08</td>
</tr>
</tbody>
</table>

Possible exposure period: E
Probable exposure period: EE
Shedding period: S
Fig 4: Chart of 7 day retrospective rolling daily counts for cases by onset and report date and average numbers of cases shedding.
**Field outbreak investigations**

All six sites were visited and a standard investigation methodology applied that uses semi-structured interviews with poultry owners and village headmen. Wherever possible, the owners of the first affected flock(s) were interviewed directly. The interview covered the details of the disease at that location, potential sources and potential spread. The issue of interest in this report is the potential source of infection. A summary of the findings for each site are shown in table 2.

There is no history of entry of live birds into the affected sites, nor of visits between the affected sites. None of the affected sites lies on a through road and in particular none lies directly on road used by traffic to and from poultry farms.

This table shows the areas for further investigation and clarification. These are

<table>
<thead>
<tr>
<th>Area for Further Investigation</th>
<th>Found in</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Possible role of domestic ducks/geese</td>
<td>3/6</td>
</tr>
<tr>
<td>2. Contact with markets</td>
<td>1/6</td>
</tr>
<tr>
<td>3. Poultry products (meat and eggs) bought by villagers</td>
<td>3-5/6</td>
</tr>
<tr>
<td>4. Role of traders/milk lorries/other vehicles</td>
<td>4/6</td>
</tr>
<tr>
<td>5. Poultry farms within 3km</td>
<td>1/6</td>
</tr>
<tr>
<td>6. Poultry workers/veterinarians living in the village</td>
<td>1/6</td>
</tr>
<tr>
<td>7. Direct contact with waterbirds</td>
<td>1/6</td>
</tr>
<tr>
<td>8. Contact with &quot;bridging&quot; species</td>
<td>6/6</td>
</tr>
<tr>
<td>9. Direct contact with remains of hunted wild birds</td>
<td>4/6</td>
</tr>
</tbody>
</table>

In several cases these are only present in one of the six sites. However, this does not rule them out as outbreaks can be made up of many different types of contacts. Equally, some are present in all cases but this does not rule them in, as there is no control group of unaffected sites against which to compare the frequency of contact. Each will be dealt with in turn.

**Domestic ducks/geese**

These were present in affected flocks in two of the six sites. At one site there were sick ducks and at another a sick goose. In total in three of the six sites had domestic ducks and/or geese present. In none of these sites was there a history of direct contact with wild birds.

As viral infection has to come from somewhere and the ill ducks and geese were to be the source of infection, they would have to have been infected from somewhere else. The lack of evidence of infection in other sites, combined with the relative sensitivity of the surveillance systems in Turkey, make it unlikely that domestic ducks and geese were the source of infection, unless they were acting as bridging species between wild birds and chickens. The fact that where these species were present in affected flocks they were also affected makes this role less likely. The close temporal clustering of the outbreak also makes their role as the primary source of infection less likely; why suddenly at this time of year in six separate locations? Additionally, the sites with ducks and geese present have other stronger possible links.

**Contact with markets**

One site had a possible, although vague, market contact involving a visit to a local market where live birds may have been sold. It is unlikely that this sort of contact would result in only one outbreak; they usually result in a cluster of outbreaks in the vicinity of the market. This is considered to be an unlikely source for this outbreak.

**Table 2: Summary results from field outbreak investigations**
<table>
<thead>
<tr>
<th>Outbreak code</th>
<th>08001</th>
<th>08002</th>
<th>08003</th>
<th>08004</th>
<th>08005</th>
<th>08006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Village</td>
<td>Sazkoy</td>
<td>Yörükler</td>
<td>Yenicam</td>
<td>Konacik</td>
<td>Aybeder</td>
<td>Tasmanli</td>
</tr>
<tr>
<td>Province</td>
<td>Zonguldak</td>
<td>Samsun</td>
<td>Sakarya</td>
<td>Sakarya</td>
<td>Samsun</td>
<td>Sinop</td>
</tr>
<tr>
<td>Date of onset clinical signs</td>
<td>19-Jan-08</td>
<td>26-Jan-08</td>
<td>28-Jan-08</td>
<td>28-Jan-08</td>
<td>05-Feb-08</td>
<td>11-Feb-08</td>
</tr>
<tr>
<td>Date reported</td>
<td>19-Jan-08</td>
<td>28-Jan-08</td>
<td>04-Feb-08</td>
<td>07-Feb-08</td>
<td>07-Feb-08</td>
<td>18-Feb-08</td>
</tr>
<tr>
<td>Days onset to report</td>
<td>1</td>
<td>3</td>
<td>7</td>
<td>10</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Date culling finished</td>
<td>22-Jan-08</td>
<td>02-Feb-08</td>
<td>05-Feb-08</td>
<td>09-Feb-08</td>
<td>08-Feb-08</td>
<td>20-Feb-08</td>
</tr>
<tr>
<td>Days report to end cull</td>
<td>4</td>
<td>6</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Culled on basis of</td>
<td>Rapid test</td>
<td>PCR</td>
<td>Rapid test</td>
<td>Rapid test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contact with other outbreak sites</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Live birds brought to village</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Domestic ducks/geese in site</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Domestic ducks/geese in affected flocks</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Contact with markets</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Movement of villagers to outbreak sites</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Poultry products bought by villagers</td>
<td>?</td>
<td>?</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Traders, milk lorry etc</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Poultry farms within 3km</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Poultry farm workers, vet staff, agric staff in village</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Village on through road</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Regular vehicle traffic past outbreak site</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Direct contact with wild waterbirds</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Contact with “bridging species”</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Direct contact with remains of hunted birds</td>
<td>Y</td>
<td>Stated “No” but possible</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Stated “No” but possible</td>
</tr>
</tbody>
</table>
Commercial poultry products: meat
In this part of Turkey many villagers source much of the chicken meat they eat from local shops, all of which is from the commercial broiler industry in Turkey, either chilled or frozen. Meat is a rare route of spread.

The location of the outbreaks rules out poultry meat as a source of the infection. Were a broiler flock to be infected, this would affect one batch of meat which would tend to be distributed in discrete areas, not over a 500km stretch of the Black Sea coast line. Additionally, all broiler flocks are subject to pre-movement inspection (including examination of mortality records), pre-movement testing using a rapid test (single test using samples from five birds) and ante-mortem inspection at the slaughterhouse by an official veterinarian. There is therefore a constant and intensive active surveillance for disease in these flocks at the time of slaughter. It is unlikely that disease would go undetected or reported.

Commercial poultry products: Eggs
Although preferring eggs from their own poultry, rural households do purchase commercially produced eggs when their own supplies are insufficient and this is particularly so in winter when backyard birds cease laying for at least some period. However, to be the source of infection, it is probable that there would need to be faecal contamination of either the packaging or the egg shells. The latter can sometimes be seen on commercially produced eggs in Turkey, making eggs a potential source.

Again, the distribution of the outbreaks makes this a highly unlikely source. Marketing patterns of eggs tend to be related to distance from the egg packing station and certainly not in a thin strip along the Black Sea coast. If commercial eggs were to be the source, it would be expected that there would be more clustered outbreaks and at varying distances from the coast line.

Poultry farms within 3km
Only one outbreak was within 3km of a poultry farm. HPAI spreads roughly radially from infected premises, mostly along transport routes. It is unlikely, but not impossible that a single outbreak would occur and not be followed by any further outbreaks from an undetected poultry farm infection. However, the poultry farm in question was tested and found to be negative both clinically and on sampling. The pattern of disease and the results of testing indicate that this is a very unlikely source of the outbreak.

Local traders, milk tankers, local minibuses (dolmus) and other vehicles
Four of the six outbreaks reported contacts with local traders. The two that did not were relatively remote locations, but one of these had a local minibus service that ran to and from the village and the local town (based in the village). Several of the villages had milk producers and the village was visited most days by a milk tanker that travelled between villages.

Investigation of these contacts showed that in all but one case, there was no possibility of contact between outbreak sites - the exception being between 08002 and 08006. The latter site had sold a bovine around a month before to a trader said to be based in Bafra who could perhaps have visited the closer by site at Yörükler. Examination of the timelines shows that this contact would have to have been in the less likely exposure contact for 08006 and was probably before even this period. However, it is being investigated but remains an unlikely source and certainly less likely than other sources.

Poultry workers and veterinarians living in the village
None of the sites had any poultry workers living at the site or nearby. One village had a veterinarian who was living in the village but who had had no contact with the previous outbreak in the province. These can be ruled out a source or infection.

Conclusion 1:
From the above, it can be concluded that
a) there is no credible temporally or spatially consistent source of infection for these outbreaks.

b) there is no credible evidence of spread between outbreaks.

These conclusions are consistent with (and pre-dated) the analysis of the tempero-spatial pattern of the outbreak.

**Direct contact with wild waterbirds**

There was a history of contact with wild waterbirds at one site. In this case the chickens lived by a major water channel containing reed beds and at the time of the outbreak there were many wild water birds, mostly Eurasian coots (*Fulica atra*) but also grebes of various species but mostly great crested (*Podiceps cristatus*) and some duck species (not speciated at the time). There is no doubt that direct contact between domestic poultry and wild birds could have taken place at this site. There could also have been exposure to water contaminated with faeces.

No unusual die offs of wild water birds were reported at any of the sites. At one site, several dead and sick birds were seen and samples/collected. At another site, a single dead waterbird was seen and collected but had probably dies of starvation.

**Direct contact with "bridging"species**

Direct contact with "bridging"species was possible at all sites, although numbers seen at the time of the investigation were low at several of the sites. It is of course the case that "bridging" species are present in varying numbers at all villages in Turkey. The difference in these outbreaks could be the proximity to waterbodies, or the combination of proximity to the coast and waterbodies.

The role of bridging species cannot be ruled out, but given the more direct contact reported below, it seems unnecessary to invoke them in most of the outbreaks.

**Direct contact with the remains of hunted wild birds**

In four outbreaks there was clear stated recent contact between the first affected flocks and the remains of hunted wild birds. In all cases, the wild waterbirds had been shot, brought back to the house where they had been prepared for eating and the internal organs and feathers had been disposed of in areas where the affected poultry were known to have routine access. Given the tight tempero-spatial linkage, and the absence of a suitable domestic poultry source, these would seem to be the most likely source of infection for the domestic poultry.

In three of the four cases (08003, 08004 and 08005) the location and species hunted (mallard, *Anas platyrhynchos*) and coots. No capture attempts were made at any of these three sites.

At a fifth site (08006), hunting was explicitly denied. However, evidence seen indicates recent hunting activity by the nearby reservoir, including recently used shotgun cartridges and the feathers that had been cut from a large white bird (swan or egret?).

**Conclusion 2:**

At five of the six sites there is clear evidence of credible temporally and spatially consistent exposure to wild water birds. Four of these six involve hunted wild birds and the fifth direct contact with wild birds. At the sixth site the evidence is equivocal but hunting contacts cannot be ruled out.

**Virus typing**

The 2008 strain has been typed in Turkey and shown to be 98% similar to the 2006 strain from Turkey. This finding does not mean that the disease has been endemic in Turkey since 2006. The strain is equally similar to the strain isolated more recently in Romania, by implication, to strains found recently in the UK. This strain has been present in several parts of the globe for several years

**Infection status of Turkey**
HPAI is an acute and rapidly spreading disease, especially in gallinaceous poultry species.
HPAI has a high profile with the press.
Turkey has a relatively sensitive passive surveillance system capable of detecting small outbreaks in isolated areas.
There are strong monitoring processes in commercial poultry that involve both private and official veterinarians.
No disease has ever been reported in the large scale commercial poultry sector (Sectors 1 & 2).
Poultry slaughterhouses are booked in advance. Sending sick poultry suddenly is not likely to be possible.
Culling large flocks on site would be difficult to hide.

It is therefore highly unlikely that outbreaks in backyard poultry could go undetected for over nine months from April 2007 to early January 2008 and it is practically impossible that ongoing losses in commercial birds could be hidden.

In 2008 all the outbreak investigations to date and the spatial and temporal analysis point to reintroductions and that these have come from outside Turkey to the Black Sea coast rather than from within Turkey. This is in contrast to the same methodology applied in Turkey in 2006 and 2007 which clearly showed an epidemic propagating through local spread.

**Overall conclusions**
- There is no evidence that the 2008 outbreak has a domestic poultry source in backyard poultry, commercial broilers or commercial egg layers.
- There is no evidence to date of local spread. Focal control and elimination appears to have been rapid and effective; vigilance for new introductions is warranted, however.
- There is strong evidence that the 2008 outbreak has a wild bird source, most likely via hunting practices.
- The 2008 outbreak in Turkey is one of the clearest examples of a wild bird source of H5N1 HPAI in domestic poultry to date.
- The link to hunting is particularly noteworthy.
Emerging knowledge of H5N1 HPAI epidemiology

- Most (>95%) spread is from domestic poultry to domestic poultry
- Between sites in an epidemic, spread is predominantly human mediated
- A minority of spread is from wild birds to domestic poultry
- Some wild bird to domestic poultry spread is human mediated via hunting
- Direct contact between wild birds and domestic poultry is implicated in only a small minority of spread events
- The overriding principle remains: **H5N1 HPAI is a disease of poultry mainly spread by people**

This pattern of spread can be summed up in the following diagram.
Annex 5: Data from census activities

Samsun Aybeder Census: transects extending of 500m around the outbreak site (house)
21 February 2008
Team: Javier Sanz-Alvarez, Kiraz Erciyas, Ozge Kesapli Can, Okan Can, Yakup Sancar Baris, Cemal Ozsemir
Observed species and numbers based on both point counts and line transects

Squacco heron 1 (dead)
Lapwing 140
Chaffinch 27
Song thrush 8
Goldfinch 8
Reed bunting 8
House sparrow 7
Robin 5
Meadow pipit 5
Blackbird 5
Coot 4
Marsh harrier 3
Hooded crow 3
Great White Egret 3
Pied Wagtail 2
Rook 2
Starling 2
Cetti's warbler 2
Grey heron 2
Pygmy cormorant 2
Hen harrier 1
Barn owl 1
Snipe 1
Dunnock 1
Redwing 1
Moorhen 1
Great tit 1
Blue tit 1
Water rail 1
Little egret 1
Grey Wagtail 1
Black-necked Grebe 1
Great Crested Grebe 1
Wren 1
Buzzard 1
Woodcock 1

36 species
254 birds

N.B. Census not undertaken at the site at which the ducks thought to be the source of infection were hunted but included other wetlands adjacent to the outbreak site
Samsun Yörüklere Census: transects extending of 500m circumference around the outbreak site (house)  
22 February 2008  
Team: Javier Sanz-Alvarez, Kiraz Erciyas, Ozge Kesapli Can, Okan Can, Yakup Sancar Baris, Cemal Ozsemir  
Observed species and numbers based on both point counts and line transects

Bittern 1  
Black redstart 1  
Blackbird 50  
Blackcap 1  
Blue tit 5  
Buzzard 2  
Chaffinch 19  
Coot 121  
Cormorant 1  
Crested lark 2  
Dunnock 1  
Fieldfare 3  
Goldcrest 1  
Goldfinch 10  
Great crested grebe 1  
Great egret 1  
Great tit 3  
Grey Heron 3  
Hooded Crow 3  
Jay 3  
Lapwing 2  
Marsh Harrier 4  
Mistle Thrush 1  
Redwing 12  
Reed banting 2  
Robin 5  
Rock bunting 1  
Rook 23  
Sardinian warbler 1  
Song Thrush 32  
Sparrowhawk 1  
Sparrows 200  
Syrian Woodpecker 3  
Tawny 1  
Wood pigeon 3  
Wood cock 1  
Yellow hammer 3  
Yellow legged gull 2

38 species  
529 birds

N.B. Census was undertaken at the site at which the ducks, which may have been the source of infection, were hunted.
**Sakarya Konacik Census:** circumference of 500m around the outbreak site (house)

2 March 2008

Team: Bahar Bilgen, Murat Bozdoğan

Observed species and numbers based on both point counts and line transects

Syrian woodpecker 1
Song thrush 1
Chaffinch 14
Blackbird 8
Great tit 4
Magpie 6
Hooded crow 10
Jackdaw 22
Robin 2
Pied wagtail 3
Goldfinch 2
Greenfinch 5
House sparrow 1
Blue tit 2
Grey wagtail 1
Collared dove 2
Rook 44
Rock dove 4
Yellow legged gull 4
* 1 dead mute swan seen

**20 species**

**137 birds**

N.B. Census not undertaken at the site at which the ducks thought to be the source of infection were hunted
**Sakarya Yeniçam Census:** circumference of 500m around the outbreak site (house)
2 March 2008
Team: Bahar Bilgen, Murat Bozdoğan, Scott Newman
Observed species and numbers based on both point counts and line transects.

- Chaffinch 11
- Goldfinch 10
- Hooded crow 7
- Jackdaw 15
- House sparrow 6
- Collared dove 3
- Pied wagtail 3
- Rock dove 3
- Magpie 7
- Fieldfare 30
- Buzzard 1

**11 species**
**96 birds**

In addition, a point survey of non-passerine species at Arikler Lake where the hunted bird(s) were reportedly taken included:
- Coots ~ 1500
- Mallard 36
- Magpie 31
- Pochard 22

**4 species**
**1589 birds**

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**N.B.** Census was undertaken at the site at which the ducks thought to be the source of infection were hunted
**Sinop Taşmanlı Village Census**: circumference of 1000m around the outbreak site (house) that included Taşmanlı pond
1 March 2008
Team: Okan Can, Cemal Özsemir
Observed species and numbers based on both point counts and line transects

Little Grebe 11
Great Crested Grebe 22
Black-necked Grebe 7
Cormorant 2
Gadwall 1
Hen Harrier 1
Sparrowhawk 2
Buzzard 1
Coot 14
Crane 60
Green Sandpiper 6
Rock Dove 30
Woodpigeon 30
Green Woodpecker 1
Syrian Woodpecker 2
Crested Lark 7
Skylark 10
Meadow Pipit 10
Grey Wagtail 2
Pied Wagtail 1
Robin 50
Blackbird 20
Song Thrush 14
Cetti's Warbler 1
Chiffchaff 1
Goldcrest 20
Firecrest 3
Long tailed Tit 12
Blue Tit 4
Great Tit 8
Wren 10
Jay 7
Rook 35
Hooded Crow 4
Starling 50
House Sparrow 100
Chaffinch 50
Cirl Bunting 6
Corn Bunting 3
Serin 10
Greenfinch 2
Goldfinch 20

**42 species**
**650 birds**

N.B. Census was undertaken at the site at which the ducks, which may have been the source of infection, were hunted
Annex 6:  Dead birds and two cats recovered and submitted for HPAI testing

Coot 18
Great Crested Grebe 7
Buzzard 4
Pochard* 3
Robin** 3
Chaffinch 1
Blackbird 1
Mute Swan** 1
Gadwall* 1
Teal 1
Barn Owl 1
Whooper Swan 1
Yellow legged Gull 1
Adult Cat-feline 1
Kitten-feline 1

* These 4 were hunted birds and only oropharyngeal/tracheal and cloacal swabs were collected post-mortem

** The mute swan and 1 robin were both sampled alive and submitted as dead bird samples after expiring
### Annex 7: Samples from live birds submitted to the laboratory for HPAI Analysis

<table>
<thead>
<tr>
<th>Species</th>
<th>Sampled live</th>
</tr>
</thead>
<tbody>
<tr>
<td>House Sparrow</td>
<td>88</td>
</tr>
<tr>
<td>Coot</td>
<td>24</td>
</tr>
<tr>
<td>Blackbird</td>
<td>23</td>
</tr>
<tr>
<td>Song thrush</td>
<td>9</td>
</tr>
<tr>
<td>Long-tailed tit</td>
<td>6</td>
</tr>
<tr>
<td>Red Wing</td>
<td>4</td>
</tr>
<tr>
<td>Dunnock</td>
<td>4</td>
</tr>
<tr>
<td>Fieldfare</td>
<td>4</td>
</tr>
<tr>
<td>Great tit</td>
<td>3</td>
</tr>
<tr>
<td>Robin</td>
<td>3</td>
</tr>
<tr>
<td>Yellowhammer</td>
<td>3</td>
</tr>
<tr>
<td>Starling</td>
<td>2</td>
</tr>
<tr>
<td>Blue tit</td>
<td>1</td>
</tr>
<tr>
<td>Goldfinch</td>
<td>1</td>
</tr>
<tr>
<td>Hawfinch</td>
<td>1</td>
</tr>
<tr>
<td>Mute Swan</td>
<td>1</td>
</tr>
</tbody>
</table>

Total 177
Annex 8: Technical specifications

PPE recommendations for biologists:

If working at outbreak sites within 21 days of the last day of culling, to conduct:
   a) capturing wild birds: full PPE
   b) collecting carcasses: full PPE
   c) conducting census work: protective footwear that can be decontaminated or removed and completely disposed of

If working at a wetland known to be the source of H5N1 HPAI positive birds:
   a) capturing wild birds: full PPE
   b) collecting carcasses: full PPE
   c) conducting census work: protective footwear that can be decontaminated or removed and completely disposed of

If working at outbreak sites after the site has been declared free of HPAI, protective footwear recommended

In all cases, carry water free hand cleaning materials so that hands and surfaces of equipment can be wiped clean if contaminated.