Scientific Opinion on

Animal health and welfare risks associated with the import of wild birds other than poultry into the European Union

Adopted on 27 October 2006

EFSA-Q-2005-057

Summary

The European Commission is increasingly conscious of the animal health and welfare risks posed by the import of wild birds other than poultry into the European Union. Many of these birds are destined to be kept as pets, for show or in zoos. Limited scientific evidence is already available on specific aspects of this issue.

Therefore, a mandate was sent by the Commission to EFSA asking for a qualitative risk assessment to determine 1) the animal health and welfare risks associated with the import of wild birds other than poultry into the EU; 2) the risk of introducing "exotic" infectious agents into the EU which could spread among the indigenous EU bird populations, and 3) the possible tools and options which could reduce any identified risks.

At the Plenary Meeting of 14/15 March 2005, the AHAW Panel decided to entrust the scientific report and risk assessment to a WG under the Chairmanship of Dr. James Michael Sharp. The Scientific Opinion was adopted at the Plenary Meeting on 26/27 October 2006.

The Scientific Report considers all relevant health and welfare aspects using two qualitative risk assessments, one for health and the other for welfare, and leads to the conclusions and recommendations forming the Scientific Opinion by the AHAW Panel.

The most relevant conclusions and recommendations were:

According to CITES, EU was the major importer of wild birds with around 800.000 birds imported each year from 1999 up to the ban. A big proportion of the birds imported into the EU were transported over large distances within the EU before arriving at the final quarantine station from the BIP. Therefore, it was recommended that the distances that birds are transported between BIP and quarantine should be reduced to the minimum possible.

With respect to the health aspects the probability of infectious agents being introduced into the EU by the release from quarantine of wild captured birds varies from negligible to high. The probability that any individual wild captured bird is infected at release will depend upon the species and the probability of sub-clinical shedding. This led to a recommendation that the need to continue the importation of captive wild birds should be carefully considered. Improvements at the point of export were regarded to have the most impact in reducing the probability that infected birds would be presented for transport to the EU. The testing of the imported captive birds as well as the validation and harmonisation of the current diagnostic test was suggested, together with the development of the new and more rapid diagnostic techniques in order to support global surveillance efforts.

On the welfare aspects the Panel concluded that the during the captive bird pathway, several hazards lead to adverse consequences that are very serious for the welfare of the birds, indicated by high mortality. These adverse consequences vary at different stages of the pathway but the probability of occurring is lower once the birds leave the Third Country. This led to a recommendation that the need to continue the importation of captive wild birds should be carefully considered, unless measures can be put in place to adequately protect the welfare of captured wild birds at all stages. Captive bred birds are subjected to fewer hazards than those experienced by captive wild birds. Captive breeding with high animal welfare standards, therefore could be considered as an alternative for as many species as possible, providing that a reliable method of distinguishing wild caught birds from captive bred birds is available.

Key words: Wild birds, risk assessment, welfare aspects, health aspects, needs of birds, captive birds, avian diseases, Avian Influenza, Newcastle Disease, Chlamydiosis.

1. Background

The European Commission is increasingly conscious of the animal health and welfare risks posed by the import of wild birds other than poultry into the European Union. Many of these birds are destined to be kept as pets, for show or in zoos. Limited scientific evidence is already available on specific aspects of this issue. For example in April 2002 the Scientific Committee on Animal Health and Animal Welfare adopted a report[1] on "Avian chlamydiosis as a zoonotic disease and risk reduction strategies" which recommended that the importation of Chlamydia psittaci infected birds into the EU from third countries should be particularly controlled.

Furthermore, in response to a request from the Commission, on 30 March 2004 EFSA adopted an opinion[2] on the welfare of animals during transport which recommended that the transport of wild caught animals should be discouraged and concluded that wild caught birds are often transported at excessive stocking densities with inadequate ventilation and no feed or water, with the possibility of high mortalities occurring pre-, post- or during transport.

2. Terms of reference

The Commission requests EFSA to issue a scientific opinion on the animal health and welfare risks associated with the import of wild birds other than poultry into the EU. This opinion should consider *inter alia*:

- the animal health and welfare risks associated with pre- and post-transport factors (such as the sourcing, capture and breeding of such birds, the import of wild caught versus captive bred birds, appropriate quarantine conditions and sampling protocols to limit the spread of infectious diseases, etc.);
- the risk of introducing "exotic" infectious agents into the EU which could spread among the indigenous EU bird populations (including domestic poultry) and jeopardise the current EU approach to control animal disease agents of major importance;
- the possible tools and options which could reduce any identified risks.

2.1. Clarification of the terms of reference

Based on more recently available data the opinion should also update and expand upon the chapter on the transport of wild birds contained within the 2004 EFSA opinion on the welfare of animals during transport.

It was further confirmed that:

1) the term "wild birds other than poultry" used in the mandate's terms of reference shall cover both "captured wild birds" and "captive birds bred in the source countries (outside EU)".

2) other risks than animal heath or welfare associated with these imports such as nature conservation in the source countries are outside the mandate.

[1] http://europa.eu.int/comm/food/fs/sc/scah/out73_en.pdf

[2] http://www.efsa.eu.int/science/ahaw/ahaw_opinions/424_en.html

3) although not specifically mentioned in the terms of reference it was understood that eggs for incubation taken from wild/captive birds should also be considered, as previously done in the EFSA transport opinion 2004.

The mandate outlined above was accepted by the Panel on Animal Health and Welfare (AHAW) at the Plenary Meeting, on 14/15 March 2005. It was decided to establish a Working Group of AHAW experts (WG) chaired by one Panel member. Therefore the Plenary entrusted a scientific report and risk assessment to a working group under the Chairmanship of Dr. James Michael Sharp. The members of the working group are listed at the end of this report.

The Scientific Report considers all relevant health and welfare aspects using two qualitative risk assessment one for health and the other for welfare, leading to the conclusions and recommendations by the AHAW Panel which are included in this Scientific Opinion.

According to the mandate of EFSA, ethical, socio-economic, cultural and religious aspects are outside the scope of this scientific opinion.

3. The risk analysis approach to import of captive birds

3.1. Introduction

The health and welfare of non-poultry avian species imported into the EU will be influenced by a number of management processes that they experience from capture to release in the EU. These management processes will vary depending on whether the birds are captive bred from captive bird populations, hatched from eggs taken from nests of wild birds, captured as nestlings and captive reared, or caught as adults or sub-adults in the wild. A large number of bird species are imported into the EU but references on their health and welfare tend to be species specific. However, birds are traded throughout the world and additional information may be obtained from investigations into bird health and welfare from birds imported into non-EU destinations, such as the trade in raptors into the Middle East.

The report addresses two broad topics, as described in the Terms of Reference (chapter 2). Although many factors affect the risks mentioned above, this report is principally concerned with the consequences of capture, holding conditions, transport and transmissible diseases.

3.2. Principles of the risk analysis approach

The proposed methodology used for this report follows the principles of risk analysis as outlined by the OIE (OIE, 2004) and developed in the context of infectious diseases. The risk analysis process is divided into four principal parts: hazard identification, risk assessment (divided into sub-groupings of release assessment, exposure assessment, consequence assessment and risk estimation), risk management and risk communication. The report focuses primarily upon the first two stages of hazard identification and risk assessment; risk management and risk communication fall outside the scope of this report.

For the health risk assessment, standard OIE-based methodologies of risk assessment are directly applicable. Focusing specifically upon health issues, the aim is to estimate in qualitative terms, for an arbitrary disease agent X, the probability that agent X previously exotic to the EU is imported into and becomes established within the EU as a direct result of the importation of captive birds. The hazard identification and subsequent release-exposure-consequence steps of infectious disease risk assessment are laid down by the OIE (2004). In contrast, techniques for welfare risk assessment are historically far less developed than those for infectious disease-related health risk assessment. We therefore describe the application of

the OIE methodology in import risk assessment, and an extension to welfare contexts as follows:

- Hazard identification is the step prior to risk assessment
  i) For infectious disease risk assessment, the OIE definition of hazard is the pathogenic agent(s), which may be present in the animal or animal product under consideration and which could therefore potentially be imported into another country or region.
  ii) In a similar vein in the first stage in a welfare risk assessment, an analogous definition of hazard would be the features in existence (e.g. environmental, nutritional etc.), associated with the animal under consideration, which could potentially lead to adverse welfare consequences.
- The first stage in the infectious disease risk assessment itself is the "release" stage, which involves a description of the steps in the pathway(s) necessary for release of a particular agent into the region of interest (here the EU), and evaluates either quantitatively or qualitatively the probability of each of those steps occurring.
- The "exposure" stage describes the steps in the potential exposure pathway(s) and evaluates either quantitatively or qualitatively the probability that exposure to the hazard of interest within the population of interest (here, EU native animals) will occur.
- In the context of welfare, the analogous process is best described by combining the release and exposure stages into a single stage, effectively an exposure pathway, which allow potential adverse welfare consequences to result from the features in existence (e.g. environmental, nutritional etc.), and again evaluates either quantitatively or qualitatively the probability of that exposure occurring.
- The next stage of the risk assessment in both contexts is the recognition, description and estimation of the probability of the effects i.e. consequence of each of the identified hazards, given exposure.
- The risk estimate (final stage) is the resultant probability of a specific consequence, from all the above stages.

One important distinction between the disease and welfare risk assessments is that the disease risk assessment is primarily interested in an overall outcome: what is the probability that agent X is brought into the EU by captive birds, with the potential for subsequent establishment within the EU? In contrast, the welfare risk assessment is concerned with the probability that the features in existence will produce adverse welfare consequences. The features in existence will change through the importation pathway, and the probability of adverse welfare consequences must be evaluated at each of these stages. The key features of, and distinctions between, the health and welfare risk assessments are summarised in Table 3.1

Risk assessments can be conducted either within a qualitative or a quantitative framework, so that the key probabilities are estimated either in quantitative or qualitative terms. When strictly quantitative data amenable to probabilistic modelling are lacking, a qualitative assessment can prove the most productive approach. Indeed, it has been noted that when statistical data or quantitative information are sparse, qualitative approaches can prove more useful than a quantitative assessment (Hardman, 1997).

Table 3.1: Distinctions between infectious disease-related and welfare-related release-exposure-consequence risk assessments

Stage of process	Disease RA	Welfare RA
Hazard identification	Identify pathogens potentially present in animal(s)	Identify/describe features of environment, nutrition, husbandry etc in which animals are kept (here, specifically, at each stage of importation process)
Release	What is the probability that agent X is introduced into the EU?	What is the probability that feature X results in exposure of the animals to conditions which may result in adverse welfare consequences? How likely is it that such exposure occurs, at each stage of transport?
Exposure	What is the probability that native animals are exposed to agent X ?	
Consequence	What are the probable consequences of exposure (e.g. infection, local spread, epidemic, etc.), and what is the probability of each occurring?	What are the probable consequences of exposure (e.g. stress, malnutrition, death etc.), and what is the probability of each occurring?

For the purposes of this project, a qualitative approach is used to assess both the animal welfare and health risks associated with the importation of captive birds. It is the belief of the Panel that the complex processes involved in the importation of captive birds coupled with the substantial areas in which formal and objective quantitative data are lacking prohibit a more quantitative approach.

3.3. Health risk assessment

Following the OIE framework (OIE, 2004) the questions of interest are:

- What is the risk of release of agent X? (country of export to country of import)
- Given a release, what is the risk of exposure of the indigenous bird population (including domestic poultry)?
- Given exposure of the indigenous bird population, what is the risk (and probability) of spread and subsequent establishment within the EU?

In order to estimate these probabilities, detailed consideration of the exposure pathway, from point of capture through the point of release into the EU, is required. Two principal factors drive this process; first, a random bird must be infected with agent X; secondly, the infection of the bird with the agent must go undetected at all of the key stages of the importation chain in order that the potential for the introduction and subsequent establishment of the agent in the EU can arise. Therefore, the approach has been to draw up a schematic representation of the captive bird importation pathway, define the key probabilities within this, and estimate these probabilities qualitatively based upon a combination of all available, relevant data sources and, where formal data are lacking, expert opinion.

3.3.1. Health hazard definitions

The disease agents which could in principle be studied via this risk assessment approach are numerous and varied. Detailed consideration of all of these is prohibitive as a consequence of time and resource constraints, and therefore a generic pathway was developed, the principle of which can be applied to any disease-causing agent that has an avian host. To illustrate the applicability of the risk assessment process in this context, three specific examples were selected, which the panel judged to be of highly significant and current importance; Avian Influenza Virus (AIV), *Chlamydia psittaci* (CP) and Newcastle Disease Virus (NDV).

3.4. Welfare risk assessment

The approach to the assessment of welfare risks is based upon a sequence of tables, each of which describes a stage in the captive bird importation pathway. Because of the fundamental distinctions between the structures of the health and of welfare risk assessments, a decision was made to present the welfare risk assessment in a tabular form.

First the hazard is identified; then the probability of exposure is considered.The latter comprises two parts; frequency, describing the frequency with which hazard X is judged to occur within a hypothetical population of captive birds; and duration, describing the length of exposure for a typical bird from that population. In this way, critical points (Critical Control Points) can be determined; these must be clearly identifiable and replicable and stages at which decisions can and should be made to take action to minimise adverse effects.

3.4.1. Defining the needs of birds

In order to establish the key welfare hazards in the captive bird importation process, it is necessary first to define the needs of birds which is based on general knowledge of bird biology and welfare available in texts such as Welty and Baptista (1988), Fraser and Broom (1997) and Broom and Fraser (2007, in press).

In order for adult birds to survive and for growing birds to maintain bodily integrity while growing and preparing for adult life they have a series of needs that are relevant to the conditions experienced in captivity. Because of the great variety of bird species and their various ecological niches, their needs will vary according to their way of life and biological adaptation to it. If these needs are not met the welfare of the animal will become poor, either slowly or rapidly. There is a close link between poor welfare and susceptibility to disease in captive birds. When birds are disturbed by handling or other impacts on their environment they are likely to show behavioural and physiological responses. For example, there are several behavioural changes associated with captivity, such as biting/aggression, screaming/vocalisations, psychogenic water and food consumption, regurgitation, masturbation, chronic egg laying, escape attempts, feather picking, repetitive movements and suppression of reproduction (Harrison and Davies, 1986; Hudelson and Hudelson, 2006). Fudge (1997) and Hudelson and Hudelson (2006) also describe how corticosterone increase occurs in many different stressful situations, with moderate transient hyperglycaemia (up to 800 mg/dl). Leucocytosis has been reported in birds as a result of disease or other stress in a variety of bird species, including macaws, cockatoos and African grey parrots.

When the welfare of the birds is compromised it is important that we are able to recognise signs of poor and good welfare in all the species of birds that are traded. A consideration of the needs of birds can help to decide what may be important to birds, but short-term deprivation of some needs may have very different effects from a long-term absence of them e.g. some nutrients as opposed to being able to breathe. The signs that birds show when they have poor welfare e.g. when they are frightened or in pain, or dehydrated, or have some

internal injury will depend on the species, as well as what they have experienced in their life. A more detailed assessment of welfare, including frequency, duration and intensity is given in the Tables in Chapter 7.

1. Breathe

Birds need air that has sufficient oxygen and a low level of noxious gases in it.

2. Rest and sleep

Birds need to rest and sleep in order to recuperate and avoid danger. They need to use particular postures. Sleep disruption may occur if comfortable resting positions cannot be adopted or if there is disturbance to resting animals.

3. Exercise

Exercise is needed for normal bone and muscle maintenance and development.

4. Avoid fear

Most bird species, even species that are predatory themselves, are very vulnerable to predation especially by other birds and mammals including humans. As a consequence, their biological functioning is strongly adapted to maximise the chance of recognition of danger and escape from it. Birds respond to sudden events and approaches by humans or other animals perceived to be potentially dangerous with substantial sympathetic nervous system and hypothalamic-pituitary-adrenocortical (HPA) changes. These physiological changes are followed by rapid and often vigorous behavioural responses. Fear is a major factor in the life of most birds and has a great effect on their welfare.

5. Drink and feed

5.1. Drinking

Birds have a need to obtain sufficient water and will drink water unless there is sufficient fluid in their diet. If the temperature is high, birds need more water.

5.2. Obtain nutrients

A variety of nutrients are needed by birds. If any are lacking, the bird may be able to recognise this or may not but there will be adverse consequences if essential nutrients are unavailable.

5.3. Feeding behaviour

In addition to the need to ingest nutrients, birds need to carry out the movements normally involved in obtaining food.

6. Have access to an appropriate hiding or resting place.

All birds need to rest and to spend the resting period in a safe place, the danger of predation being greater in some species than in others. This place will be one in which the individual is hidden from potential predators in some species but will be a place where rapid escape is possible in other species.

7. Explore

Exploration is important as a means of preparing for the avoidance of danger and is a behaviour shown by all birds. Exploration is also valuable for establishing where food sources are located. Higher levels of abnormal behaviour and fearfulness in inadequate conditions can be a consequence of inability to explore.

8. Have social contact

The need to show full social interaction is important in those species that live socially and obtain benefits from doing so. Such birds are often stressed by separation from conspecifics.

9. Minimise disease

Many mechanisms have the function of reducing the likelihood of contact with pathogens or parasites or responding to infection so as to combat it directly or to minimise the adverse effects of disease.

10. Preen

Preening behaviour is important as a means of minimising disease and parasitism and birds make considerable efforts to preen themselves thoroughly.

12. Thermoregulation

Birds need to maintain their body temperature within a tolerable range. They do this by means of a variety of behavioural and physiological mechanisms.

12.1. Selection of location

When birds are over-heated, or when they predict that they are likely to become over-heated, they move to locations that are cooler. If no such movement is possible, the bird may become disturbed, thus exacerbating the problem and other changes in behaviour and physiology will be employed. Responses to a temperature that is too low will also involve location change if possible.

12.2. Body position

Over-heated, or potentially over-heated, birds adopt positions that maximise the surface area from which heat can be lost. If too cold, birds fluff-up the feathers and minimise surface area.

13. Avoid harmful chemical agents

Birds need to avoid ingesting toxic substances and to react appropriately if harmful chemical agents are detected within their bodies.

14. Avoid pain

Any environmental impact that may cause pain and injury is avoided by birds.

3.4.2. Welfare hazard definitions (and potential consequences)

On the basis of the information concerning the needs of birds, the welfare hazards and associated consequences considered in this report are defined in Table 3.2. In keeping with

the qualitative nature of this risk assessment, consequences are presented on an ordinal scale, broadly running from least to most severe e.g. stress [least severe] to death [most severe]:

Table 3.2: Welfare hazards and associated consequences for captive birds

	Hazard	**Potential consequences (given exposure)**
1	Inappropriate air condition	Stress, disease, suffocation, (fatigue), death
2	Inappropriate conditions for rest/sleep	Distress , exhaustion, injury, disease
3	Inappropriate opportunity for movement	Distress, injury,
4	Inappropriate handling	Distress, fear, injury, disease, death
5	Inappropriate access to water	Distress, dehydration, drowning, death
6	Inappropriate access to nutrients	Distress, malnutrition, disease, death
7	Inappropriate opportunity to carry out normal feeding behaviour	Distress, malnutrition, injury, death
8	Lack of appropriate opportunity to explore or to locate hiding place or escape route	Distress, fear, exhaustion, injury, death
9	Inappropriate social contact (for example social isolation or unwanted proximity)	Distress, stereotypic behaviour, depression, anxiety, aggression, injury, death
10	Infectious agents (welfare issue but covered under other parts of risk assessment)	Disease, death
11	Inappropriate opportunity to preen	Distress, feather damage and function (waterfowl), parasitism
12	Inappropriate opportunity for thermoregulation	Distress, hyperthermia, hypothermia, death
13	Inappropriate presence of chemical agents (e.g. disinfectant, pesticides)	Poisoning, death
14	Inappropriate (high) density (*crowding*) of birds	Distress, injury, suffocation, malnutrition (see individual aspects e.g. social contact, food, drinking, air etc.)
15	Inappropriate mixing of species	Distress, aggression, injury, death
16	Inappropriate hygiene conditions	Disease, death

3.5. Health and Welfare import pathways

Generic and schematic representations of the captive bird importation pathway and highlight issues related to both infectious disease and welfare are presented in Figs 3.1 and 3.2.

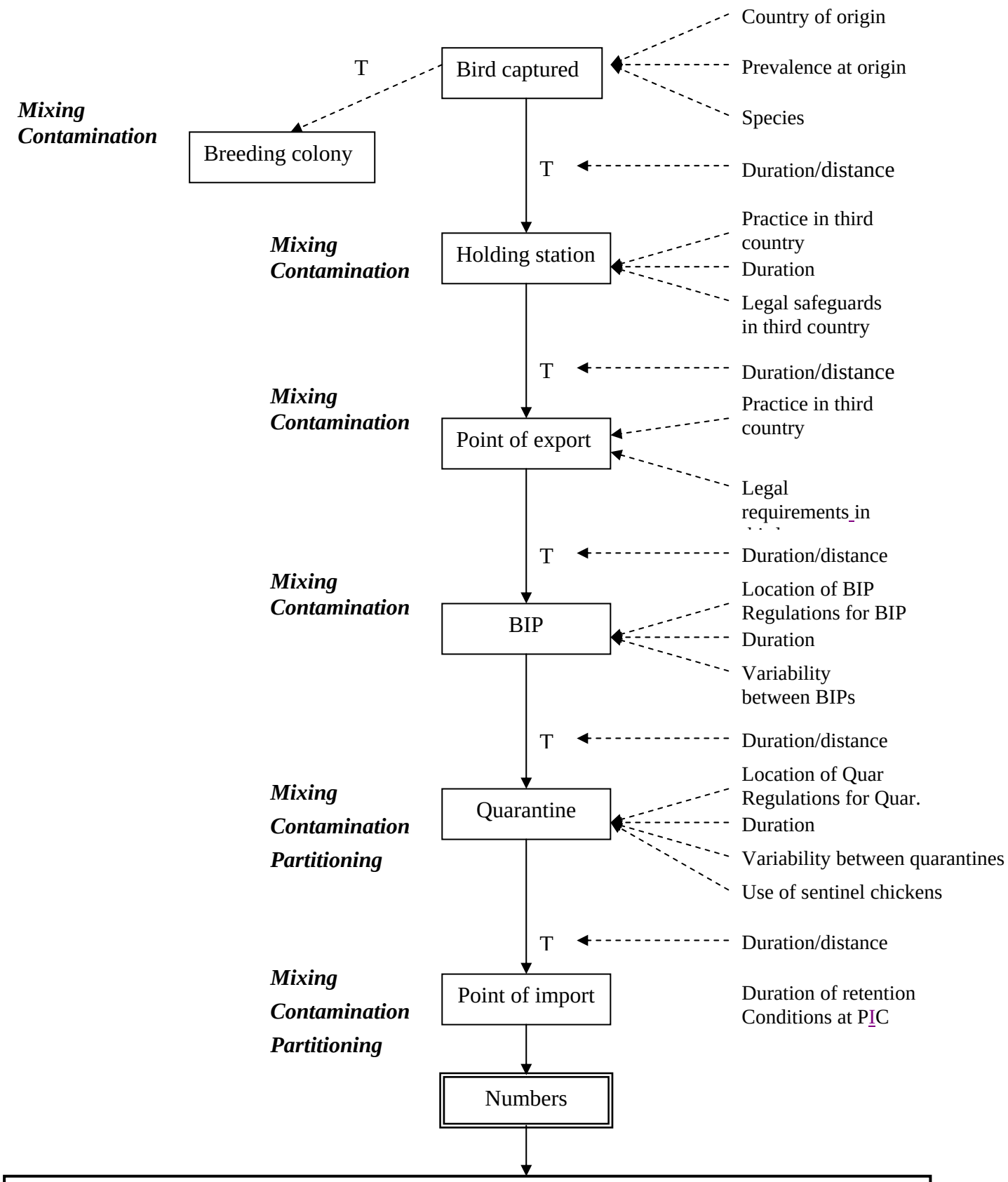
3.5.1. Infectious disease pathway

The generic pathway for the introduction of an arbitrary infectious agent X into the EU via the importation of captive birds is given in Figure 3.1. Key parameters and processes that must be considered to assess the probability of the importation of an arbitrary infectious agent X are highlighted.

3.5.2. Welfare pathway

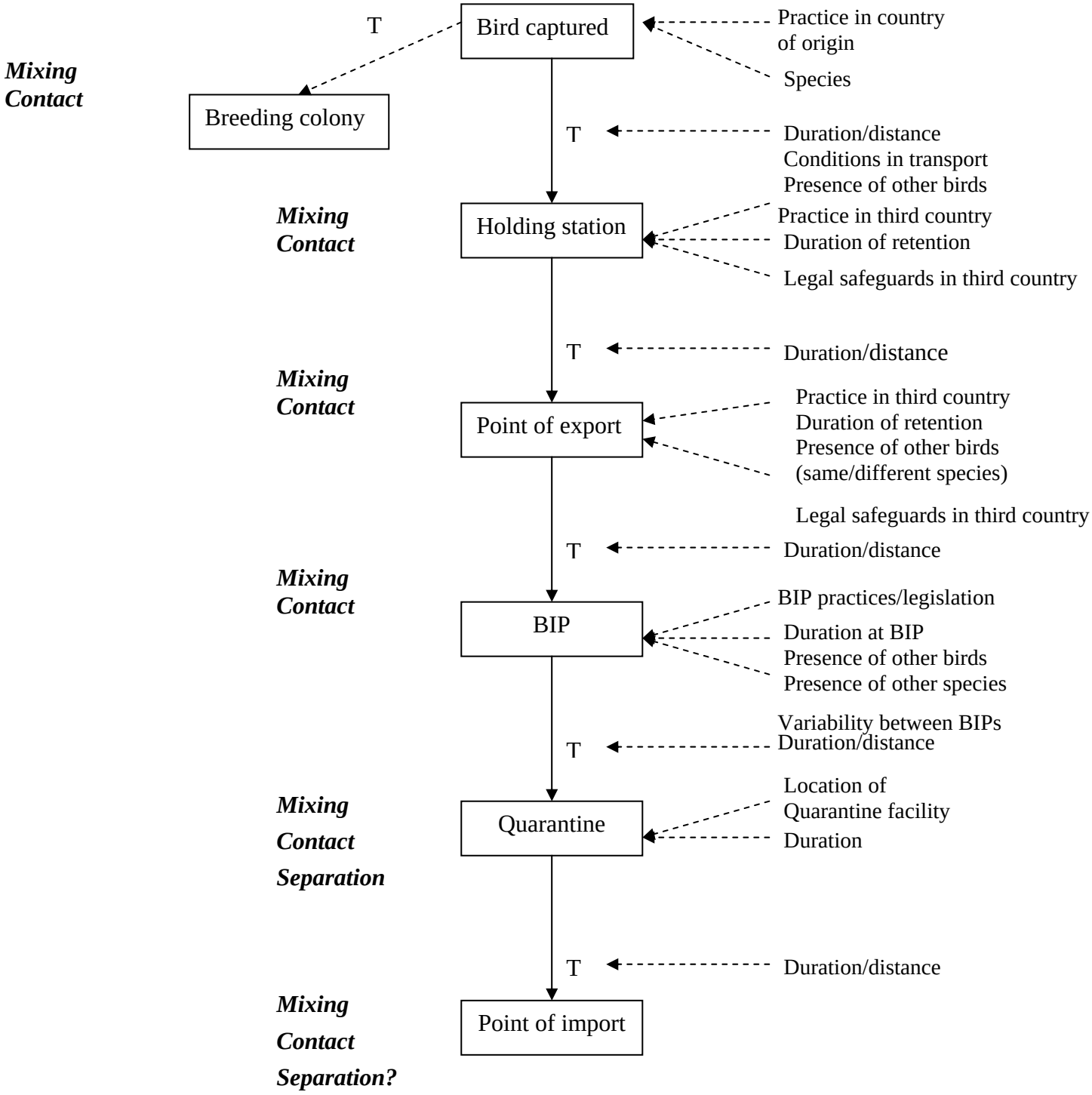
The same broad framework is relevant in defining a pathway for the welfare risk assessment. Different processes and parameters are, however, relevant, and these are given in Figure 3.2.

Figure 3.1. Risk pathway for the entry of an arbitrary infectious agent X from a third country into the EU, and data requirements



T = transport: possibility of ***mixing*** or ***partitioning*** of live birds and ***contamination*** at all stages

Figure 3.2. Risk pathway for welfare considerations during importation of captive birds from third country through to the EU, and data requirements



Before going to discuss the data available for the infectious disease-related risk assessment, a number of important points must be highlighted:

- Extensive searches of the literature have identified a number of important areas in which data are sparse.
- Stages of the importation chain prior to the point of export are particularly lacking in objective data. Much of the information which exists is anecdotal and based upon observations within fairly specific and narrow environments. This is unsurprising as capture is frequently carried out in developing countries, where there are other research priorities. Furthermore, the capture and sale of birds to dealers is usually a "cottage industry" and is often carried out in remote locations.
- Data on the mortality rates of caught birds are scarce and the causes of death are not usually identified.
- These areas of uncertainty have a significant bearing on our ability to provide even qualitative estimates of risk at these points.
- The exercise of conducting the wider risk assessment has helped in identifying areas in which an improvement in the level of knowledge is required.

4. Practice and trade of captive wild birds in the EU

4.1. Conclusions on Trade of captive wild birds in the EU

- The most popular pet bird species: budgerigar, canary, zebra finch, lovebird and cockatiel are almost entirely captive bred. Such birds are not the subject of this report
- There is a large global trade in captive birds; at least 17 different orders exported from 43 countries from all continents
- CITES Data indicate that around 800.000 birds are taken from the wild and imported into the EU as captive birds each year.
- The EU has been the major importer of wild birds for the past 7 years up to the time of the ban.
- Passeriformes [64%], Psittaciformes [17%] and Galliformes [14%] currently account for 95% of all imported birds.
- The large majority (88% in 2005) of wild birds are imported from the African continent; 78% from 5 African states
- Although 17 EU MS imported birds directly from outside the EU in 2005, only a small number of EU MS were responsible for importing over 80%.
- Almost half of the birds that went into quarantine in 2005 in 5 MS (total 243.626 birds = 47% of all birds) all came into the EU through BIPs of other EU MS. This means that almost half of all birds imported into the EU were transported over large distances within the EU before arriving at the final quarantine station, e.g. The Netherlands, which had no operating BIP for birds, received birds transported from BIPs in Belgium, France, Great Britain, Portugal, Luxembourg, Italy and Germany.
- There appears to be a trend suggesting a slow decrease in the numbers of traded Passeriformes and Psittaciformes during the last 7 years
- In general, wild caught birds are cheaper than birds produced in captivity

- Some bird species adapt better to captivity than others, but this depends on many variables, particularly the age at which the bird first has human contact.
- A large proportion of legally traded Psittaciformes (exported captive wild birds plus captive bred bird) already originate from captive breeding sources, particularly the Agapornis and Cacatua genera.
- The import of captive bred Passeriformes at 2% was much lower, but for some genera this has reached 7%
- Most of this breeding, however, is not taking place in the countries of origin, but in the EU.
- There are few data on the breeding success and the practices used in exporting countries
- The value of some birds is high and wild-caught birds can easily be, and are, presented for sale as being captive-bred. It is very seldom possible to distinguish between wild-caught and captive-bred birds with certainty. This is true both for birds bred in captivity in the country of origin and for birds bred in captivity in the country of sale.
- Methods of marking, such as close-ringing of the leg or implanting an electronic identifier, can be applied to wild-caught as well as captive bred birds.
- Customs seizures for every year from 2000-2005 indicate that illegal imports continue to occur. These represent less than 0.2% of the legal trade for the same period.
- The US has not reported any increase in illegal imports following the WBCA ban on import of wild birds

4.2. Recommendations on Trade of captive wild birds in the EU

- the distances that birds are transported between BIP and quarantine should be reduced, preferably to the minimum possible
- captive breeding already is the main source for some species and should be considered for as many species as possible, particularly Passeriformes, in order to reduce the need to import wild birds
- when captive breeding is the main source of a species, the need to import these species from the wild is questionable
- there is a need for more data on the captive breeding success and the practices used in exporting countries
- consider ways to encourage captive breeding, especially in third countries, to standards that meet EU requirements
- support the development and use of techniques to identify individual birds and to distinguish between wild caught and captive bred birds. The effectiveness of these techniques would be strengthened by implementation within a registration framework
- additional means to detect illegal imports should be considered

5. The Captive Wild Bird Pathway

5.1. Conclusions on the Captive Wild Bird Pathway

- There is a general paucity of objective and quantitative data for important parts of the pathway. Much of the evidence for sectors in Third Countries is gleaned or inferred from interviews with those involved in the trade and is biased towards the Psittaciformes. Consequently, a high level of uncertainty is attached to some data
- As a large variety of bird orders are captured in the wild in many Third Countries, a variety of techniques is used, which differ depending on the target species and the age at which the birds are captured
- The conditions under which the birds are handled and held and the duration of these conditions vary considerably after capture and transport to central markets, holding facilities and local markets. Several reports suggest that these conditions can be poor and can result in high rates of injury and mortality.
- Although these conditions may vary considerably, after capture, all birds (adults and nestlings) are likely to experience greater or lesser levels of fear and stress. A key factor is the age at which they have their first human contact
- Mortality at the various stages of the pathway from first attempts at capture in the country of origin to sale in the E.U. can be a useful and objective indicator of welfare. As recently as 2001-2003, separate reports recorded psittacine fledgling mortalities of 0%-30% at harvest and overall 60%-70% by the time they reached the dealers pre-export. However, during the early stages of the pathway, mortality figures can be difficult to obtain or unrecorded and therefore unreliable.
- In expert hands, mist nets that are used to capture several species of Psittaciformes and Passeriformes can be safe and result in low mortalities. Inappropriate use may result in high rates of injury and mortality
- Much bird capture is done in remote areas and transport of birds to towns and cities for further marketing and the means of transport may be primitive and slow
- Two studies showed that minimal handling times and biologically relevant enrichment of the cage environment reduce mortalities for captured Passeriformes
- The numbers of birds that are caught and the numbers that arrive at point of export are poorly documented for Passeriformes, which is the order most commonly imported into the EU
- All birds intended for legal export to the EU must fulfil the requirements stipulated in Decision 2000/666/EC. These are intended primarily to reduce the risk of introducing infectious diseases but indirectly contribute to preserving aspects of good welfare
- Surveillance and awareness of AI, ND and AC in third countries appears to rely on recognition and reporting of clinical signs. There is no routine laboratory based surveillance
- Many non-poultry species may not express clinical signs of disease when infected by AI, ND and AC and therefore may be infected when they leave the holding.
- Current requirements do not appear to stipulate a minimum distance from other bird holdings, the use of sentinel birds or testing of the birds intended for export.
- Current requirements appear to allow transport vehicles to mix crates from different holdings
- The available evidence suggests that some captive birds may be exported from some Third Countries without complying fully with Decision 2000/666/EC
- All current legal transport of captive birds is by air

- Current IATA regulations provide conditions for a high standard of transport by stipulating general requirements for all birds and specific requirements for different types of birds
- All transports fulfilling IATA guidelines can be characterised as good. The proportion of birds that are dead on arrival [DOA] is low [1.5% overall and lower for Psittaciformes] but there remain problems with some species, some shipments and most of shipments that did not meet IATA guidelines
- EU has established a network of Border Inspection Posts [BIP] in the MS to undertake veterinary checks of all birds that are introduced to the EU.
- Each consignment of captive birds from Third Countries must be imported into the EU through a BIP, where it is subject to mandatory veterinary checks according to the requirements of Directives 91/496/EEC and 97/78/EC
- BIPs represent a critical point in the chain of events for importation of birds and are the first key control point within the EU.
- The performance of BIPs in implementing the veterinary controls is evaluated on a rotating basis by the FVO according to Decision 2001/881/EC
- The most recent general review of veterinary checks in BIPs, covering the period 2002-2003, reported that a system for import control was in place in all MS that were inspected.
- Although this report did not identify findings specific to BIPs receiving captive birds, it drew attention to areas where improvements were required
- In 2005, only 16 BIPs in 13 MS received captive wild birds that then were distributed to quarantine facilities in 17 EU MS
- A small number of BIPs were very active and were responsible for over 60% of all consignments in 2005. They received consignments from the greatest numbers of Third Countries, imported the greatest number of different orders of bird, and sent birds to the largest number of destinations.
- 5 EU countries imported all of their captive birds (approximately 50% of the total EU imports) through a BIP in another MS. Consequently, some birds were transported over long distances from BIP to quarantine facility, sometimes for more than 24 hours, through several MS
- There are no specific regulations, beyond the EU transport of animals regulations, that apply to vehicles used during the transport from BIP to quarantine.
- EU legislation [Decision 2000/666/EC] requires all birds other than poultry to be placed in quarantine after their entry on to the territory of the EU, in accordance with Directive 92/65/EC, and specifies the minimum conditions for the construction, equipment and management of quarantine facilities and centres
- Infections in imported birds may be detected directly by virological techniques or indirectly by using sentinel chickens
- Routine laboratory testing of imported birds can provide a valuable source of surveillance information on the prevailing situation in their country of origin
- Sentinel chickens may not be effective at detecting some infections in quarantine facilities as used currently, particularly where effective contact between imported birds and sentinels is not established.
- If imported birds are infected with agents that are not very contagious e.g. AIV, the sentinels may not become infected and infected imported birds may be released
- The welfare of sentinel birds may be compromised in some circumstances such as when the quarantined birds e.g. birds of prey and the sentinels are of different species.
- Some infections, such as AIV, are poorly transmitted, even when birds are confined closely.

- Other birds species may be more sensitive sentinels than chickens
- Deaths in quarantine [DIQ] can be several fold higher than DOA
- There is a general lack of data available on birds that died in quarantine. Data that is available cannot be easily compared as the systems vary between facilities and MS e.g. duration of quarantine
- Generally, investigations of DIQ are restricted to statutory requirements and other causes of mortality are not investigated
- Outbreaks of disease or introduction of new infections to domestic livestock that potentially originate from imported captive birds are rare and evidence for this is largely circumstantial

5.2. Recommendations on the Captive Wild Bird Pathway

- Improved breadth and quality of data [numbers caught, numbers injured, mortality, etc] at all points in the captive bird import chain, especially for Passeriformes, will assist with the identification of species that may be regarded as 'high risk' and perhaps should not be captured in the wild and transported
- Improved infrastructure, training of personnel and monitoring at holdings and points of export in Third Countries could support the implementation and effectiveness of Decision 2000/666/EC
- Improved laboratory-based surveillance in Third Countries will contribute to an improved awareness of infections, particularly in species that do not exhibit clinical signs, and increase the quality of future risk assessments
- Actions to address any gaps identified by the FVO inspections of BIPs could help to mitigate the risks arising from import of captive birds.
- At the BIP, the use of veterinarians and other staff with expertise and knowledge of captive caged birds is recommended as this is a highly specialised area
- Birds should be transported from the BIP to the nearest quarantine facility whenever possible
- Vehicles that transport birds between BIP and quarantine can be viewed as part of the quarantine system. They therefore should be designed such that they can be cleaned and disinfected easily and that they minimise the escape into the environment of all fomites and infectious agents
- There is a need for more readily accessible data from quarantine facilities in the EU. Further harmonisation of quarantine requirements and a central database for quarantine statistics will assist with analysis and identification of trends
- A fuller investigation of deaths in quarantine beyond the statutory requirements will help to identify causes underlying the higher DIQ than DOA and contribute to identify species that are higher risk and perhaps unsuitable for transport
- Further studies are required to optimise the use of sentinel birds in quarantine facilities e.g. placement with respect to the quarantined birds and their excreta, other species as alternative sentinels to chickens
- Further studies are required to understand the dynamics and limits of transmission of the major infectious agents, especially between the major imported species and sentinels in quarantine facilities
- Other laboratory-based diagnostic procedures for AIV, NDV and *C.psittaci* may offer alternatives to the use of sentinel birds and will provide valuable surveillance data for these agents in the countries of origin

6. Animal health aspects – diseases to be considered

6.1. OIE list of notifiable avian diseases

It was agreed by all members of the working group (WG) to focus this Report (Scientific Opinion) on three major diseases that may acquire epidemic proportions. These are Newcastle disease (ND), avian influenza (AI) and avian chlamydiosis (AChl). The predominant criteria for focusing on these major three diseases were whether a given pathogen is exotic to EU countries, the ubiquity of such pathogen and its effect on animal health. A clear-cut separation of pathogens that occur in poultry and not in other avian species are desirable, but on occasions difficult to achieve. Consequently, the following text concentrates on these three pathogens and the disease they cause and identifies only those that may occur in captive birds. In addition, the presence of disease in animals can itself have a welfare impact ranging from 'severe', when animals may die over several days (e.g. pneumonia), to mild when they quickly develop an immunity after infection. Other diseases may have long-term effects with moderate adverse effects.

6.1.1. Avian influenza

6.1.1.1. Conclusions on AI

- All avian AIVs belong to the type A of Influenza viruses.
- Types B and C have no significance for birds
- The zoonotic potential of avian AIVs is generally low. However, a zoonotic potential is reported for AIVs of the current subtype H5N1.
- Forms of disease due to HPAIVs are usually absent in waterfowl, whereas gallinaceous birds, birds of prey, passerine birds usually display severe signs of disease that are associated with heavy losses.
- The detection of HPAIV of the subtype H5N1 does not necessarily prove a cause-effect relationship.
- Chronically infected birds – especially waterfowl – may excrete AIV for periods longer than 30 days, which exceed the minimum quarantine period..
- Commercial poultry are vaccinated using inactivated or vector vaccines in some countries that export captive birds.
- The stability of AIV outside the natural hosts is low. Disinfection is readily achieved with available disinfectants.
- Birds that tested positive for HPAI and LPAIV of the subtypes H5 and H7 should be destroyed.
- The orders of birds imported in the largest numbers (passeriformes and psittaciformes) do not play a major role in the epidemiology of AI.
- HPAIVs are not pathogenic for most of the imported bird species that belong to anseriformes. Therefore relying on clinical signs in quarantine stations will not detect any form of disease.
- All HPAI viruses as they are present in birds of any susceptible species have been shown to have restricted zoonotic potential. However, since the genome (or parts thereof, of the AIVs has been involved in severe pandemics in the past (and currently due to HPAIV of the subtype H5N1) a good surveillance program can prevent relevant AIVs to come into the EU through legal imported birds.
- Reassortments of differing AIV strains are likely in persistantly infected birds.

6.1.2. Newcastle Disease (ND)

6.1.2.1. Conclusions on ND

- Newcastle disease is a highly contagious disease and can be transmitted by direct physical contact, indirectly through the air, drinking water or faeces and by living and mechanical vectors.
- At least four pathotypes (velo-, meso-, lento- and apathogenic) and more than seven genotypes exist within the species Paramyxovirus 1 (PMV-1) of Newcastle disease viruses. Since 1978 a variant of NDV is known that causes high levels of morbidity and low levels of mortality in feral and related pigeons.
- Paramyxoviruses 2 to 9 (PMV-2 to PMV-9) are less virulent than velogenic PMV-1 and are especially frequently obtained from passerine and psittacine birds. PMV-2 to 9 require differentiation from all PMV-1 isolates. Some serologic cross-reactivit is seen in the haemagglutination inhibition test between PMV-1 and PMV-2 but also between PMV-1 and PMV-3 strains.
- Virulent (velo- and mesogenic) ND viruses cause severe disease and death in many orders of birds (e. g. galli-, psittaci-, passeri-, struthioni- and accipitriformes).
- The other pathotypes do not cause severe disease or high rates of death in any order of birds.
- Survivors may develop into shedders of all pathotypes of NDV for more than 30 days.
- On limited occasions lentogenic NDV may be vertically transmitted via fertile eggs whereas velogenic NDV causes embryonic death.
- Virulent ND virus does not cause disease in birds of the order anseriformes and birds of several other orders that contain shore birds, waders, gulls, puffins.
- Live and inactivated vaccines exist for long times (more than 50 years) and are frequently used in chickens and turkeys. . In Germany, vaccination of chickens and turkeys is mandatory. In the UK, Denmark and other countries, vaccination of chickens and turkeys is not allowed.
- Application of any type of vaccine interferes with serological detection of NDV infected birds and should not be used in captive birds. In addition, vaccinal serum antibodies do not prevent superinfection by virulent NDV and shedding of this virus.
- Irrespective of the patho- or genotype, NDVs are not of significance as zoonotic agents.

6.1.3. (Re)emerging viral diseases

6.1.3.1. Conclusions on (re)emerging viral diseases

- Testing birds for most of the zoonotic and non zoonotic virus diseases is possible and provides a valuable source of global surveillance data.
- Although West Nile virus is already present in some localised areas in the EU, its control and eradication are made more difficult if there are imports of birds from known endemic areas.
- Pacheco`s parrot disease herpesvirus is not important as a disease for poultry or people, but could endanger established psittacine breeding colonies in the EU.

6.1.3.2. Recommendation on (re)emerging viral diseases

- Imported wild birds, including captive bred birds, coming from countries where any hazardous viral infections are present should be tested for the presence of those viruses.

6.2. Bacterial diseases

6.2.1.1. Conclusions on bacterial diseases

- Imported wild birds with bacterial diseases are seldom an epidemiological problem because they will show clinical signs and can be treated with antibiotics.
- Most bacterial zoonosis are food-borne and the risk of import of live wild birds is considered to be minimal provided that adequate hygienic measures are taken. An exception to this conclusion is the import of birds infected with avian chlamydia.
- The other important bacterial zoonoses where birds or bird products play an important role like salmonellosis and campylobacteriosis are mainly transmitted by poultry food products. Transmission by live wild birds has been rarely reported.
- The avian *Mycobacterium avium* strains play a less important role as a zoonosis than the mammalian *Mycobacterium avium* strains.

6.3. Conclusions on the Animal Health Aspects

- Compared with poultry, little is known of the prevalence of infectious, transmissible diseases of wild birds in their natural environment before capture. The available literature points to the susceptibility of free-living birds to infection and disease by a variety of agents, although vernacular names in several languages and imprecise descriptions of the detected agents can introduce some uncertainty to the assessment of importance and associated potential risks.
- Most imported wild birds (other than poultry) will not be infected or carriers of OIE listed infectious agents. However, a few agents, such as AIV, NDV and C. psittaci are important because of their veterinary and/or zoonotic potential. In addition some newly emerging agents, such as WNV, may present future threats.
- Free-living and subsequently captive birds may become infected due to lateral spread from other infected wild birds and from the contaminated environment or as overspill from infected poultry. These modes of spread may happen in the country of origin, during all stages of transport and in quarantine facilities
- Due to the biology of the various infectious agents [low contagiousness, latent infection, and intermittent excretion], indirect detection of infected imported birds by serological testing of sentinel birds may not be sufficient to detect infection in some imported infected birds.
- Avian influenza is caused by avian influenza virus [AIV] all of which are influenza virus type A .
- Types B and C have no significance for birds AIVs are differentiated into highly pathogenic (HPAIV) and low pathogenic (LPAIV) strains on the basis of their virulence for chickens. Further differentiation is based on the presence of the viral envelope antigens haemagglutinin (H) and neuraminidase (N) and their combinations. A feature of all H5 and H7 HPAIVs to date is the presence of multiple basic amino acids at the cleavage site of the haemagglutinin. This molecular characteristic has been adopted by the OIE and the EU as an additional correlate of virulence.
- The most frequently isolated AIVs are subtypes H3, H4 and H6. Subtypes H5 and H7, which contain the highly virulent “fowl plague” viruses, are less frequently detected in free-living and domestic birds
- The majority of AIV isolates are from the Anatiformes, principally the subfamilies Anserinae and Anatinae. AIVs have been reported less frequently in Passeriformes and Psittaciformes, which are the most commonly traded wild birds.
- The majority of AIVs from captive caged birds have been subtypes H3 and H4 and obtained from Passeriformes and less commonly from Psittaciformes.

- Clinical signs are an unreliable indicator of AIV infection in many imported birds and are influenced by intercurrent bacterial infection or parasitic infestation
- The incubation period and duration of AIV excretion are very variable and influenced by the pathogenicity of the AIV and the host species. HPAIV has a very short incubation period and clinical course in gallinaceous birds, birds of prey and passerine birds leading to high mortality in a few days. Large amounts of virus are excreted during this period. At the other end of the spectrum, LPAIV and even HPAIV may not induce clinical signs in other orders, particularly Anseriformes, and can have incubation periods up to 18 days. Some birds, such as Anseriformes, may excrete AIV for more than 30 days
- AIV is spread horizontally by the faecal-oral route. Bird to bird contact is considered important although the infection does not appear to be very contagious, as it applies to the captive bird pathway.
- Validated diagnostic tests and protocols for AIV are well established and described in the OIE Manual and EU legislation. More rapid techniques have been used but these are not validated, particularly for non-poultry species.
- Vaccination can offer control of AI but is not generally employed as it can interfere with control measures. A DIVA approach may be helpful in some circumstances as vaccinated and infected birds can be differentiated by serological tests.
- Commercial poultry are vaccinated using inactivated or vector vaccines in some Third Countries that export captive birds.
- The stability of AIV outside the natural hosts is low. Disinfection is readily achieved with available disinfectants.
- The zoonotic potential of AIVs, with the possible exception of the current subtype H5N1 HPAIV, has been regarded as low because AIV Infection of humans and other mammals is a rare event. However, reassortment of AIV genomic segments has contributed to pathogenic phenotypes.
- Newcastle disease is caused by NDV, which is a paramyxovirus type 1(PMV-1). Other paramyxoviruses (PMV-2 to PMV-9) are frequently obtained from passerine and psittacine birds and require differentiation from all PMV-1 isolates
- PMV-1 have a wide host range and are regularly isolated from various wild birds in EU MS. They also have been reported in all of the most commonly traded captive wild birds
- Within the NDVs, at least four pathotypes (velogenic, mesogenic, lentogenic and apathogenic) and more than seven genotypes are recognised. The presence of multiple basic amino acids at the cleavage site of the precursor fusion glycoprotein is a molecular characteristic has been adopted by the OIE as an alternative or additional criterion for definition of an outbreak of ND.
- The virulent velogenic and mesogenic NDVs cause severe disease and death in many orders of birds (e. g. Galliformes, Psittaciformes, Passeriformes, Struthioniformes and Accipitriformes). The other two pathotypes do not cause severe disease or high rates of death in any order of birds.Clinical signs are an unreliable indicator of NDV infection in many imported birds and are influenced by intercurrent bacterial infection or parasitic infestation
- The incubation period and duration of virus excretion are very variable and influenced by the pathogenicity of the NDV and the host species. Identical viruses can induce a wide spectrum of different signs in different avian species, ranging from no signs to high morbidity and mortality. The incubation period has been reported to vary from 2-15 days. Large amounts of virus are excreted from most epithelial surfaces
- NDV can establish a carrier state in several species of wild birds, and excretion for many months has been documented in Psittaciformes

- NDV is highly contagious and is transmitted horizontally through inhalation and ingestion of fomites. It can be transmitted by direct physical contact, indirectly through the air, drinking water or faeces and by living and mechanical vectors. On limited occasions lentogenic NDV may be vertically transmitted via fertile eggs whereas velogenic NDV causes embryonic death.
- Validated diagnostic tests and protocols for NDV are well established and described in the OIE Manual and EU legislation. More rapid techniques, particularly molecular and antigenic tests, are gaining acceptance to enhance the virological and epidemiological analysis of outbreaks.
- Live and inactivated vaccines have been available for many years but interfere with serological detection of NDV infected birds. In addition, vaccinal serum antibodies do not prevent superinfection by virulent NDV and subsequent shedding of this virus. Within the EU, currently only three MS have a policy of non-vaccination
- repeated multiple introductions of NDV strains with imports of captive birds are very likely.
- . Irrespective of the pathotype or genotype, NDVs may be an occupational health risk but are not of wider public health significance
- WNV infects many different free-living birds, which then serve as (i) local carriers and shedders (ii) long-distance virus transmitters especially migrating species and (iii) source for infections of various species of mosquitoes
- Although West Nile virus is already present in some localised areas in the EU, its control and eradication are made more difficult if there are imports of birds from known endemic areas.
- Pacheco`s parrot disease herpesvirus is not important as a disease for poultry or people, but could endanger established psittacine breeding colonies in the EU.
- Imported wild birds with bacterial diseases are seldom an epidemiological problem because they will show clinical signs and can be treated with antibiotics.
- Most bacterial zoonoses are food-borne and the risk of import of live wild birds is considered to be minimal provided that adequate hygienic measures are taken. An exception to this conclusion is the import of birds infected with avian chlamydia.
- Other important bacterial zoonoses where birds or bird products play an important role e.g. salmonellosis and campylobacteriosis, are mainly transmitted by poultry food products. Transmission by live wild birds has been rarely reported.
- The avian strains of Mycobacterium avium play a less important role as a zoonosis than the mammalian strains Mycobacterium avium.
- Avian C. psittaci of various genotypes are very common in the EU
- C. psittaci have been demonstrated in many domestic and free-living species
- C. psittaci produces a systemic infection in birds, the outcome of which depends on a number of variables, including strain of organism and host species, so that virtually all avian species can be (i) healthy latently infected non-shedders, (ii) clinically-inapparent infected shedders, (iii) diseased shedders showing hepatitis, splenitis, respiratory signs, conjunctivitis and diarrhoea, (iv) dying of chlamydiosis or concomitant infections.
- Most frequent is the latent stage without clinical signs and in wild birds C, psittaci tends to produce persistent infections with periods of shedding
- It is likely that Chlamydia, including new subtypes, will continue to be introduced into EU countries by captive wild birds
- Diagnosis of C. psittaci in birds can be problematic due to the frequency of subclinical persistent infections.
- Zoonotic potential is high for Chlamydia originating from Psittacines, domestic ducks, geese and turkeys.

- Available serological testing for Chlamydia is not always reliable and will not prevent the introduction of Chlamydia.
- C. psittaci infected birds can be treated with antibiotics, such as tetracyclines, quinolones or macrolides. However, C. psittaci may remain after the end of treatment and the recovered birds can be latently infected and shedders.

6.4. Recommendations on the Animal Health Aspects

- In regard with the high risk of import of wild birds the justification for the import should be considered
- Because the indirect detection of imported birds by serological testing of sentinel birds may not be successful due to the biology of various infectious agents, direct virological and microbiological examination of the imported captive birds should be used to improve the sensitivity of detection of infected birds.
- Testing imported captive birds for the three agents considered in this report will provide additional information of their presence in Third Countries and support global surveillance efforts
- Further validation and harmonisation of existing diagnostic tests is required to provide more confidence in their performance in detecting infections in the commonly imported orders of birds
- Assessment and validation of newly developed and more rapid technologies such as molecular and antigenic detection would facilitate direct testing of the imported birds, and could provide more information to support epidemiological studies
- Import of eggs prior to incubation could provide a more efficient means to reduce the risks of importing infectious agents, providing that sanitisation of the external surface of the eggs can be achieved without damaging the embryo

7. Risk Assessment

The health and welfare risk assessments presented in this chapter address the exposure pathways (Figs 3.1 and 3.2) described in Chapter 3. These describe the importation process in a schematic form from the point of capture through to the point of release in the EU, and highlight the important parameters and processes involved. No RA has been done for the non-target species, such as decoy birds and mammals used to trap target birds. However, when target birds are trapped, it is likely that the welfare of these non-target animals will be poor as they are restricted from moving freely by glues (lime) or tethers, and so are unable to fulfil their needs, particularly to escape.

7.1. Welfare risk assessment

The welfare risk assessment is based on a novel tabular approach developed in conjunction with representatives of the EFSA working group on “The risks of poor welfare in intensive calf farming systems”. For release assessment a simple approach was adopted and states whether or not a given hazard is likely to occur at a given stage. For hazard characterisation, exposure assessment and consequence assessment, the following definitions and terminology were used:

Table 10.1 Risk Assessment terminology and abbreviations

Exposure assessment				**Consequence assessment**	
Frequency	**Code**	**Duration**	**Code**	**Consequence**	**Code**
Very rare	VR	Short	S	Slight Adverse Effect	SA
Rare	RA	Moderate	M	Adverse Effect	AE
Moderately frequent	MF	Long	L	Moderately Serious Effect	MS
Frequent	FR	Very long	VL	Serious Effect	SE
Very frequent	VF			Very Serious Effect	VS

In the subsequent tables, a separate table is used for each stage of the importation pathway, and within each table the likely occurrence of the hazard at a given stage X is assessed; if it does occur, the probability of the event is assessed at importation stage X in a hypothetical captive bird population, and for how long a random bird might be exposed to the hazard at stage X; the information is combined qualitatively to assess the severity of the consequences.

In the subsequent tables, the reader may observe that for a given hazard sometimes an equivalent exposure, duration and frequency are observed at two different stages of the captive bird importation pathway, but the resultant estimate of the consequences is different. This apparent discrepancy arises because the qualitative assessments at each stage are based on expert opinion that reflect a range of values, so it becomes plausible that two apparently equivalent sets of inputs can yield different outputs. Also, because this RA is a general assessment of the captive bird pathway, which covers all species and methods of capture,etc, a range of values is given in places, particularly for duration and consequence,

Some of the various causes of poor welfare, in birds that may or may not die prior to arrival at point of sale to those who will keep them as pets, are as follows; fear during capture; pain during capture; pain etc. as a result of injury during attempted capture; starvation of young birds whose parents have been captured or killed; fear, frustration and extreme discomfort in birds trapped with glue; dehydration, starvation and extremes of temperature in trapped birds; fear, pain, dehydration, starvation and extremes of temperature during holding after capture and transport in the country of origin; inability to fulfil needs during housing in inadequate conditions if captive bred; fear, pain, dehydration, starvation and extremes of temperature during transport to the E.U., holding on arrival in the E.U., transport within the E.U. and holding prior to sale.

7.1.1. Welfare risk assessment tables

Stage of pathway (S = 0.5 hour; M = 12h; L = 24-48h; VL = > 48h).

Process of capture	Hazards	Hazard potentially present?	Exposure									Consequences				
			Frequency					Duration								
			VR	RA	MF	FR	VF	S	M	L	VL	SA	AE	MS	SE	VS
	(1) Inappropriate air condition	NA														
	(2) Inappropriate conditions for rest/sleep	Yes					X	X	X				X			
	(3) Inappropriate opportunity for movement	Yes				X	X	X	X				X	X	X	
	(4) Inappropriate handling	Yes					X	X					X	X	X	X
	(5) Inappropriate access to water	Yes					X	X	X			X				
	(6) Inappropriate access to nutrients	Yes					X	X	X			X				
	(7) Inappropriate opportunity to carry out normal feeding behaviour	Yes					X	X	X			X				
	(8) Lack of appropriate opportunity to explore or to locate hiding place or escape route	Yes					X	X	X					X	X	X
	(9) Inappropriate social contact (for example social isolation or unwanted proximity)	Yes					X	X	X			X				
	(11) Inappropriate opportunity to preen	Yes					X	X	X			X				
	(12) Inappropriate opportunity for thermoregulation	Yes					X	X	X				X			
	(13) Inappropriate presence of chemical agents (e.g.**)	NA														
	(14) Inappropriate (high) density (*crowding*) of birds	NA														
	(15) Inappropriate mixing of species	NA														
	(16) Inappropriate hygiene conditions	YES				X	X	X	X			X				

Stage of pathway (S = 0.5 hour; M = 12h; L = 24-48h; VL = > 48h).

Transport from capture to holding station	**Hazards**	**Hazard potentially present?**	**Exposure**									**Consequences**				
			Frequency					**Duration**								
			VR	RA	MF	FR	VF	S	M	L	VL	SA	AE	MS	SE	VS
	(1) Inappropriate air condition	YES		X					X	X		X				
	(2) Inappropriate conditions for rest/sleep	YES				X			X	X			X			
	(3) Inappropriate opportunity for movement	YES				X			X	X		X	X	X	X	X
	(4) Inappropriate handling	NA														
	(5) Inappropriate access to water	YES		X	X				X	X				X		
	(6) Inappropriate access to nutrients	YES		X					X	X			X			
	(7) Inappropriate opportunity to carry out normal feeding behaviour	YES					X		X	X		X				
	(8) Lack of appropriate opportunity to explore or to locate hiding place or escape route	YES					X		X	X			X			
	(9) Inappropriate social contact (for example social isolation or unwanted proximity)	YES					X		X	X		X	X			
	(11) Inappropriate opportunity to preen	YES					X		X	X		X				
	(12) Inappropriate opportunity for thermoregulation	YES		X	X				X	X			X	X		
	(13) Inappropriate presence of chemical agents (e.g.**)	NA														
	(14) Inappropriate (high) density (*crowding*) of birds	YES				X			X	X			X	X		
	(15) Inappropriate mixing of species	YES				X			X	X		X				
	(16) Inappropriate hygiene conditions	YES					X		X	X			X			

Stage of pathway (S = 0.5 hour; M = 12h; L = 24-48h; VL = > 48h).

At holding station in third country	Hazards	Hazard potentially present?	Exposure									Consequences				
			Frequency					Duration								
			VR	RA	MF	FR	VF	S	M	L	VL	SA	AE	MS	SE	VS
	(1) Inappropriate air condition	YES	X							X	X	X				
	(2) Inappropriate conditions for rest/sleep	YES	X							X	X	X	X			
	(3) Inappropriate opportunity for movement	YES	X							X	X	X				
	(4) Inappropriate handling	YES				X	X	X						X		
	(5) Inappropriate access to water	YES	X							X	X	X				
	(6) Inappropriate access to nutrients	YES			X					X	X		X			
	(7) Inappropriate opportunity to carry out normal feeding behaviour	YES			X					X	X	X	X			
	(8) Lack of appropriate opportunity to explore or to locate hiding place or escape route	YES				X				X	X		X	X	X	X
	(9) Inappropriate social contact (for example social isolation or unwanted proximity)	YES				X				X	X		X			
	(11) Inappropriate opportunity to preen	YES			X					X	X	X				
	(12) Inappropriate opportunity for thermoregulation	YES		X						X	X	X				
	(13) Inappropriate presence of chemical agents (e.g.**)	YES			X					X	X		X			
	(14) Inappropriate (high) density (*crowding*) of birds	YES				X				X	X			X		
	(15) Inappropriate mixing of species	YES		X						X	X	X	X			
	(16) Inappropriate hygiene conditions	YES				X				X	X			X		

Stage of pathway (S = 0.5 hour; M = 12h; L = 24-48h; VL = > 48h).

Transport btw HS & point of export	**Hazards**	**Hazard potentially present?**	**Exposure**									**Consequences**				
			Frequency					**Duration**								
			VR	RA	MF	FR	VF	S	M	L	VL	SA	AE	MS	SE	VS
	(1) Inappropriate air condition	YES		X						X	X	X				
	(2) Inappropriate conditions for rest/sleep	YES					X			X	X		X			
	(3) Inappropriate opportunity for movement	YES					X			X	X		X	X	X	
	(4) Inappropriate handling	NA														
	(5) Inappropriate access to water	YES		X						X	X		X			
	(6) Inappropriate access to nutrients	YES			X					X	X	X				
	(7) Inappropriate opportunity to carry out normal feeding behaviour	YES					X			X	X	X				
	(8) Lack of appropriate opportunity to explore or to locate hiding place or escape route	YES					X			X	X		X	X	X	
	(9) Inappropriate social contact (for example social isolation or unwanted proximity)	YES					X			X	X		X			
	(11) Inappropriate opportunity to preen	YES					X			X	X	X				
	(12) Inappropriate opportunity for thermoregulation	YES				X				X	X			X		
	(13) Inappropriate presence of chemical agents (e.g.**)	NA														
	(14) Inappropriate (high) density (*crowding*) of birds	YES				X				X	X			X		
	(15) Inappropriate mixing of species	YES		X						X	X	X				
	(16) Inappropriate hygiene conditions	YES				X				X	X			X		

Stage of pathway (S = 0.5 hour; M = 12h; L = 24-48h; VL = > 48h).

At point of export	Hazards	Hazard potentially present?	Exposure									Consequences				
			Frequency					Duration								
			VR	RA	MF	FR	VF	S	M	L	VL	SA	AE	MS	SE	VS
	(1) Inappropriate air condition	YES		X						X	X	X				
	(2) Inappropriate conditions for rest/sleep	YES			X					X	X		X			
	(3) Inappropriate opportunity for movement	YES		X						X	X		X			
	(4) Inappropriate handling	YES				X		X						X		
	(5) Inappropriate access to water	YES		X						X	X	X				
	(6) Inappropriate access to nutrients	YES			X					X	X		X			
	(7) Inappropriate opportunity to carry out normal feeding behaviour	YES			X					X	X	X	X			
	(8) Lack of appropriate opportunity to explore or to locate hiding place or escape route	YES				X				X	X			X		
	(9) Inappropriate social contact (for example social isolation or unwanted proximity)	YES				X				X	X		X			
	(11) Inappropriate opportunity to preen	YES		X						X	X	X				
	(12) Inappropriate opportunity for thermoregulation	YES		X						X	X	X				
	(13) Inappropriate presence of chemical agents (e.g.**)	YES	X	X	X	X	X			X	X		X			
	(14) Inappropriate (high) density (*crowding*) of birds	YES				X				X	X		X			
	(15) Inappropriate mixing of species	YES		X						X	X	X				
	(16) Inappropriate hygiene conditions	YES		X	X					X	X			X		

Stage of pathway (S = 0.5 hour; M = 12h; L = 24-48h; VL = > 48h).

Transport between point of export and BIP	**Hazards**	**Hazard potentially present?**	**Exposure**									**Consequences**				
			Frequency					**Duration**								
			VR	RA	MF	FR	VF	S	M	L	VL	SA	AE	MS	SE	VS
	(1) Inappropriate air condition	YES	X							X	X	X				
	(2) Inappropriate conditions for rest/sleep	YES		X						X	X		X			
	(3) Inappropriate opportunity for movement	YES					X			X	X		X			
	(4) Inappropriate handling	NA														
	(5) Inappropriate access to water	YES	X							X	X	X				
	(6) Inappropriate access to nutrients	YES	X							X	X	X				
	(7) Inappropriate opportunity to carry out normal feeding behaviour	YES				X				X	X	X				
	(8) Lack of appropriate opportunity to explore or to locate hiding place or escape route	YES		X						X	X	X				
	(9) Inappropriate social contact (for example social isolation or unwanted proximity)	YES		X						X	X	X				
	(11) Inappropriate opportunity to preen	YES		X						X	X	X				
	(12) Inappropriate opportunity for thermoregulation	YES	X							X	X	X				
	(13) Inappropriate presence of chemical agents (e.g.**)	YES	X							X	X	X				
	(14) Inappropriate (high) density (*crowding*) of birds	YES		X						X	X			X		
	(15) Inappropriate mixing of species	YES	X							X	X	X				
	(16) Inappropriate hygiene conditions	YES	X							X	X	X				

Stage of pathway (S = 0.5 hour; M = 12h; L = 24-48h; VL = > 48h).

At BIP	Hazards	Hazard potentially present?	Exposure									Consequences				
			Frequency					Duration								
			VR	RA	MF	FR	VF	S	M	L	VL	SA	AE	MS	SE	VS
	(1) Inappropriate air condition	YES	X						X			X				
	(2) Inappropriate conditions for rest/sleep	YES					X		X			X				
	(3) Inappropriate opportunity for movement	YES					X		X			X				
	(4) Inappropriate handling	YES		X					X				X			
	(5) Inappropriate access to water	YES	X						X			X				
	(6) Inappropriate access to nutrients	YES		X					X			X				
	(7) Inappropriate opportunity to carry out normal feeding behaviour	YES					X		X			X				
	(8) Lack of appropriate opportunity to explore or to locate hiding place or escape route	YES					X		X			X				
	(9) Inappropriate social contact (for example social isolation or unwanted proximity)	YES					X		X			X				
	(11) Inappropriate opportunity to preen	YES					X		X			X				
	(12) Inappropriate opportunity for thermoregulation	YES		X					X			X				
	(13) Inappropriate presence of chemical agents (e.g.**)	YES	X						X			X				
	(14) Inappropriate (high) density (*crowding*) of birds	YES		X					X			X				
	(15) Inappropriate mixing of species	YES	X						X			X				
	(16) Inappropriate hygiene conditions	YES	X						X			X				

Stage of pathway (S = 0.5 hour; M = 12h; L = 24-48h; VL = > 48h).

Transport between BIP and quarantine	**Hazards**	**Hazard potentially present?**	**Exposure**									**Consequences**				
			Frequency					**Duration**								
			VR	RA	MF	FR	VF	S	M	L	VL	SA	AE	MS	SE	VS
	(1) Inappropriate air condition	YES		X					X	X	X	X				
	(2) Inappropriate conditions for rest/sleep	YES					X		X	X	X		X			
	(3) Inappropriate opportunity for movement	YES					X		X	X	X		X			
	(4) Inappropriate handling	NA														
	(5) Inappropriate access to water	YES	X						X	X	X	X				
	(6) Inappropriate access to nutrients	YES		X					X	X	X	X				
	(7) Inappropriate opportunity to carry out normal feeding behaviour	YES					X		X	X	X	X				
	(8) Lack of appropriate opportunity to explore or to locate hiding place or escape route	YES					X		X	X	X		X			
	(9) Inappropriate social contact (for example social isolation or unwanted proximity)	YES					X		X	X	X		X			
	(11) Inappropriate opportunity to preen	YES					X		X	X	X	X				
	(12) Inappropriate opportunity for thermoregulation	YES		X	X				X	X	X		X			
	(13) Inappropriate presence of chemical agents (e.g.**)	YES	X						X	X	X	X				
	(14) Inappropriate (high) density (*crowding*) of birds	YES		X					X	X	X		X			
	(15) Inappropriate mixing of species	YES	X						X	X	X	X				
	(16) Inappropriate hygiene conditions	YES		X					X	X	X	X				

Stage of pathway (S = 0.5 hour; M = 12h; L = 24-48h; VL = > 48h).

In MS quarantine facility	Hazards	Hazard potentially present?	Exposure									Consequences				
			Frequency					Duration								
			VR	RA	MF	FR	VF	S	M	L	VL	SA	AE	MS	SE	VS
	(1) Inappropriate air condition	YES	X								X	X				
	(2) Inappropriate conditions for rest/sleep	YES	X								X	X				
	(3) Inappropriate opportunity for movement	YES	X								X	X				
	(4) Inappropriate handling	YES		X							X	X				
	(5) Inappropriate access to water	YES	X								X	X				
	(6) Inappropriate access to nutrients	YES		X							X	X				
	(7) Inappropriate opportunity to carry out normal feeding behaviour	YES			X						X		X			
	(8) Lack of appropriate opportunity to explore or to locate hiding place or escape route	YES			X						X		X			
	(9) Inappropriate social contact (for example social isolation or unwanted proximity)	YES			X						X		X			
	(11) Inappropriate opportunity to preen	YES		X							X	X				
	(12) Inappropriate opportunity for thermoregulation	YES		X							X	X				
	(13) Inappropriate presence of chemical agents (e.g.**)	YES	X								X	X				
	(14) Inappropriate (high) density (*crowding*) of birds	YES	X								X	X				
	(15) Inappropriate mixing of species	YES	X								X	X				
	(16) Inappropriate hygiene conditions	YES		X							X	X				

Stage of pathway (S = 0.5 hour; M = 12h; L = 24-48h; VL = > 48h).

Transport between MS quarantine and point of import	**Hazards**	**Hazard potentially present?**	**Exposure**									**Consequences**				
			Frequency					**Duration**								
			VR	RA	MF	FR	VF	S	M	L	VL	SA	AE	MS	SE	VS
	(1) Inappropriate air condition	YES		X					X			X				
	(2) Inappropriate conditions for rest/sleep	YES					X		X			X				
	(3) Inappropriate opportunity for movement	YES				X			X			X				
	(4) Inappropriate handling	NA														
	(5) Inappropriate access to water	YES		X					X			X				
	(6) Inappropriate access to nutrients	YES		X					X			X				
	(7) Inappropriate opportunity to carry out normal feeding behaviour	YES					X		X			X				
	(8) Lack of appropriate opportunity to explore or to locate hiding place or escape route	YES				X			X			X				
	(9) Inappropriate social contact (for example social isolation or unwanted proximity)	YES				X			X			X				
	(11) Inappropriate opportunity to preen	YES				X			X			X				
	(12) Inappropriate opportunity for thermoregulation	YES		X					X				X			
	(13) Inappropriate presence of chemical agents (e.g.**)	YES	X						X			X				
	(14) Inappropriate (high) density (*crowding*) of birds	YES			X				X				X			
	(15) Inappropriate mixing of species	YES	X						X			X				
	(16) Inappropriate hygiene conditions	YES		X					X			X				

Stage of pathway (S = 0.5 hour; M = 12h; L = 24-48h; VL = > 48h).

Point of import	Hazards	Hazard potentially present?	Exposure									Consequences				
			Frequency					Duration								
			VR	RA	MF	FR	VF	S	M	L	VL	SA	AE	MS	SE	VS
	(1) Inappropriate air condition	YES	X							X	X	X				
	(2) Inappropriate conditions for rest/sleep	YES		X						X	X		X	X		
	(3) Inappropriate opportunity for movement	YES		X						X	X		X	X		
	(4) Inappropriate handling	YES		X	X					X	X		X	X	X	
	(5) Inappropriate access to water	YES	X							X	X	X				
	(6) Inappropriate access to nutrients	YES		X						X	X		X	X		
	(7) Inappropriate opportunity to carry out normal feeding behaviour	YES	X	X	X					X	X	X	X	X		
	(8) Lack of appropriate opportunity to explore or to locate hiding place or escape route	YES	X	X	X					X	X	X	X	X		
	(9) Inappropriate social contact (for example social isolation or unwanted proximity)	YES		X	X	X				X	X		X	X		
	(11) Inappropriate opportunity to preen	YES	X							X	X	X				
	(12) Inappropriate opportunity for thermoregulation	YES		X						X	X		X			
	(13) Inappropriate presence of chemical agents (e.g.**)	YES		X						X	X		X			
	(14) Inappropriate (high) density (*crowding*) of birds	YES		X						X	X		X	X		
	(15) Inappropriate mixing of species	YES	X							X	X	X				
	(16) Inappropriate hygiene conditions	YES		X	X					X	X		X	X		

7.1.2. Conclusions on the Welfare Risk Assessment

- Welfare is reduced if the needs of animals are not met. The needs of birds have been determined as a result of studies of their biology and form the basis of the risk analysis in this report.
- The justification for continuing the importation of these birds should be carefully considered, because the welfare is very poor and there is no indication that measures can be put in place to adequately protect their welfare at all stages
- During the captive bird pathway, several hazards lead to adverse consequences that can be very serious for the welfare of the birds. These adverse consequences vary at different stages of the pathway but are reduced once the birds leave the Third Country. Captive bred birds from the country of origin also are subject to several hazards but these are less than those experienced by captive wild birds.
- Although there is uncertainty due to the type of published data and general lack of data, particularly for the early stages of the pathway, these and expert opinion support the conclusion that a high number of injuries and deaths can be frequent events at several stages
- No studies have been undertaken to determine which hazard or combination of hazards contribute(s) to the deaths of captive wild birds at each stage of he pathway.
- Although these conditions may vary considerably, after capture, all birds (adults and nestlings) are likely to experience greater or lesser levels of fear and stress. A key factor is the age at which they have their first human contact
- Mortality at the various stages of the pathway from first attempts at capture in the country of origin to sale in the E.U. can be a useful and objective indicator of welfare. As recently as 2001-2003, separate reports recorded psittacine fledgling mortalities of 0%-30% at capture and overall 60%-70% by the time they reached the dealers pre-export.
- For parrots caught as adults the reported mortality could be as high as 67%.
- When target birds are wounded with guns their welfare is poor due to the injuries they sustain.
- When target birds are trapped, it is likely that the welfare of non-target decoy birds and mammals will be poor as they are restricted from moving freely by glues (lime) or tethers, and so are unable to fulfil their needs, particularly to escape.
- All transports fulfilling IATA guidelines can be characterised as good and the proportion of birds that are dead on arrival [DOA] is low [1.5% overall and lower for Psittaciformes]. Nevertheless, international air transport results in high mortality for some species and some shipments, indicating that the critical needs of some birds have not been met and these hazards have very serious consequences. Similarly, the higher DOA resulting from most shipments that did not meet IATA guidelines and for non-CITES species indicates that the critical needs of these birds have not been met.
- The higher mortality for wild caught birds than for captive bred birds and the much greater DIQ than DOA suggest that a failure to reduce or remove critical hazards during the pre-transport stages adversely affects survival of the birds.
- Recent practical experience suggests that current mortality rates post-quarantine are considerably lower. A reasonable estimate for this mortality, if quarantine and post-quarantine mortalities have both decreased by 40% since 1991, is 20%. However, it must be stressed that only one study supports this statement.
- The overall mortality of wild-caught birds from the beginning of the capture procedure to arrival at the point of sale to those who keep them as pets can vary greatly

depending on the species, but is generally high and can be over 70% on the basis of data in published papers

- Mortality figures for captive wild birds are very much higher than those for mortality of domestic livestock during handling, transport and keeping that occur in any other area of human usage of animals.
- The death of wild-caught birds is usually preceded by a period of poor welfare.
- The likelihood of poor welfare in birds taken from the wild is very much greater than in birds that have been bred in captivity because the wild-caught birds are more disturbed by human presence and adapt much less well to confinement. Adult birds taken from the wild can hardly ever adapt to captivity so that their welfare in captivity is generally poor. A few survive but many die. Birds of some species taken as fledglings may adapt to captivity and their welfare then depends on the quality of the keeping conditions in relation to the needs of the birds.
- The import of fertile eggs is safer and has fewer negative welfare implications than hatched birds

7.1.3. Recommendations on the Welfare risk assessment

- Because the welfare of captive wild birds is often very poor, justification for continuing the importation of these birds should be carefully considered
- At present methods for distinguishing wild caught birds from captive bred birds are not reliable, so further research and improvement of the quality control and on the traceability systems is essential
- Captive breeding meeting high animal welfare standards should be considered for as many species as possible, particularly Passeriformes, provided that a method of distinguishing wild caught birds from captive bred birds is available.
- Further studies to determine the remaining causes of mortality during IATA transport and post-BIP are required to ensure that the critical needs of birds are met and to identify 'high risk' species that perhaps should not be transported post-hatching except in special circumstances. The value of these studies should be strengthened if improved data recording and collection is undertaken and harmonised.
- The import of eggs that are to be hatched in the E.U. should be considered species by species as a means of importing birds into the EU.
- Accurate records should be kept of disease prevalence, mortality rates and other indicators of poor welfare in any birds permitted to enter the E.U.

7.2. Risk of introducing infectious agents through import of captive birds

The following pathway summarises the sequence of events which would have to take place for a generic agent X to become established within the EU as a direct result of the importation of captive birds.

- Wild bird infected at point of capture
- Undetected infected wild bird retained for export
- Uninfected bird becomes infected during transport from point of capture to holding station
- Undetected infected bird introduced into holding station
- Uninfected bird becomes infected at holding station
- Undetected infected bird released from holding station
- Uninfected bird becomes infected during transport from holding station to point of export
- Undetected infected bird introduced into point of export
- Uninfected bird becomes infected at point of export in third country
- Undetected infected bird released from point of export into transportation to BIP

- Uninfected bird becomes infected during transport between point of export and Border Inspection Point (BIP)
- Undetected infected bird introduced into BIP
- Uninfected bird becomes infected at BIP
- Undetected infected bird released from BIP
- Uninfected bird becomes infected during transport between BIP and quarantine
- Undetected infected bird introduced into quarantine
- Uninfected bird becomes infected during quarantine
- Undetected infected bird released from quarantine
- Uninfected bird becomes infected during transport between quarantine and point of distribution
- Infected bird released into EU
- Agent becomes established within EU poultry and/or wild bird populations

7.2.1. Hazard definition

In the animal health context, there are three hazards of interest; avian influenza virus, chlamydiae and Newcastle disease virus.

7.2.2. Hazard characterisation

The next step of the risk assessment is the characterisation of each of the hazards of interest. We adopt an equivalent terminology to that used in the assessment of the welfare hazards:

HAZARD CHARACTERISATION:	SA: Slightly Adverse; A: Adverse; MS: Moderately Serious; S: Serious; VS: Very Serious.

In characterising the hazard we must consider the consequences of each of the agents under study being introduced into and subsequently becoming established in the EU.

7.2.3. Avian Influenza

The implications of the importation of Avian Influenza virus into the EU are highly strain dependent. Some strains are highly pathogenic to poultry. We adopt a pessimistic approach and implement our risk assessment on the basis of these highly pathogenic avian influenza (HPAI) strains. In keeping with this approach, the hazard must be characterised as **very serious** (VS).

7.2.4. Chlamydiosis

Chlamydia is widespread in avian species. Virtually all avian species can be any of (i) healthy latently infected non-shedders, (ii) healthy latently infected shedders via pharynx and cloaca, (iii) diseased shedders showing hepatitis, splenitis, respiratory signs, conjunctivitis and diarrhoea, (iv) dying of chlamydiosis or concomitant infections (section 8.3.3.2). Most frequent is the latent stage without signs. Chlamydiae are already present in birds within the EU, but as they represent a serious public health problem (not least as a result of its high zoonotic potential), any importation of these organisms add to the present disease burden. This hazard is therefore categorised as **very serious** (VS).

7.2.5. Newcastle disease

As with avian influenza, there is a large degree of variation in the ability of Newcastle disease strains to cause disease in avian hosts. For those strains which are the most virulent (and which therefore represent a pessimistic scenario) (eg **) the hazard must be characterised as **very serious** (VS).

7.3. Health Risk assessment

The three case study agents have been considered in turn.

7.3.1. Avian influenza

Note that we have to consider all avian influenza A viruses, in particular AIVs of the haemagglutinin subtypes H5 and H7 – not only the current H5N1 AIV.

Pre-point of export

Probability that a caught bird is infected with AIV at the point of capture

Conclusions

- Captured birds other than Anseriformes are less likely to be infected by avian influenza viruses of any HA subtype..
- The probability of captured Anseriformes in a third country being positive for AI is uncertain.

Probability that an undetected AIV-infected wild birds is retained for export

Conclusions

- Although there are few data on the selection criteria at the point of capture, it is expert experience that most captured birds are retained and enter the captive bird pathway sale.
- Clinical signs which might result in captured birds being rejected are species and AI virus subtype dependant. In some species (e.g. galliform birds) clinical signs may be observed and the probability of retention is low; in most other species (e.g. psittaciformes) shedding without clinical signs may occur and the probability of retention is high.

Probability that a bird is infected with AIV during transport to holding station

Conclusions

- During transport from capture to the holding station the probability that a bird which is a member of a susceptible order becomes infected with AI is uncertain and a pessimistic approach suggests that could be **moderate to high**, dependent upon transport conditions and duration;
- During transport from capture to the holding station the probability that a bird which is a member of a non-susceptible order becomes infected with AIV is **low to negligible**.

Probability that an undetected AIV-infected bird is introduced in the holding station

Conclusions

- Given a random bird infected with AI, the probability that the bird is released undetected into the holding station is **high**.
- Tests to detect AIV either by virus isolation or by PCR are not done

Probability that an AIV-infected bird infects other birds at holding station

Conclusion

- At the holding station the probability that a bird which is a member of a susceptible family/order becomes infected with AI in the presence of an infected bird could be **low to moderate**, although considerable uncertainty exists around this estimate as a result of sparse data.
- At the holding station the probability that a bird which is a member of a non-susceptible family/order becomes infected with AI in the presence of an infected bird is **low to negligible**.

Probability that an AIV-infected bird is released undetected from a holding station

Conclusion:

- The probability that an AIV-infected bird is released undetected from a holding station is species dependent; for some bird groups which do not experience clinical signs it will be **high.**

Probability that a bird becomes infected with AIV during transport from the holding station to the point of export

Conclusion

- The probability that a bird becomes infected during transport from the holding station to the point of export is subject to **great uncertainty**, as it depends on journey length, species and mixing.

Probability that a new AIV infection is introduced at the point of export

Conclusion

- The probability that a new infection is introduced at the point of export is **uncertain** resulting from a number of factors related to both the mixing of species and mixing of birds from different third countries.

Summary conclusions on the pre-export chain

The probability that a randomly selected captive bird reaches the point of export infected with AI is:

- **low** in birds (predominantly anseriformes but also Columbiformes and Charadriiformes) originating from countries with a low level of naturally-occurring AI and which do not export birds from third countries with a higher risk profile;
- **uncertain** in birds (predominantly Anseriformes, Columbiformes and Charadriiformes) originating from countries with a low level of naturally-occurring AI which export birds from third countries with a higher risk profile due to potential for mixing
- **high** in birds (predominantly anseriformes) originating from countries with a high level of naturally-occurring AI.

Probability that an AIV-infected bird is detected at point of export

Conclusions

- The probability that an infected bird is detected at the point of export is highly variable and heavily dependent on testing capabilities in the third country. The exact nature of testing in third countries is uncertain, but the probability of detection via this route is likely to be low as a consequence of inherent infrastructures
- Pre-export testing of exported captive birds is not a legal requirement currently (Dimmock report).
- Where testing does not take place, the probability that an infected bird is detected at the point of export is **low**
- If the bird displays clinical signs (possible for HPAI in certain host species) the probability that an infected bird is detected at the point of export is **high**.

Post-point of export

Probability that an uninfected bird becomes infected with AIV during transport between point of export and Border Inspection Point (BIP)

Conclusions

- Based upon 2005 data, most transportation from point of export to BIP take place via an air route, and their duration is hence as short as it can be over a given fixed distance. Depends also on direct flights and transits.
- Despite this, some transportation will have duration of a moderate to high number of hours as a consequence of physical distance between point of export and BIP.
- There may be a relationship between value of bird and probability of infectious disease transmission, but the nature of this is uncertain.
- The probability that a bid becomes infected with AIV during transport from a point of export to a BIP may be **low** for short journeys.
- A pessimistic approach suggests that this same probability could be **high** for longer journeys, but the exact nature of the probability is both **uncertain** and **variable** as a result of dependence upon factors such as mixing, transmission efficacy of AIV in this environment and length of travel.
- The applicability of the data upon which these conclusions have been based to a randomly selected year is uncertain.

Probability that an undetected AIV-infected bird introduced into BIP

Conclusions

- AIV could be present in birds that arrive at a BIP and may be more likely in some species [Anseriformes]
- Absent or incomplete documentation accompanying consignments of birds leads to a greater likelihood of an undetected AIV-infected bird being admitted to the BIP. Incomplete and obviously false documentation results in longer periods of time at BIP. The longer time enhances the chance of lateral spread.

Probability that a bird becomes infected with AIV at a BIP

Conclusions

- The probability that a bird becomes newly infected with AIV at a BIP is negligible.

Probability that an infected bird is released from the BIP to the quarantine

Conclusion

- The probability that an AIV infected bird is released from the BIP is **high**

Probability that a captive bird is infected with AIV during transport from BIP to quarantine

Conclusions

- When criteria specified in the health questionnaire which must be presented on arrival at a quarantine are strictly enforced, the probability of infection during transport from BIP to quarantine should be **low**.
- The rigour with which health certificates are examined at different BIPs is **uncertain** and likely to be **variable**.
- The probability in general of becoming infected during transport from BIP to quarantine is **highly variable** and is **uncertain** as a result of combination of a number of uncertain and variable factors.

Probability that a captive bird during transport between BIP and quarantine infects indigenous EU birds with AIV

Conclusions

- Given the most likely routes of transmission and the opportunity of exposure of EU wild birds via these routes, we conclude that the probability of a captive bird during transport from BIP to quarantine station infects indigenous EU birds with AIV is **Negligible**.

Probability that an undetected infected bird is introduced into a quarantine station

Conclusions

- Given that many AIV infections in captive birds are subclinical and formal testing does not generally take place until at least one week into the quarantine period, there is a **high** probability of a subclinically infected being introduced into the quarantine station.

Probability that a bird becomes infected during quarantine

Conclusions

- The possibility of variation in the interpretation of the EU directive governing the construction of quarantine stations means that the probability that a captive bird becomes infected during quarantine remains **low** (**uncertain)**.
- Data on the practices employed in quarantine stations, coupled with information from EC Directive 2000/666, would prove valuable in informing our estimates of the likelihood of disease transmission.

Release of infected birds from quarantine

Conclusions

- Reliance on clinical signs for diagnosis of AIV infection in captive birds is potentially misleading and unreliable.
- The usefulness of using sentinel chickens to diagnose AIV infection in captive birds is uncertain, as a consequence of problems in ensuring adequate levels for AIV transmission of faecal-oral contact between captive bird and sentinel.

- Given the short incubation period, a bird which either arrives with AIV infection or becomes infected during the quarantine period and is to become clinically ill as a result of AIV infection should display clinical signs within the quarantine period. The probability of such a bird being released undetected from quarantine is hence **negligible** to **low**.
- The fact that all birds are tested in consignments of 60 birds or less means that the probability of an undetected subclinically infected bird being released from quarantine is **low**.
- There is a risk that some birds which are prone to sub-clinical infection may become infected post-microbiological and serological testing and hence may be released infected.
- The fact that a maximum of 60 birds are tested irrespective of consignment size coupled with the possible inefficacy of sentinel bird-based diagnosis in the captive bird environment means that the probability of an indetected subclinically infected bird in a consignment of 60 birds or more being released from quarantine is **higher than that for small consignments**, with probability increasing with consignment size.

7.3.2. Chlamydiosis

Probability that a caught bird is infected with AC at the point of capture

Conclusions

- Most of the wild birds imported into the EU to be kept as captive can be infected with AC and can act as carriers.
- AC is widespread throughout many of the countries from which captive birds are imported into the EU.
- AC already exists in the EU with outbreaks occurring sporadically and largely unquantified; information on the numbers of deaths is sparse.
- The probability of a captured bird being positive for AC is country dependent and is likely to be higher in those countries which have a high naturally occurring prevalence of AC.
- Reporting bias and the fact that the summaries presented here are based on outbreak data means that the naturally occurring prevalence in third countries remains uncertain. In particular, the fact that the best available data comes from developed countries makes us confident that the data presented should **in no way be regarded as representative of naturally-occurring prevalence**. No outbreaks evidenced in a given third country does not equate to AC being absent from this country. Outbreak data is not a substitute for surveillance data.

Probability that an undetected AC-infected wild bird is retained for export

Conclusions

- The probability that an AC-infected wild bird is retained for export is likely to be influenced by the stress induced by its capture, as stressed birds may be more inclined to show clinical disease.
- The probability that an AC-infected wild bird is retained for export is likely to be **lower** for young birds than for older birds, as clinical signs are more frequent.

Probability that a bird is infected with AC during transport to holding station

Conclusions

- Given the likely lack of clinical signs of infected birds coupled with transport conditions and the robustness of AC, a pessimistic approach suggests that the probability that a bird becomes infected with AC could be **high**, though this is dependent upon transport conditions and duration.

Probability that an AC-infected bird is introduced into the holding station

Conclusions

- Given that many wild birds (particularly psittacines) do not display clinical signs and that latent carrier status is common, the probability that an AC-infected bird is released undetected into the holding station could be **high** for some species and age groups.
- Stress increases the likelihood that birds will go on to show clinical signs, and the levels of stress encountered prior to this point may be influential in determining whether the bird is introduced into the holding station.

Probability that an AC-infected bird infects other birds at holding station

Conclusions

- At the holding station the probability that a captive bird becomes infected with AC in the presence of an infected bird could be **high** as a consequence of the contagious nature of this agent and mechanisms by which it is spread.

Probability that a bird is infected at a breeding colony

Conclusions

- The probability that a bird is infected at a breeding colony is **low** to **moderate**.

Probability that an AC-infected bird is released undetected from a holding station

Conclusions

- The probability that an AC-infected bird is released undetected from a holding station is variable; in birds prone to latent carriage without clinical disease manifestation it may be **high**, but in younger birds or birds subjected to stress it could be **lower**.

Probability that a bird becomes infected with AC during transport from the holding station to the point of export

Conclusions

- As in the transportation between capture and holding station, the probability that a bird becomes infected with AC may be **high**, again dependent upon transport conditions and duration.

Probability that a new AC infection is introduced at the point of export

Conclusions

- Given the host-species diversity and the fact that AC may well be widespread throughout much of the world (exact distribution unclear due to reporting bias issues), the probability that a bird arriving from one of these countries brings an infection to

the point of export may be **high**; an exception to this may exist for either particularly young, or stressed birds which may have a greater likelihood of demonstrating clinical disease and should hence be rejected prior to export.

- Given the fact that an unknown number of birds may already be infected with AC upon arrival at export, the probability of a new infection being introduced at the point of export is **uncertain**.

Summary conclusions on the pre-export chain

The probability that a randomly selected captive bird reaches the point of export infected with NDV is

- Uncertain in captive birds originating from third countries for which no documentary evidence of AC status exists. This includes many countries which regularly export large numbers of captive birds.
- A pessimistic approach and a comparison with developed countries which have a more solid reporting infrastructure suggests that, taking all other factors into account, AC is likely to be present (though undetected) in these countries, and hence the probability that a randomly selected captive bird reaches the point of export infected with AC could be **high.**
- An exception may be present for very young or stressed birds, which may have demonstrated clinical disease at some point in the import chain up to this point and may hence have been rejected. For these birds, the probability that a randomly selected captive bird reaches the point of export infected with AC could be **low**.

Probability that an AC infected bird is detected at point of export

Conclusions

- The probability that an infected bird is detected at the point of export is highly variable and dependent on species, age of bird, bird's stress levels and testing capabilities in the third country. The exact nature of testing in third countries is uncertain, but the probability of detection via this route is likely to be low as a consequence of infrastructures which do not support detailed evaluation.
- Sub-clinical carriage of AChl is possible in many avian species, and the probability of birds which fall into this category but are not tested prior to export being detected is **low**. Exceptions to this might be young or severely stressed birds **(**see next point).
- In younger birds or stressed birds the probability that the bird is detected at the point of export may be **higher.**

Probability that an uninfected bird becomes infected with AC during transport between point of export and Border Inspection Point (BIP)

Conclusions

- Based upon 2005 data, most journeys from point of export to BIP take place via an air route, and their duration is hence as short as it can be over a given fixed distance.
- Despite this some journeys will take a moderate to high number of hours as a consequence of physical distance between point of export and BIP.
- There may be a relationship between value of bird and probability of infectious disease transmission, but the nature of this is uncertain.
- The probability that a bid becomes infected with AC during transport from a point of export to a BIP may be **low** for short journeys, though the potential for spread via the

environment and the difficulties in achieving adequate disinfection in a dusty environment suggests that this probability may be higher than the equivalent for AIV.
- A pessimistic approach suggests that this same probability could be **high** for longer journeys, but the exact nature of the probability is both **uncertain** and **variable**.
- The applicability of the data upon which these conclusions have been based to a randomly selected year is uncertain.

Probability that an undetected AC infected bird introduced into BIP

Conclusions
- AC could be present in birds that arrive at a BIP. Younger birds and stressed birds have a greater predisposition towards showing clinical signs, but the commonest state is one of latent sub-clinical carriage.
- Absent or incomplete documentation accompanying consignments of birds leads to a greater likelihood of an undetected AC-infected bird being admitted to the BIP.

Probability that a bird becomes infected with AC at a BIP

Conclusions
- The probability that a captive bird becomes newly infected at a BIP is **low**.
- Inadequate cleaning and disinfection between consignments of birds may convey a greater risk.

Probability that an AC-infected bird is released from the BIP to the quarantine

Conclusions
- The probability that a sub-clinically AC infected captive bird is released from the BIP is **high;**
- The probability of a stressed or young bird with an AC infection being released from a BIP might be **lower**.

Probability that a captive bird is infected with AC during transport from BIP to quarantine

Conclusions
- When criteria specified in the health questionnaire which must be presented on arrival at quarantine are strictly enforced, the probability of infection with AC during transport from BIP to quarantine should be **low**.
- Disinfection of vehicles between consignments may prove difficult and this may convey a greater risk.
- The rigour with which health certificates are examined at different BIPs is **uncertain** and likely to be **variable**.
- The probability in general of becoming infected during transport from BIP to quarantine is **highly variable** and is **uncertain** as a result of combination of a number of uncertain and variable factors.
- Given the likely horizontal routes of transmission and the limited opportunity for exposure of EU wild birds via these routes, we conclude that the probability of a captive bird during transport from BIP to quarantine station infects indigenous EU birds with AC is **low**.

Probability that an AC infected bird is introduced into a quarantine station

Conclusions

- AC infections in captive birds can sometimes be subclinical; when this is the case there is a **high** probability of a subclinically infected being introduced into the quarantine station.
- When a clinical infection is present, either as a result of the age of the bird or stressed status, the probability that an AC infected bird is introduced into a quarantine station is **low.**

Probability that a bird becomes infected during quarantine

Conclusions

- The possibility of variation in the interpretation of the EU directive governing the construction of quarantine stations means that the probability that a captive bird becomes infected during quarantine remains **uncertain**.
- Data on the practices employed in quarantine stations, coupled with information from EC directive 2000/666, would prove valuable in informing our estimates of the likelihood of infection transmission within this environment.

Probability that an AC infected bird is released from quarantine

Conclusions

- Some birds (those which are very young or very stressed) may display clinical signs of AC during the quarantine period. However this cannot be relied upon as a diagnostic in isolation, as latent carriage of AC in captive birds does occur, particularly in psittacines.
- The usefulness of using sentinel chickens to diagnose AC infection in captive birds is unclear. Sentinels were introduced as a means of diagnosing AIV and NDV, and so their relevance in the context of AC remains uncertain.
- Even when implemented, serological testing for AChl is not always reliable. Hence there is a possibility that infected birds which are subjected to this may be missed.
- There is a risk that some birds which are prone to sub-clinical infection may become infected post-testing (if it occurs) and hence may be released infected.
- The fact that the testing of birds for AChl is not routinely implemented in quarantine, coupled with the unknown capability of sentinel bird-based diagnosis of AChl in the captive bird environment, means that the probability that a subclinically AChl infected bird remains undetected and is subsequently released from quarantine, though **uncertain**, could be high.

7.3.3. Newcastle disease

Pre-point of export

Probability that a caught bird is infected with NDV at the point of capture

Conclusions

- Most of the wild birds imported into the EU to be kept as captive can be infected with ND virus and can be virus shedders and act as carriers.

- NDV is widespread throughout many of the countries from which captive birds are imported into the EU.
- NDV already exists in the EU, albeit with sporadic outbreaks, often involving small numbers of cases and associated deaths.
- The **probability** of a captured bird being positive for NDV is **country dependent** and is likely to be higher in those countries which have a high naturally occurring prevalence of NDV.
- Countries in Africa and Asia have reported the most cases, which may suggest a greater risk in birds imported from countries in these continents.
- Reporting bias and the fact that the summaries presented here are based on outbreak data means that the naturally occurring prevalence in third countries remains uncertain. No outbreaks evidenced in a given third country does not equate to NDV being absent from this country. Outbreak data is not a substitute for surveillance data.

Probability that an undetected NDV-infected wild bird is retained for export

Conclusions

- The probability that a NDV-infected wild bird is retained for export is **high**.

Probability that a bird is infected with NDV during transport to holding station

Conclusions

- Given the contagiousness of NDV coupled with the potential for air-borne spread and the fact that airspace will probably be shared by birds in the same consignment, a pessimistic approach suggests that the probability that a bird becomes infected with NDV could be **high**, dependent upon transport conditions and duration.

Probability that a NDV-infected bird is introduced into the holding station

Conclusion

- Given that many wild birds do not display clinical signs and may act as reservoirs for NDV, the probability that a NDV-infected bird is released undetected into the holding station is **high**.

Probability that a DNV-infected bird infects other birds at holding station

Conclusion

- At the holding station the probability that a captive bird becomes infected with NDV in the presence of an infected bird could be **high** as a consequence of the contagious nature of this agent and mechanisms by which it is spread.

Probability that a NDV-infected bird is released undetected from a holding station

Conclusion

- The probability that a NDV-infected bird is released undetected from a holding station is **high**.

Probability that a bird becomes infected with NDV during transport from the holding station to the point of export

Conclusion

- As in the transportation between capture and holding station, the probability that a bird becomes infected with NDV may be **high**, again dependent upon transport conditions and duration.

Probability that a new NDV infection is introduced at the point of export

Conclusion

- Given the host-species diversity and the apparent widespread nature of NDV throughout much of Africa, Asia and Central and South America, the probability that a bird arriving from one of these countries brings an infection to the point of export may be **high**; however, given the fact that an unknown number of birds may already be infected with NDV upon arrival at export the probability of a new infection being introduced at the point of export is **uncertain**.

Summary conclusions on the pre-export chain

The probability that a randomly selected captive bird reaches the point of export infected with NDV is

- **High** in captive birds originating in countries which report numerous and large outbreaks of NDV, particularily in free-running village chickens but not to the same extent in large commercial chicken farms;
- **Low** in captive birds originating from countries which report few small outbreaks of NDV, or do not experience any outbreaks of NDV;
- Uncertain in captive birds originating from third countries for which no documentary evidence of NDV status exists

Probability that a NDV-infected bird is detected at point of export

Conclusions

- The probability that an infected bird is detected at the point of export is highly variable and dependent on testing capabilities in the third country. The exact nature of testing in third countries is uncertain, but the probability of detection via this route is likely to be low as a consequence of inherent infrastructures.
- Since vaccination is easier and more rapid to perform and also less costly, countries that have a ND-associated problem prefer vaccination of birds as compared to testing (virus isolation and / or serology) for export.
- Pre-export testing of exported captive birds is not a legal requirement currently (Dimmock report).
- Where testing does not take place, the probability that an infected bird is detected at the point of export is **low**
- If the bird displays clinical signs (unlikely in most captive birds) the probability that an infected bird can be detected at the point of export is **high.**

Probability that an uninfected bird becomes infected with AIV during transport between point of export and Border Inspection Point (BIP)

Conclusions

- Based upon 2005 data, most transportations from point of export to BIP take place via an air route, and their duration is hence as short as it can be over a given fixed distance.

- Despite this some transportations will have duration of a moderate to high number of hours as a consequence of physical distance between point of export and BIP.
- There may be a relationship between value of bird and probability of infectious disease transmission, but the nature of this is uncertain.
- The probability that a bird becomes infected with NDV during transport from a point of export to a BIP may be **low** for short journeys, though the potential for air-borne spread suggests that this probability may be higher than the equivalent for AIV.
- A pessimistic approach suggests that this same probability could be **high** for longer journeys, but the exact nature of the probability is both **uncertain** and **variable**.
- The applicability of the data upon which these conclusions have been based to a randomly selected year is uncertain.

Probability that an undetected NDV-infected bird introduced into BIP

Conclusions

- NDV could be present in birds that arrive at a BIP. The potential for sub-clinical carriage in families of birds which might be imported as captive has been demonstrated.
- Absent or incomplete documentation accompanying consignments of birds leads to a greater likelihood of an undetected NDV-infected bird being admitted to the BIP.

Probability that a bird becomes infected with NDV at a BIP

Conclusion

- The probability that a captive bird becomes newly infected at a BIP is **low**, but may be higher than the equivalent probability for AIV.

Probability that a NDV-infected bird is released from the BIP to the quarantine

Conclusions

- The probability that a NDV infected captive bird is released from the BIP is **high.**

Probability that a captive bird is infected with NDV during transport from BIP to quarantine

Conclusions

- When criteria specified in the health questionnaire which must be presented on arrival at a quarantine are strictly enforced, the probability of infection with NDV during transport from BIP to quarantine should be **low**.
- The rigour with which health certificates are examined at different BIPs is **uncertain** and likely to be **variable**.
- The probability in general of becoming infected during transport from BIP to quarantine is **highly variable** and is **uncertain** as a result of combination of a number of uncertain and variable factors.

Probability that a captive bird during transport between BIP and quarantine infects indigenous EU birds with NDV

Conclusions

- Given the most likely routes of transmission and the opportunity of exposure of EU wild birds via these routes, we conclude that the probability of a captive bird during transport from BIP to quarantine station infects indigenous EU birds with NDV is **low**, but may be marginally higher than the equivalent for AIV as a consequence of the possibility of air-borne transmission.

Probability of establishment of AIV/NDV/AC in the EU

For NDV, it seems misleading to discuss the probability of establishment of the agent within the EU, since it is known that NDV is already responsible for intermittent outbreaks within poultry within the EU (Handistatus II), but interest here concerns the extra burden which may be brought into the EU as a direct result of the importation of captive birds. A similar point applies for AC, which is known to be established in many EU countries.

For each of the three agents, there is potentially a risk from captive birds placed in nature parks and zoos, as they may have a greater opportunity to make contact with the indigenous wild bird population, or, perhaps more significantly, to generate waste products (for AIV and NDV faecal material and for AC feathers, dust, dander) which may be accessible to the indigenous wild bird population. Contact between indigenous wild birds and captive birds which are placed in a domestic environment indoors seemsm less likely (excepting in the event of an escape of an indoor-housed captive bird, where direct contact immediately becomes a possibility). Captive birds placed in a domestic environment outdoors (perhaps in an aviary or a breeding colony) might convey a transmission risk; the level of likely contact between birds housed in this manner and the indigenous EU population of wild birds is uncertain.

7.3.4. Risk Assessment Summary Table

Table 10.3. Summary of probabilities and uncertainties for Avian Influenza (AIV), Newcastle Disesase (ND) and Avian Clhamidyosis (AChl) for each considered event

Event	Probability		
	AIV	**ND**	**AChl**
Wild bird infected at point of capture	Uncertain For anseriformes high Others lower	High for some species Uncertain for other species	Uncertain
Infected wild bird retained for export	Low (galliformes) High (other birds)	High	High (older birds) Lower (young birds) Low (stressed birds)
Uninfected bird becomes infected during transport from point of capture to holding station	Moderate-High (susceptible birds) Negligible-Low (non-susceptible birds)	High (transport conditions and duration dependant)	Moderate-high
Infected bird introduced into holding station	High	High	High (species and age dependent)
Uninfected bird becomes infected at holding station	Low-Moderate (susceptible birds) Negligible-Low (non-susceptible birds) Uncertain	High	High
Infected bird released for export from holding station	High (sub-clinical shedders)	High	High (sub-clinical carriers)

			Lower (young birds) Lower (stressed birds)
Uninfected bird becomes infected during transport from holding station to point of export	uncertain Moderate-High (susceptible birds) Negligible-Low (non-susceptible birds)	High (transport conditions and duration dependant)	Uncertain Moderate-high
Infected bird introduced into point of export	Uncertain	High - Uncertain	High (sub-clinical carriers) Lower (young birds) Lower (stressed birds)
Infected bird reaches the point of export in third country	Low…. Uncertain….. High…..	Uncertain	
Infected bird is detected at point of export	Uncertain (countries which test) Low (countries which do not test) High (presence of clinical signs)	High (ill birds) Low (for latent infections)	Uncertain (countries which test) High (countries which do not test) Negligible-Low (presence of clinical signs)
Uninfected bird becomes infected during transport between point of export and Border Inspection Point (BIP)	Low (short journeys) High but uncertain (longer journeys)	High but uncertain	Low (short journeys) High but uncertain (longer journeys)
Infected bird introduced into BIP	High (sub-clinical shedders)	High but uncertain	High (sub-clinical shedders)
Uninfected bird becomes infected at BIP	Negligible	Low	Negligible-Low (issues surrounding adequate disinfection)
Undetected infected bird released from BIP	High (sub-clinical shedders) Low (presence of clinical signs)	High	High (sub-clincial infections) Lower (young or stressed birds)
Uninfected bird becomes infected during transport between BIP and quarantine	Low (“ideal” conditions) Uncertain (less than “ideal” conditions)	High	Low (questionnaire criteria satisfied) Uncertain but possibly higher (risk of survival in environment following inadequate disinfection)
Bird being transported between BIP and quarantine infects indigenous EU birds	Negligible	Low	Low
Infected bird introduced into quarantine	High (sub-clinical shedders)	High	High (sub-clinical shedders) Lower (clinical disease)
Uninfected bird becomes infected during quarantine	Low (Uncertain)	High within epidemiological units. Low between units	Negligible-low (clinical signs)
Infected bird released from quarantine	Negligible-Low (clinical signs) Negligible-Low (consignment < 60 birds) Higher [uncertain] (consignment > 60 birds)	High for latently infected birds Low for sick birds.	Higher (sub-clinical carriage)

7.3.5. Health Risk Assessment Recommendations

- In regard to the risks of introducing major infectious agents into EU the need to continue the importation of these birds should be carefully considered
- Regular assessments of the risk of importing infectious diseases should be undertaken to identify high risk zones and countries and high risk species, as these will vary over time.
- This exercise would benefit from improved surveillance in the source countries to reduce the current uncertainty attached to some areas of data.
- Improvements at the point of export are required as these will have most impact in reducing the probability that infected birds are presented for entry to the EU. The improvements to be considered include infrastructure, training of personnel, health checks including enhanced laboratory testing of birds intended for export to the EU, quality control and traceability systems, FVO inspections
- Containment to avoid cross contamination should be ensured during transport and appropriate biosecurity measures should be applied.
- The potential occupational health risks should be considered
- More extensive investigations of mortality, both DOA and DIQ, should be undertaken
- There should be harmonisation of data collected from all quarantine facilities and BIPs in EU Member States and establishment of a central EU database to facilitate analysis and identify trends that will provide better information on importation of infectious diseases.
- Validation and harmonisation of the current diagnostic tests and development and implementation of more sensitive and more rapid screening tests are suggested.
- The risk of importing infectious diseases should be reduced by importation of eggs rather than live birds, and the risks are further reduced by sanitising the external surface.

8. References

References used in this Scientific Opinion are available and are listed in the Scientific Report published at the EFSA web (www.efsa.eu.int).

9. Working Group Members and Acknowledgements

The AHAW Panel wishes to thank the members of the Working Group chaired by panel member J. M. Sharp, D. M. Broom, H. Clough, L. Crosta, G. Dorrestein, E. Kaleta, K. Stafford, G. Theodoropoulos for the preparation of the Scientific Report, which has been used as the basis of this Scientific Opinion.
The scientific co-ordination for this Scientific Opinion has been undertaken by the EFSA AHAW Panel Scientific Officer O. Ribó.

10. AHAW Scientific Panel Members

The Scientific AHAW Panel adopted the current Scientific Opinion on 27 October 2006. Members of the AHAW Panel are:
Bo Algers, Harry J. Blokhuis, Donald M. Broom, Patrizia Costa, Mariano Domingo, Mathias Greiner, Daniel Guemene, Jörg Hartung, Trevor Hastings, Per Have, Frank Koenen, Christine Muller-Graf, David B. Morton, Albert Osterhaus, Dirk U. Pfeiffer, Moez Sanaa, Mo Salman, J. Michael Sharp, Philippe Vannier, Martin Wierup, Marion Wooldridge.

***Annex to the EFSA Journal (2006*) 410, 1-55, "**Animal health and welfare risks associated with the import of wild birds other than poultry into the European Union**"**

Scientific Report on

Animal health and welfare risks associated with the import of wild birds other than poultry into the European Union

Adopted on 27 October 2006

EFSA-Q-2005-057

Summary

The European Commission is increasingly conscious of the animal health and welfare risks posed by the import of wild birds other than poultry into the European Union. Many of these birds are destined to be kept as pets, for show or in zoos. Limited scientific evidence is already available on specific aspects of this issue.

Therefore, a mandate was sent by the Commission to EFSA asking for a qualitative risk assessment to determine 1) the animal health and welfare risks associated with the import of wild birds other than poultry into the EU; 2) the risk of introducing "exotic" infectious agents into the EU which could spread among the indigenous EU bird populations, and 3) the possible tools and options which could reduce any identified risks.

At the Plenary Meeting of 14/15 March 2005, the AHAW Panel decided to entrust the scientific report and risk assessment to a WG under the Chairmanship of Dr. James Michael Sharp. The Scientific Opinion was adopted at the Plenary Meeting on 26/27 October 2006.

The Scientific Report considers all relevant health and welfare aspects using two qualitative risk assessments, one for health and the other for welfare, and leads to the conclusions and recommendations forming the Scientific Opinion by the AHAW Panel.

The most relevant conclusions and recommendations were:

According to CITES, EU was the major importer of wild birds with around 800.000 birds imported each year from 1999 up to the ban. A big proportion of the birds imported into the EU were transported over large distances within the EU before arriving at the final quarantine station from the BIP. Therefore, it was recommended that the distances that birds are transported between BIP and quarantine should be reduced to the minimum possible.

With respect to the health aspects the probability of infectious agents being introduced into the EU by the release from quarantine of wild captured birds varies from negligible to high. The probability that any individual wild captured bird is infected at release will depend upon the species and the probability of sub-clinical shedding. This led to a recommendation that the need to continue the importation of captive wild birds should be carefully considered. Improvements at the point of export were regarded to have the most impact in reducing the probability that infected birds would be presented for transport to the EU. The testing of the imported captive birds as well as the validation and harmonisation of the current diagnostic test was suggested, together with the development of the new and more rapid diagnostic techniques in order to support global surveillance efforts.

On the welfare aspects the Panel concluded that the during the captive bird pathway, several hazards lead to adverse consequences that are very serious for the welfare of the birds, indicated by high mortality. These adverse consequences vary at different stages of the pathway but the probability of occurring is lower once the birds leave the Third Country. This led to a recommendation that the need to continue the importation of captive wild birds should be carefully considered, unless measures can be put in place to adequately protect the welfare of captured wild birds at all stages. Captive bred birds are subjected to fewer hazards than those experienced by captive wild birds. Captive breeding with high animal welfare standards, therefore could be considered as an alternative for as many species as possible, providing that a reliable method of distinguishing wild caught birds from captive bred birds is available.

1. Glossary

Birds (Decision 2000/666/EC)
Animals of avian species not covered by Article 2 number 1 of Council Directive 90/539/EEC excluding birds referred to in Article 1 third paragraph (relating to pet birds accompanying their owner) and Article 19 of Directive 92/65/EEC (relating to birds for zoos, circuses, amusement parks and experimental laboratories),

Border Inspection Post (Directive 91/496/EC)
Any inspection post located in the immediate vicinity of the external border of one of the territories referred to in Annex I to Council Directive 90/675/EEC of 10 December 1990 laying down the principles governing the organization of veterinary checks on products entering the Community from third countries and designated and approved in accordance with Article 6.

Consignment (Directive 91/496/EC)
A quantity of animals of the same species, covered by the same veterinary certificate or document, conveyed by the same means of transport and coming from the same third country or same part of such country;

Commercial poultry holding (Directive 2005/94/EC)
Holding where poultry are kept for commercial purposes.

Exotic diseases
non-indigenous diseases, diseases not normally present in the EU

Exotic infectious agents
Infectious agents that are not normally present in the EU

Holding (Directive 2005/94/EC)
means any agricultural or other premises, including hatcheries, circuses, zoos, pet bird shops, bird markets, and aviaries, where poultry or other captive birds are being bred or kept . However, this definition does not include slaughterhouses, means of transport, quarantine facilities and centres, border inspection posts and laboratories authorised by the competent authority to hold avian influenza virus;

Mixing
Putting together into an air space, in relation to disease transmission, or into a container in relation to social interactions, birds that have not been kept together for long enough for reactions to pathogens in the group and for social relationships to stabilise.

Officially registered rare breeds of poultry or other captive birds (Directive 2005/94/EC)
Any poultry or other captive birds that the competent authority has officially recognised as a rare breed within their contingency plan provided for in Article 62 of Directive 2005/94.

Other captive bird (Directive 2005/94/EC)
Any bird other than poultry that is kept in captivity for any reason other than those referred to poultry including those that are kept for shows, races, exhibitions, competitions, breeding or selling.

Poultry (Directive 2005/94/EC)
all birds that are reared or kept in captivity for the production of meat or eggs for consumption, the production of other products, for restocking supplies of game birds or for the purposes of any breeding programme for the production of these categories of birds.

Quarantine facility (Decision 2000/666/EC)
Premises which are separated from poultry holdings and other bird holdings by a reasonable distance, when taking into account the epidemiology of Newcastle disease and avian

influenza as regards airborne spread, and in which quarantine of imported birds is carried out on an ‘all-in, all-out ’basis

Quarantine centre (Decision 2000/666/EC)
Premises containing a number of units, which are operationally and physically separated from each other and in which each unit contains only birds of the same consignment, with the same health status and being therefore one epidemiological unit; and within each unit of which the quarantine of imported birds is carried out on an ‘all-in, all-out ’basis; and which are separated from poultry holdings and other bird holdings by a reasonable distance, when taking into account the epidemiology of Newcastle disease and avian influenza as regards airborne spread.

Sentinel chickens (Decision 2000/666/EC)
Sentinel chickens are naïve susceptible birds that are placed in contact with imported birds in such a way that they can become infected with infectious agents that may be excreted by the imported birds. These sentinels are monitored for the development of clinical signs, excretion of the agent or the development of specific immune responses e.g antibodies.

Wild bird (Directive 2005/94/EC)
Free-living bird which is not kept on any holding

Zoonoses
For the purposes of this report zoonosis is taken to mean a disease whose infectious agent can be transmitted from a non-human species to a human.

1.1. Risk assessment terminology

Terms in this section have been modified from those provided in the Scientific Report on the risks of poor welfare in intensive calf farming systems (EFSA, 2005). We have sought to provide a terminology which is common to both welfare and health-related issues.

Dose-reponse Assessment
The determination of the relationship between the level of exposure of birds to a given hazard and the severity and frequency of resultant adverse effects on birds.

Exposure Assessment
The quantitative and qualitative evaluation of the likelihood of hazards occurring in a given bird population.

Hazard
Any factor, occurring from attempts to capture the bird in the third country to release in the EU, which has the potential to cause an adverse effect on captive birds.

Hazard characterisation
The qualitative and quantitative evaluation of the nature of the adverse effects associated with the hazard.

Hazard Identification
The identification of any factor, occurring from attempt to capture a bird in the third country to release into the EU, which has the potential to cause an adverse effect on the bird.

Risk
A function of the probability of an adverse effect and the severity of that effect, consequent to a hazard to birds.

Risk Characterisation
The process of determining the qualitative or quantitative estimation, including attendant uncertainties, of the probability of occurrence and severity of known or potential adverse effects on birds based on hazard identification, hazard characterisation, and exposure assessment.

The following CAC (Codex Alimentarius Commission) definitions are reproduced verbatim. (Note: for completeness ALL definitions used by CAC - while not necessarily used in this document - have been included):

Quantitative Risk Assessment
A risk assessment that provides numerical expressions of risk and an indication of the attendant uncertainties (stated in the 1995 expert consultation definition on risk analysis).

Qualitative Risk Assessment
A risk assessment based on data which, while forming an inadequate basis for numerical risk estimations, nevertheless, when conditioned by prior expert knowledge and identification of attendant uncertainties, permits risk ranking or separation into descriptive categories of risk.

Risk Analysis
A process consisting of three components: risk assessment, risk management and risk communication.

Risk Assessment
A scientifically based process consisting of the following steps: i) hazard identification, ii) hazard characterisation, iii) exposure assessment and iv) risk characterisation.

Risk Communication
The interactive exchange of information and opinions concerning the risk and risk management among risk assessors, risk managers, consumers and other interested parties.

Risk Estimate
Output of risk characterisation.

Risk Management
The process of weighing policy alternatives in the light of the results of risk assessment and, if required, selecting and implementing appropriate control options (i.e. prevention, elimination, or reduction of hazards and /or minimization of risks) options, including regulatory measures.

Sensitivity Analysis
A method to examine the behaviour of a model by measuring the variation in its outputs resulting from changes to its inputs.

Transparent
Characteristics of a process where the rationale, the logic of development, constraints, assumptions, value judgements, decisions, limitations and uncertainties of the expressed determination are fully and systematically stated, documented, and accessible for review.

Uncertainty Analysis

A method used to estimate the uncertainty associated with model inputs, assumptions and structure/form.

2. Abbreviations

AChL	Avian Chlamydiosis
AI	Avian Influenza
AIV	Avian Influenza Virus
BIP	Border Inspection Post
CITES	Convention on International Trade in Endangered Species
CVEDA	Common Veterinary Entry Document for Animals
DEFRA	Department for the Environment, Food and Rural Affairs
DIQ	Dead in Quarantine
DOA	Dead on Arrival
FVO	Food and Veterinary Office
HPAI	High Pathogenic Avian Influenza
IATA	International Air Transport Association
IUCN	International Union for the Conservation of Nature and Natural Resources
OIE	Office International des Epizooties
MAFF	Ministry for Agriculture Fisheries and Food
ND	Newcastle Disease
NDV	Newcastle Disease Virus
RA	Risk Assessment
RSPCA	Royal Society for the Prevention of Cruelty to Animals
TRACES	Trade Control and Expert System
UNEP	United Nations Environment Programme
WBCA	Wild Birds Conservation Act
WCMC	World Conservation Monitoring Centre (UNEP)
WNV	West Nile Virus

3. Tables and figures

4. Background

The European Commission is increasingly conscious of the animal health and welfare risks posed by the import of wild birds other than poultry into the European Union. Many of these birds are destined to be kept as pets, for show or in zoos. Limited scientific evidence is already available on specific aspects of this issue. For example in April 2002 the Scientific

Committee on Animal Health and Animal Welfare adopted a report1 on "Avian chlamydiosis as a zoonotic disease and risk reduction strategies" which recommended that the importation of Chlamydia psittaci infected birds into the EU from third countries should be particularly controlled.

Furthermore, in response to a request from the Commission, on 30 March 2004 EFSA adopted an opinion2 on the welfare of animals during transport which recommended that the transport of wild caught animals should be discouraged and concluded that wild caught birds are often transported at excessive stocking densities with inadequate ventilation and no feed or water, with the possibility of high mortalities occurring pre-, post- or during transport.

5. Terms of reference

The Commission requests EFSA to issue a scientific opinion on the animal health and welfare risks associated with the import of wild birds other than poultry into the EU. This opinion should consider *inter alia*:

- the animal health and welfare risks associated with pre- and post-transport factors (such as the sourcing, capture and breeding of such birds, the import of wild caught versus captive bred birds, appropriate quarantine conditions and sampling protocols to limit the spread of infectious diseases, etc.);
- the risk of introducing "exotic" infectious agents into the EU which could spread among the indigenous EU bird populations (including domestic poultry) and jeopardise the current EU approach to control animal disease agents of major importance;
- the possible tools and options which could reduce any identified risks.

5.1. Clarification of the terms of reference

Based on more recently available data the opinion should also update and expand upon the chapter on the transport of wild birds contained within the 2004 EFSA opinion on the welfare of animals during transport.

It was further confirmed that:

1) the term "wild birds other than poultry" used in the mandate's terms of reference shall cover both "captured wild birds" and "captive birds bred in the source countries (outside EU)".

2) other risks than animal heath or welfare associated with these imports such as nature conservation in the source countries are outside the mandate.

3) although not specifically mentioned in the terms of reference it was understood that eggs for incubation taken from wild/captive birds should also be considered, as previously done in the EFSA transport opinion 2004.

[1] http://europa.eu.int/comm/food/fs/sc/scah/out73_en.pdf

[2] http://www.efsa.eu.int/science/ahaw/ahaw_opinions/424_en.html

The mandate outlined above was accepted by the Panel on Animal Health and Welfare (AHAW) at the Plenary Meeting, on 14/15 March 2005. It was decided to establish a Working Group of AHAW experts (WG) chaired by one Panel member. Therefore the Plenary entrusted a scientific report and risk assessment to a working group under the Chairmanship of Dr. James Michael Sharp. The members of the working group are listed at the end of this report.

This Scientific Report considers all relevant health and welfare aspects using two qualitative risk assessment one for health and the other for welfare, and leads to the conclusions and recommendations forming the scientific opinion by the AHAW Panel.

According to the mandate of EFSA, ethical, socio-economic, cultural and religious aspects are outside the scope of this scientific opinion.

6. The risk analysis approach to import of captive birds

6.1. Introduction

The health and welfare of non-poultry avian species imported into the EU will be influenced by a number of management processes that they experience from capture to release in the EU. These management processes will vary depending on whether the birds are captive bred from captive bird populations, hatched from eggs taken from nests of wild birds, captured as nestlings and captive reared, or caught as adults or sub-adults in the wild. A large number of bird species are imported into the EU but references on their health and welfare tend to be species specific. However, birds are traded throughout the world and additional information may be obtained from investigations into bird health and welfare from birds imported into non-EU destinations, such as the trade in raptors into the Middle East.

The report addresses two broad topics, as described in the Terms of Reference (chapter 5). Although many factors affect the risks mentioned above, this report is principally concerned with the consequences of capture, holding conditions, transport and transmissible diseases.

6.2. Principles of the risk analysis approach

The proposed methodology used for this report follows the principles of risk analysis as outlined by the OIE (OIE, 2004) and developed in the context of infectious diseases. The risk analysis process is divided into four principal parts: hazard identification, risk assessment (divided into sub-groupings of release assessment, exposure assessment, consequence assessment and risk estimation), risk management and risk communication. The report focuses primarily upon the first two stages of hazard identification and risk assessment; risk management and risk communication fall outside the scope of this report.

For the health risk assessment, standard OIE-based methodologies of risk assessment are directly applicable. Focusing specifically upon health issues, the aim is to estimate in qualitative terms, for an arbitrary disease agent X, the probability that agent X previously exotic to the EU is imported into and becomes established within the EU as a direct result of the importation of captive birds. The hazard identification and subsequent release-exposure-consequence steps of infectious disease risk assessment are laid down by the OIE (2004). In contrast, techniques for welfare risk assessment are historically far less developed than those for infectious disease-related health risk assessment. We therefore describe the application of the OIE methodology in import risk assessment, and an extension to welfare contexts as follows:

- Hazard identification is the step prior to risk assessment
  i) For infectious disease risk assessment, the OIE definition of hazard is the pathogenic agent(s), which may be present in the animal or animal product under consideration and which could therefore potentially be imported into another country or region.
  ii) In a similar vein in the first stage in a welfare risk assessment, an analogous definition of hazard would be the features in existence (e.g. environmental, nutritional etc.), associated with the animal under consideration, which could potentially lead to adverse welfare consequences.
- The first stage in the infectious disease risk assessment itself is the "release" stage, which involves a description of the steps in the pathway(s) necessary for release of a particular agent into the region of interest (here the EU), and evaluates either quantitatively or qualitatively the probability of each of those steps occurring.
- The "exposure" stage describes the steps in the potential exposure pathway(s) and evaluates either quantitatively or qualitatively the probability that exposure to the hazard of interest within the population of interest (here, EU native animals) will occur.
- In the context of welfare, the analogous process is best described by combining the release and exposure stages into a single stage, effectively an exposure pathway, which allow potential adverse welfare consequences to result from the features in existence (e.g. environmental, nutritional etc.), and again evaluates either quantitatively or qualitatively the probability of that exposure occurring.
- The next stage of the risk assessment in both contexts is the recognition, description and estimation of the probability of the effects i.e. consequence of each of the identified hazards, given exposure.
- The risk estimate (final stage) is the resultant probability of a specific consequence, from all the above stages.

One important distinction between the disease and welfare risk assessments is that the disease risk assessment is primarily interested in an overall outcome: what is the probability that agent X is brought into the EU by captive birds, with the potential for subsequent establishment within the EU? In contrast, the welfare risk assessment is concerned with the probability that the features in existence will produce adverse welfare consequences. The features in existence will change through the importation pathway, and the probability of adverse welfare consequences must be evaluated at each of these stages. The key features of, and distinctions between, the health and welfare risk assessments are summarised in Table 6.1

Risk assessments can be conducted either within a qualitative or a quantitative framework, so that the key probabilities are estimated either in quantitative or qualitative terms. When strictly quantitative data amenable to probabilistic modelling are lacking, a qualitative assessment can prove the most productive approach. Indeed, it has been noted that when statistical data or quantitative information are sparse, qualitative approaches can prove more useful than a quantitative assessment (Hardman, 1997).

Table 6.1: Distinctions between infectious disease-related and welfare-related release-exposure-consequence risk assessments

Stage of process	Disease RA	Welfare RA
Hazard identification	Identify pathogens potentially present in animal(s)	Identify/describe features of environment, nutrition, husbandry etc in which animals are kept (here, specifically, at each stage of importation process)
Release	What is the probability that agent X is introduced into the EU?	What is the probability that feature X results in exposure of the animals to conditions which may result in adverse welfare consequences? How likely is it that such exposure occurs, at each stage of transport?
Exposure	What is the probability that native animals are exposed to agent X ?	
Consequence	What are the probable consequences of exposure (e.g. infection, local spread, epidemic, etc.), and what is the probability of each occurring?	What are the probable consequences of exposure (e.g. stress, malnutrition, death etc.), and what is the probability of each occurring?

For the purposes of this project, a qualitative approach is used to assess both the animal welfare and health risks associated with the importation of captive birds. It is the belief of the Panel that the complex processes involved in the importation of captive birds coupled with the substantial areas in which formal and objective quantitative data are lacking prohibit a more quantitative approach.

6.3. Health risk assessment

Following the OIE framework (OIE, 2004) the questions of interest are:

- What is the risk of release of agent X? (country of export to country of import)
- Given a release, what is the risk of exposure of the indigenous bird population (including domestic poultry)?
- Given exposure of the indigenous bird population, what is the risk (and probability) of spread and subsequent establishment within the EU?

In order to estimate these probabilities, detailed consideration of the exposure pathway, from point of capture through the point of release into the EU, is required. Two principal factors drive this process; first, a random bird must be infected with agent X; secondly, the infection of the bird with the agent must go undetected at all of the key stages of the importation chain in order that the potential for the introduction and subsequent establishment of the agent in the EU can arise. Therefore, the approach has been to draw up a schematic representation of the captive bird importation pathway, define the key probabilities within this, and estimate these probabilities qualitatively based upon a combination of all available, relevant data sources and, where formal data are lacking, expert opinion.

6.3.1. Health hazard definitions

The disease agents which could in principle be studied via this risk assessment approach are numerous and varied. Detailed consideration of all of these is prohibitive as a consequence of time and resource constraints, and therefore a generic pathway was developed, the principle of which can be applied to any disease-causing agent that has an avian host. To illustrate the applicability of the risk assessment process in this context three specific examples were selected, which the panel judged to be of highly significant and current importance; Avian Influenza Virus (AIV), *Chlamydia psittaci* (CP) and Newcastle Disease Virus (NDV).

6.4. Welfare risk assessment

The approach to the assessment of welfare risks is based upon a sequence of tables, each of which describes a stage in the captive bird importation pathway. Because of the fundamental distinctions between the structures of the health and of welfare risk assessments, a decision was made to present the welfare risk assessment in a tabular form.

First the hazard is identified; then the probability of exposure is considered.The latter comprises two parts; frequency, describing the frequency with which hazard X is judged to occur within a hypothetical population of captive birds; and duration, describing the length of exposure for a typical bird from that population. In this way, critical points (Critical Control Points) can be determined; these must be clearly identifiable and replicable and stages at which decisions can and should be made to take action to minimise adverse effects .

6.4.1. Defining the needs of birds

In order to establish the key welfare hazards in the captive bird importation process, it is necessary first to define the needs of birds which is based on general knowledge of bird biology and welfare available in texts such as Welty and Baptista (1988), Fraser and Broom (1997) and Broom and Fraser (2007, in press).

In order for adult birds to survive and for growing birds to maintain bodily integrity while growing and preparing for adult life they have a series of needs that are relevant to the conditions experienced in captivity. Because of the great variety of bird species and their various ecological niches, their needs will vary according to their way of life and biological adaptation to it. If these needs are not met the welfare of the animal will become poor, either slowly or rapidly. There is a close link between poor welfare and susceptibility to disease in captive birds. When birds are disturbed by handling or other impacts on their environment they are likely to show behavioural and physiological responses. For example, there are several behavioural changes associated with captivity, such as biting/aggression, screaming/vocalisations, psychogenic water and food consumption, regurgitation, masturbation, chronic egg laying, escape attempts, feather picking, repetitive movements and suppression of reproduction (Harrison and Davies, 1986; Hudelson and Hudelson, 2006). Fudge (1997) and Hudelson and Hudelson (2006) also describe how corticosterone increase occurs in many different stressful situations, with moderate transient hyperglycaemia (up to 800 mg/dl). Leucocytosis has been reported in birds as a result of disease or other stress in a variety of bird species, including macaws, cockatoos and African grey parrots.

When the welfare of the birds is compromised it is important that we are able to recognise signs of poor and good welfare in all the species of birds that are traded. A consideration of the needs of birds can help to decide what may be important to birds, but short-term deprivation of some needs may have very different effects from a long-term absence of them e.g. some nutrients as opposed to being able to breathe. The signs that birds show when they have poor welfare e.g. when they are frightened or in pain, or dehydrated, or have some internal injury will depend on the species, as well as what they have experienced in their life.

A more detailed assessment of welfare, including frequency, duration and intensity is given in the Tables in Chapter 10.

1. Breathe

Birds need air that has sufficient oxygen and a low level of noxious gases in it.

2. Rest and sleep

Birds need to rest and sleep in order to recuperate and avoid danger. They need to use particular postures. Sleep disruption may occur if comfortable resting positions cannot be adopted or if there is disturbance to resting animals.

3. Exercise

Exercise is needed for normal bone and muscle maintenance and development.

4. Avoid fear

Most bird species, even species that are predatory themselves, are very vulnerable to predation especially by other birds and mammals including humans. As a consequence, their biological functioning is strongly adapted to maximise the chance of recognition of danger and escape from it. Birds respond to sudden events and approaches by humans or other animals perceived to be potentially dangerous with substantial sympathetic nervous system and hypothalamic-pituitary-adrenocortical (HPA) changes. These physiological changes are followed by rapid and often vigorous behavioural responses. Fear is a major factor in the life of most birds and has a great effect on their welfare.

5. Drink and feed

5.1. Drinking

Birds have a need to obtain sufficient water and will drink water unless there is sufficient fluid in their diet. If the temperature is high, birds need more water.

5.2. Obtain nutrients

A variety of nutrients are needed by birds. If any are lacking, the bird may be able to recognise this or may not but there will be adverse consequences if essential nutrients are unavailable.

5.3. Feeding behaviour

In addition to the need to ingest nutrients, birds need to carry out the movements normally involved in obtaining food.

6. Have access to an appropriate hiding or resting place.

All birds need to rest and to spend the resting period in a safe place, the danger of predation being greater in some species than in others. This place will be one in which the individual is hidden from potential predators in some species but will be a place where rapid escape is possible in other species.

7. Explore

Exploration is important as a means of preparing for the avoidance of danger and is a behaviour shown by all birds. Exploration is also valuable for establishing where food sources are located. Higher levels of abnormal behaviour and fearfulness in inadequate conditions can be a consequence of inability to explore.

8. Have social contact

The need to show full social interaction is important in those species that live socially and obtain benefits from doing so. Such birds are often stressed by separation from conspecifics.

9. Minimise disease

Many mechanisms have the function of reducing the likelihood of contact with pathogens or parasites or responding to infection so as to combat it directly or to minimise the adverse effects of disease.

10. Preen

Preening behaviour is important as a means of minimising disease and parasitism and birds make considerable efforts to preen themselves thoroughly.

12. Thermoregulation

Birds need to maintain their body temperature within a tolerable range. They do this by means of a variety of behavioural and physiological mechanisms.

12.1. Selection of location

When birds are over-heated, or when they predict that they are likely to become over-heated, they move to locations that are cooler. If no such movement is possible, the bird may become disturbed, thus exacerbating the problem and other changes in behaviour and physiology will be employed. Responses to a temperature that is too low will also involve location change if possible.

12.2. Body position

Over-heated, or potentially over-heated, birds adopt positions that maximise the surface area from which heat can be lost. If too cold, birds fluff-up the feathers and minimise surface area.

13. Avoid harmful chemical agents

Birds need to avoid ingesting toxic substances and to react appropriately if harmful chemical agents are detected within their bodies.

14. Avoid pain

Any environmental impact that may cause pain and injury is avoided by birds.

6.4.2. Welfare hazard definitions (and potential consequences)

On the basis of the information concerning the needs of birds, the welfare hazards and associated consequences considered in this report are defined in Table 6.2. In keeping with

the qualitative nature of this risk assessment, consequences are presented on an ordinal scale, broadly running from least to most severe e.g. stress [least severe] to death [most severe]:

Table 6.2: Welfare hazards and associated consequences for captive birds

	Hazard	**Potential consequences (given exposure)**
1	Inappropriate air condition	Stress, disease, suffocation, (fatigue), death
2	Inappropriate conditions for rest/sleep	Distress , exhaustion, injury, disease
3	Inappropriate opportunity for movement	Distress, injury,
4	Inappropriate handling	Distress, fear, injury, disease, death
5	Inappropriate access to water	Distress, dehydration, drowning, death
6	Inappropriate access to nutrients	Distress, malnutrition, disease, death
7	Inappropriate opportunity to carry out normal feeding behaviour	Distress, malnutrition, injury, death
8	Lack of appropriate opportunity to explore or to locate hiding place or escape route	Distress, fear, exhaustion, injury, death
9	Inappropriate social contact (for example social isolation or unwanted proximity)	Distress, stereotypic behaviour, depression, anxiety, aggression, injury, death
10	Infectious agents (welfare issue but covered under other parts of risk assessment)	Disease, death
11	Inappropriate opportunity to preen	Distress, feather damage and function (waterfowl), parasitism
12	Inappropriate opportunity for thermoregulation	Distress, hyperthermia, hypothermia, death
13	Inappropriate presence of chemical agents (e.g. disinfectant, pesticides)	Poisoning, death
14	Inappropriate (high) density (*crowding*) of birds	Distress, injury, suffocation, malnutrition (see individual aspects e.g. social contact, food, drinking, air etc.)
15	Inappropriate mixing of species	Distress, aggression, injury, death
16	Inappropriate hygiene conditions	Disease, death

6.5. Health and Welfare import pathways

Generic and schematic representations of the captive bird importation pathway and highlight issues related to both infectious disease and welfare are presented in Figs 6.1 and 6.2.

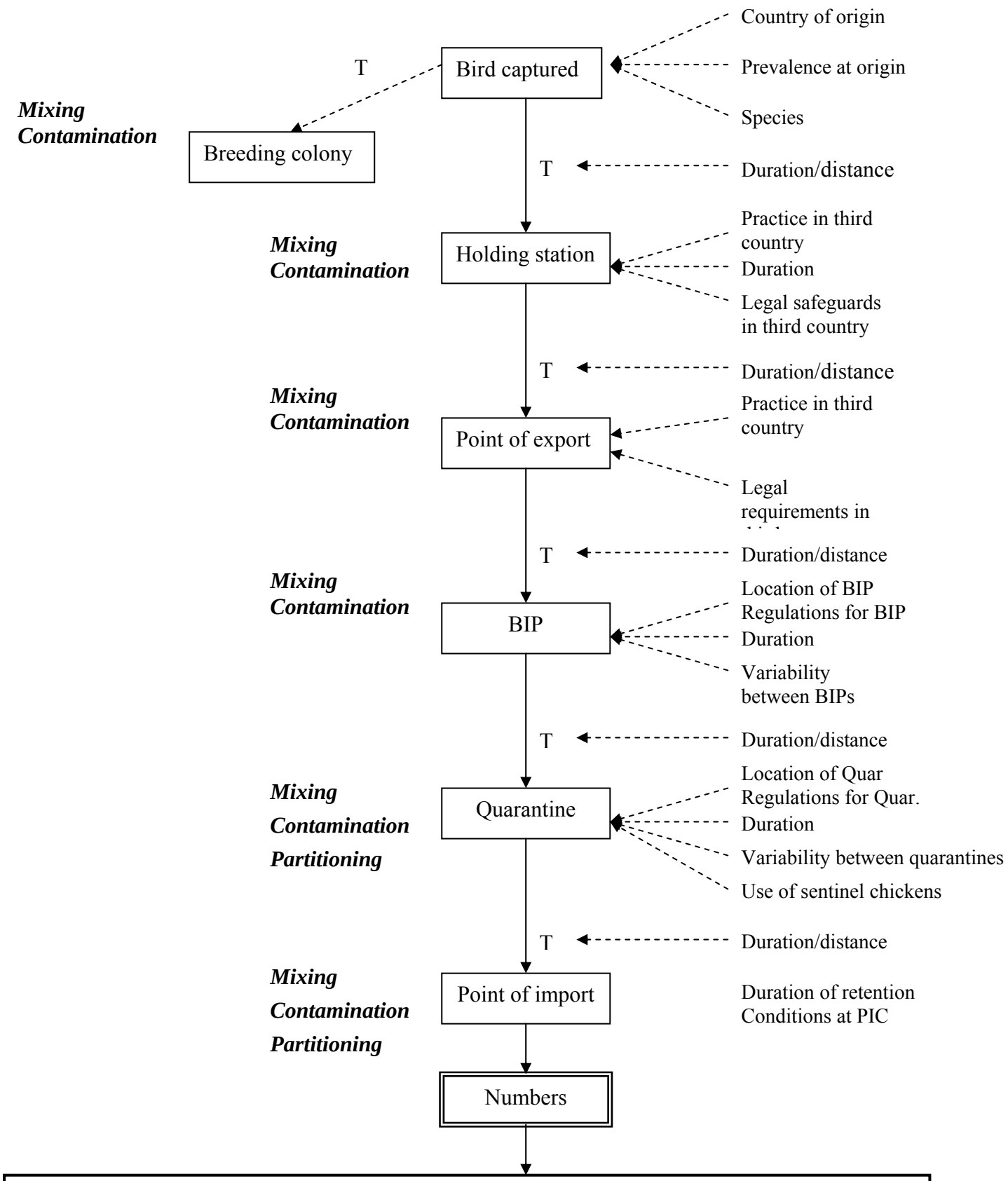
6.5.1. Infectious disease pathway

The generic pathway for the introduction of an arbitrary infectious agent X into the EU via the importation of captive birds is given in Figure 6.1. Key parameters and processes that must be considered to assess the probability of the importation of an arbitrary infectious agent X are highlighted.

6.5.2. Welfare pathway

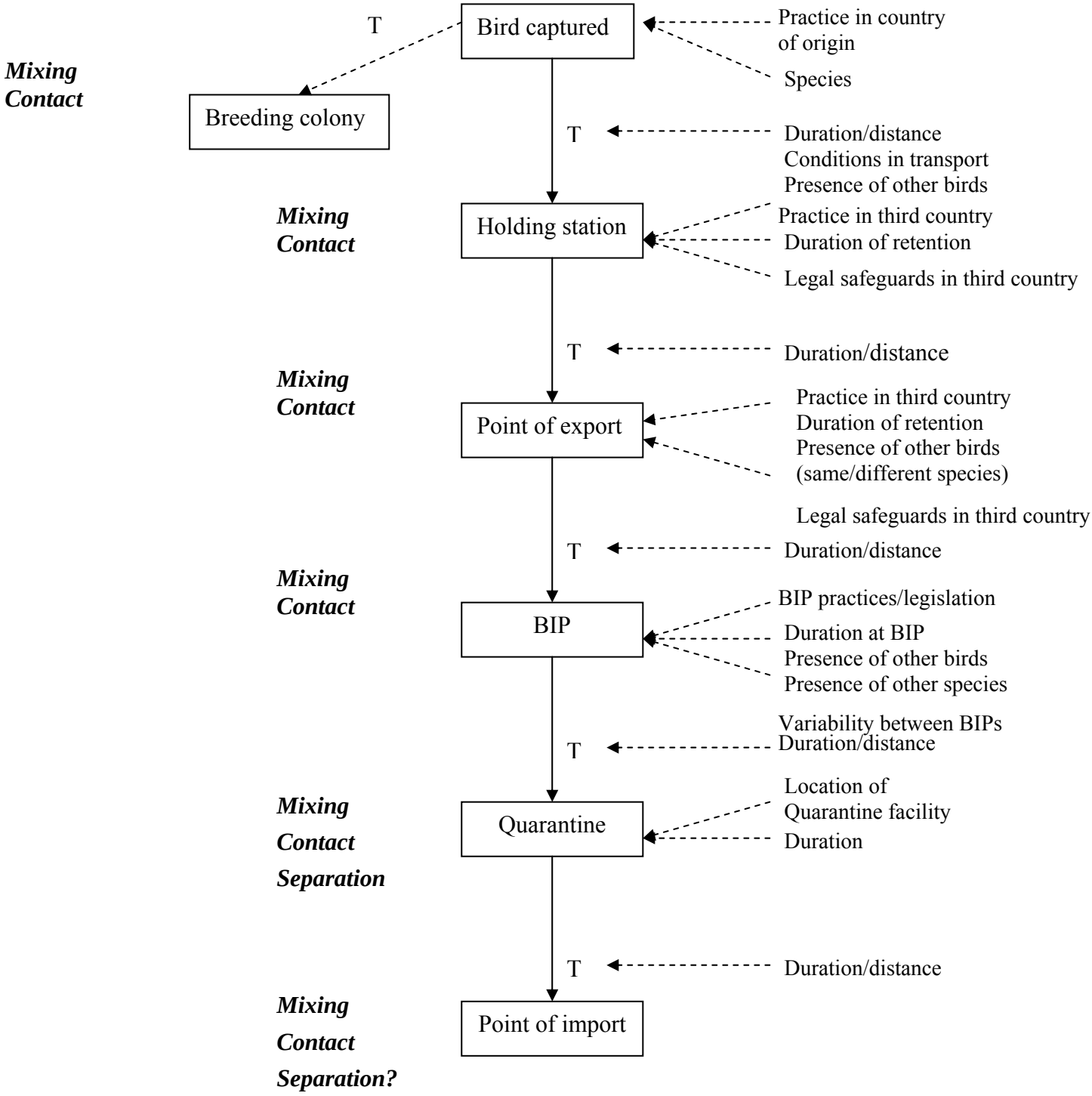
The same broad framework is relevant in defining a pathway for the welfare risk assessment. Different processes and parameters are, however, relevant, and these are given in Figure 6.2.

Figure 6.1. Risk pathway for the entry of an arbitrary infectious agent X from a third country into the EU, and data requirements



T = transport: possibility of ***mixing*** or ***partitioning*** of live birds and ***contamination*** at all stages)

Figure 6.2. Risk pathway for welfare considerations during importation of captive birds from third country through to the EU, and data requirements



Before going to discuss the data available for the infectious disease-related risk assessment, a number of important points must be highlighted:

- Extensive searches of the literature have identified a number of important areas in which data are sparse.
- Stages of the importation chain prior to the point of export are particularly lacking in objective data. Much of the information which exists is anecdotal and based upon observations within fairly specific and narrow environments. This is unsurprising as capture is frequently carried out in developing countries, where there are other research priorities. Furthermore, the capture and sale of birds to dealers is usually a "cottage industry" and is often carried out in remote locations.
- Data on the mortality rates of caught birds are scarce and the causes of death are not usually identified.
- These areas of uncertainty have a significant bearing on our ability to provide even qualitative estimates of risk at these points.
- The exercise of conducting the wider risk assessment has helped in identifying areas in which an improvement in the level of knowledge is required.

7. Practice and trade of captive wild birds in the EU

7.1. Legal trade

In order to position the extent of the import and trade of the EU in the context of the total trade of (wild) captive birds, paragraph 7.1.1 presents data based on available literature and information extracted from the CITES Data Base for the period 1999-2003. The most complete recent year for data in the CITES Data Base is 2003. In paragraph 7.1.2 the different exporting countries, the importing EU MSs, the volume and orders of birds that were traded in 2005 are demonstrated based upon CVEDA Quarantine Data 2005.

7.1.1. The EU is the major market for captive wild birds

7.1.1.1. The volume and diversity of the legal EU import

About 1.2 million parrots (Psittaciformes, including parakeets) were traded between 1991 and 1996 worldwide (Beissinger, 2001). In the 3 years following the enactment of the Wild Bird Conservation Act in the USA in 1992 the European Economic Union accounted for over 75% of the legally imported parrots (Beissinger, 2001) and between 1997 and 2000 more than 469,000 wild caught parrots (Psittaciformes) were officially imported into Europe (Low, 2003).
The EU is now the major market for wild birds in the world and 90% of trade in CITES listed species is to the EU (Cooney, 2005 and Table 7.3 CITES Trade DataBase). According to CITES at least 650,000 were legally imported annually into the EU between 1999 and 2003 (Table 7.4), although some authors suggest that a total of 2 million birds are imported each year (CITES Trade Database, Karesh et al., 2005). In more recent years (1999 – 2003) the number of exported psittacines has reduced to about 150.000 annually worldwide (Table 7.1).

In the most complete recent 5 years in the CITES Trade Database from 1999 till 2003 many thousands of CITES listed wild caught birds were exported from source countries (Table 7.1). Most of these were Passeriformes (average of 550.000 birds annually) and Psittaciformes (average of 150.000 birds each year). These 2 orders counted for 80% of all exported birds in 2005 (CVEDA Quarantine Data). This means that with an additional 20% (175.000 birds)

yearly about 875,000 wild birds were traded legally in the world (CITES trade database). In table 7.1 and figure 7.1 it can be seen that for the 2 most traded wild bird orders the numbers have decreased in the last 7 years.
Table 7.2 shows that the EU also exported 6-8% of the total of exported wild birds. For some genera of the Psittaciformes these percentages were much higher; Agapornis 80%, Cacatua 16% and Ara 13%. In the same table it is shown that of the total of legally traded psittacines (exported wild birds plus captive bred bird) 66% already originated from captive breeding sources. This was predominantly caused by export of captive bred genus Agapornis (97%), but based on the CITES database also involved a large proportion of the genus Cacatua 78%, genus Aratinga 55%, genus Ara 31%, the popular African grey parrot (genus Psittacus) 21% and for the genus Amazon 12%. The export of captive bred Passeriformes at 2% was much lower, but for some genera this had reached already 7%.

Table 7.1. The most commonly exported genera listed in CITES originating from the wild and exported for any purpose between 1999-2003[1] presented per year. (Source: UNEP-WCMC CITES Trade Database)

Genus	**1999**	**2000**	**2001**	**2002**	**2003**
Passeriformes	726.334	636.065	407.369	331.286	546.347
Serinus	255.634	268.664	171.327	132.093	239.074
Estrilda	236.726	219.089	146.695	129.944	210.017
Lonchura	57.971	57.435	49.158	35.911	43.472
Amandava	51.967	40.469	29.641	28.894	48.584
Leiothrix	98.633	19.937	250	0	500
Gracula	25.403	30.471	10.298	4.444	4.700
Psittaciformes	174.832	145.035	135.533	130.616	146.579
Poicephalus	61.293	44.079	42.602	42.915	50.323
Psittacus	47.307	41.942	42.448	35.964	46.007
Amazona	21.976	18.284	21.241	16.671	18.461
Myopsitta	12.813	12.989	4.948	8.010	8.234
Agapornis	6.530	6.546	7.362	5.405	7.260
Aratinga	6.595	5.247	4.286	9.629	6.117
Cyanoliseus	8.241	10.507	4.228	2.660	3.386
Ara	3.920	3.210	3.457	2.900	4.001
Nandayus	4.814	1.606	4.057	4.538	1.100
Cacatua	1.343	625	904	1.924	1.690

[1]The most complete recent year for data is 2003.

Figure 7.1. Estimated numbers of the 2 most traded orders of wild birds

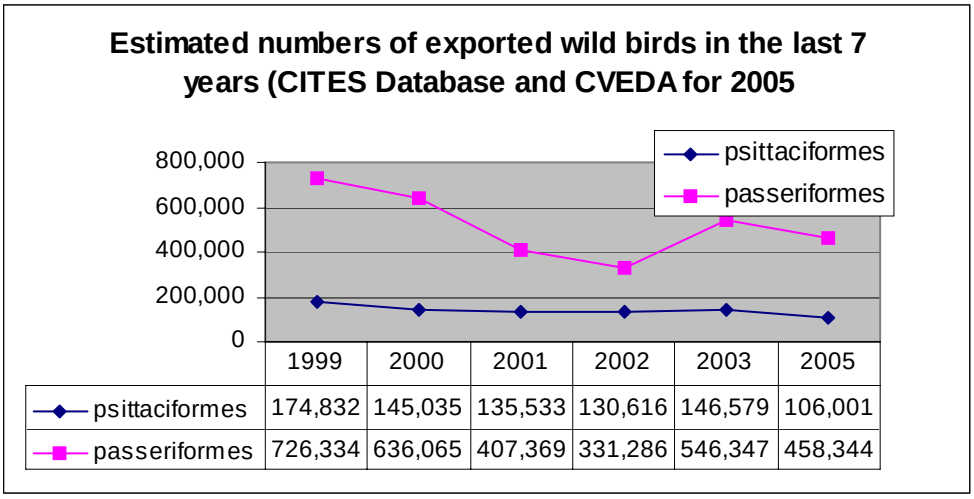


Table 7.2. A comparison of the volumes exported and captive bred for the most commonly exported genera listed in CITES originating from the wild and exported for any purpose between 1999-2003[1]. (Source: UNEP-WCMC CITES Trade Database)

Genus	Total export	Export from EU	%	Captive bred	%
Passeriformes	2.647.401	146.857	6%	42.729	2%
Serinus	1.066.792	84.888	8%	896	0%
Estrilda	942.471	43351	5%	10.051	1%
Lonchura	243.947	7.249	3%	17.681	7%
Amandava	199.555	7.686	4%	500	0%
Leiothrix	119.320	1225	1%	9.609	7%
Gracula	75.316	2.458	3%	3.992	5%
Psittaciformes	732.595	58.365	8%	1.413.852	66%
Poicephalus	241.212	9.126	4%	19.082	7%
Psittacus	213.668	9.370	4%	56.266	21%
Amazona	96.633	7.581	8%	13.633	12%
Myopsitta	46.994	932	2%	2.431	5%
Agapornis	33.103	26.415	80%	1.250.168	97%
Aratinga	31.874	961	3%	38.743	55%
Cyanoliseus	29.022	474	2%	1.124	4%
Ara	17.488	2.221	13%	7.841	31%
Nandayus	16.115	265	2%	1.199	7%
Cacatua	6.486	1.020	16%	23.365	78%

[1]The most complete recent year for data is 2003.

In table 7.3 it can be seen that of the most commonly imported bird genera, the EU imported 87% of all imported Passeriformes. For the Psittaciformes this was 85% between 1999 and 2003. In Table 7.4 and figure 7.2 the different importing EU countries are presented. The most important importing countries were The Netherlands (105.761 captive wild birds annually), Spain (101.340), Italy (98.459), Portugal (88.382), Belgium (87.171), and France (74.470). These countries imported 85% of all the EU imported birds. Most of the North European member states and Ireland imported no or only very limited numbers of captive wild birds (see also the situation in 2005, paragraph 7.1.1.3).

Table 7.3. The EU part of the total import of the most commonly imported genera listed in CITES originating from the wild and imported for any purpose between 1999-2003[1]. (Source: UNEP-WCMC CITES Trade Database)

Genus	Into EU	Non EU	% EU import	Total volume	Average annually
Serinus	1.080.460	170.024	86%	1.250.484	250.097
Estrilda	974.292	117.437	89%	1.091.729	218.346
Lonchura	248.408	21.061	92%	269.469	53.894
Amandava	215.601	24.741	90%	240.342	48.068
Leiothrix	96.508	17.412	85%	113.920	22.784
Gracula	45.636	29.680	61%	75.316	15.063
Passeriformes	2.660.905	380.355	87%	3.041.260	608.252
Poicephalus	204.501	36.122	85%	240.623	48.125
Psittacus	176.836	48.547	78%	225.383	45.077
Amazona	76.623	25.249	75%	101.872	20.374
Myiopsitta	42.605	4.877	90%	47.482	9.496
Agapornis	23.104	39.225	37%	62.329	12.466
Aratinga	27.297	5.606	83%	32.903	6.581
Cyanoliseus	24.434	4.588	84%	29.022	5.804
Ara	10.247	9.654	51%	19.901	3.980
Cacatua	2.498	5.074	33%	7.572	1.514
Nandayus	13.482	2.633	84%	16.115	3.223
Psittaciformes	601.627	181.575	77%	783.202	156.640
Total	3.262.532	561.930	85%	3.824.462	764.892

[1]The most complete recent year for data is 2003.

Figure 7.2. EU Imports of Wild Birds (genera as in Table 7.1) listed in the CITES Database exported between 1999-2003. (Source: UNEP-WCMC CITES Trade Database)

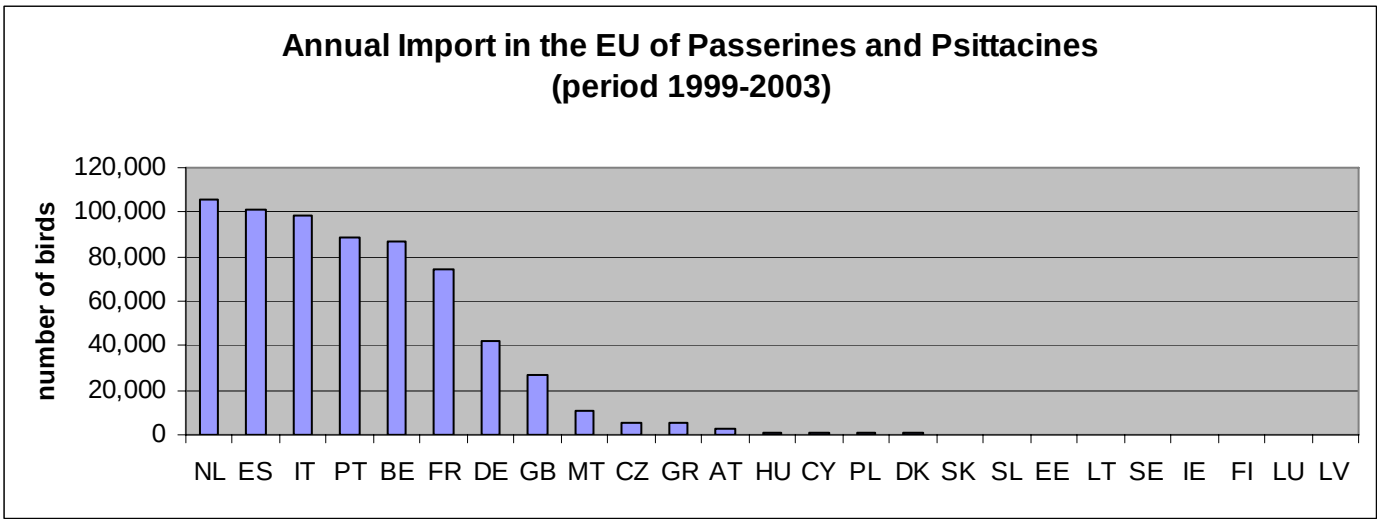


Table 7.4. EU Imports of Wild Birds (genera as in table 7.1) listed in the CITES Database exported between 1999-2003. (Source: UNEP-WCMC CITES Trade Database)

Country	Passeriformes	Psittaciformes	1999-2003	Annually
NL	405.713	123.093	528.806	105.761
ES	375.084	131.615	506.699	101.340
IT	446.974	45.320	492.294	98.459
PT	346.054	95.854	441.908	88.382
BE	390.218	45.639	435.857	87.171
FR	316.800	55.549	372.349	74.470
DE	190.387	20.069	210.456	42.091
GB	93.242	43.048	136.290	27.258
MT	53.438	1.856	55.294	11.059
CZ	4.715	24.255	28.970	5.794
GR	16.804	8.833	25.637	5.127
AT	11.281	968	12.249	2.450
HU	2.073	2.515	4.588	918
CY	3.317	900	4.217	843
PL	2.415	733	3.148	630
DK	2.180	245	2.425	485
SK	0	525	525	105
SL	0	427	427	85
EE	210	129	339	68
LT	0	33	33	7
SE	0	15	15	3
IE	0	3	3	1
FI	0	2	2	0
LU	0	1	1	0
LV	0	0	0	0
Total EU	2.660.905	601.627	3.262.532	652.506

[1]The most complete recent year for data is 2003.

7.1.1.2. Value of captive wild birds

In general, wild caught birds are cheaper than birds produced in captivity so there is an ongoing market for the former. When prices are high (table 7.5) the volume of captive bred birds will increase (table 7.2). The purchaser, however, cannot in most cases differentiate between captive bred, legally imported wild caught birds and illegally imported birds. Only a good identification (fixed leg bands, transponders) and registration system will be able to help to overcome this problem. Captive birds also can be more expensive when they have specific crossbred genetic characteristics that wild birds do not e.g. colour of plumage. They are also likely to be in better health and so less likely to die when bought.

The prices in Table 7.5 are estimates before the EU import ban entered into force. Since then, prices in both the EU and the Countries of origin have changed. In most cases the prices of birds have increased, but not always, depending on local market, availability, offer and request.

Table 7.5. Maximum and minimum prices of imported captive birds (expert opinion)

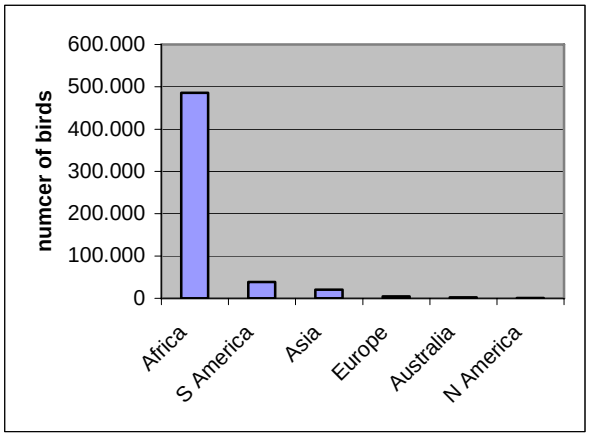
Common name	Species	Wild caught		Captive bred	
		min	max	min	max
African grey parrot	*Psittacus erithacus*	€ 200	€ 250	€ 400	€ 700
Blue and gold macaw	*Ara ararauna*	€ 650	€ 800	€ 1.000	€ 1.600
Green winged macaw	*Ara chloroptera*	€ 700	€ 1.000	€ 1.200	€ 2.000
Blue fronted amazon	*Amazona aestiva*	€ 300	€ 450	€ 600	€ 750
Senegal parrot	*Poicephalus senegalus*	€ 30	€ 30	€ 80	€ 100
Hill mynah	*Gracula religiosa*	€ 200	€ 250	€ 500	€ 700
Yellow-fronted canary	*Serinus mozambicus*	€ 6	€ 7	€ 20	€ 30
African Estrildid finches	Various	€ 6	€ 7	€ 20	€ 30
Grey crowned crane	*Balearica regulorum*	€ 500	€ 600	€ 1.000	€ 2.000
Turkey vulture	*Cathartes aura*	€ 600	€ 600	€ 1.000	€ 1.000

7.2. Analysis of the Quarantine Data of 2005

7.2.1. Principal exporting and importing countries in 2005

Based on CVEDA Quarantine Data from 2005, the different exporting countries and the orders of birds that are exported are demonstrated in Appendix 7.1. It demonstrates that representatives of at least 17 different orders were exported out of 43 countries from all continents. Similarly, the EU countries of final destination and the birds (grouped in orders) are presented in Appendix 7.2.
The continents of export and the total numbers of the birds exported are given in Figure 7.3 and Table 7.6. It can be seen that Africa was the biggest exporter in 2005 responsible for 87.9% of captive wild birds brought into the EU. The second continent was South America with 38.608 birds (7.0%), followed by Asia with only 3.7%.

Figure 7.3 and Table 7.6 Continents exporting birds into the EU in 2005



	Number	%
Africa	486.169	87,9
S America	38.608	7,0
Asia	20.358	3,7
Europe	4.667	0,8
Australia	2.022	0,4
N America	1.018	0,2
	552.842	**100,0**

The volumes of birds involved in 2005 for the country of origin are displayed in Figure 7.4 and Table 7.7. and for country of destination in Figure 7.5. and tables 7.8 and 7.9.

Figure 7.4 and Table 7.7 show that (looking at the totals number of exported birds) Ghana exported in 2005 136.065 birds (24,6%), Mali 135.392 birds (24,5%) and Tanzania 57.349 (10.4%). The top 5 countries Ghana, Mali, Tanzania, Guinea and Senegal are all from the African continent and these 5 countries exported 77.7% of all birds to the EU in 2005.

It is apparent from Table 7.8 and Figure 7.5 that the Netherlands imported the greatest number of birds in 2005 (229 470 = 41.5%). The top 5 importing countries in the EU, The Netherlands, France (14.6%), Great Britain (11.1%), Portugal (7.6%) and Belgium (5.8%), imported in 2005 80.6% of all wild birds that went into quarantine. In contrast, Malta, Hungary, Cyprus, Poland, and Sweden imported together 4.615 wild birds (0.8%), with Sweden in fact importing only 3 birds in that year. Only 17 EU MS imported birds directly from outside the EU in 2005; Estonia, Finland, Ireland, Lithuania, Luxembourg, Latvia, Slovenia and Slovakia imported legally no birds from outside the EU.
However, it should be noted that in 2005 Luxembourg imported through its BIP 775 birds in 7 shipments, which went into quarantine in the Netherlands, Belgium and Germany (see Chapter 8). The birds that went into quarantine in 2005 in the Netherlands, Greece, Hungary, Malta, and Sweden (total 243.626 birds = 47% of all birds) all came into the EU through BIPs of other EU MS. This means that almost half of all imported birds into the EU were transported over more or less large distances within the EU before arriving at the final quarantine station (e.g. transports from BIPs in Belgium, France, Great Britain, Portugal, Luxembourg, Italy and Germany to the Netherlands.

Figure 7.4. Total number of exported birds in 2005 from different countries (only countries exporting more than 2000 birds)

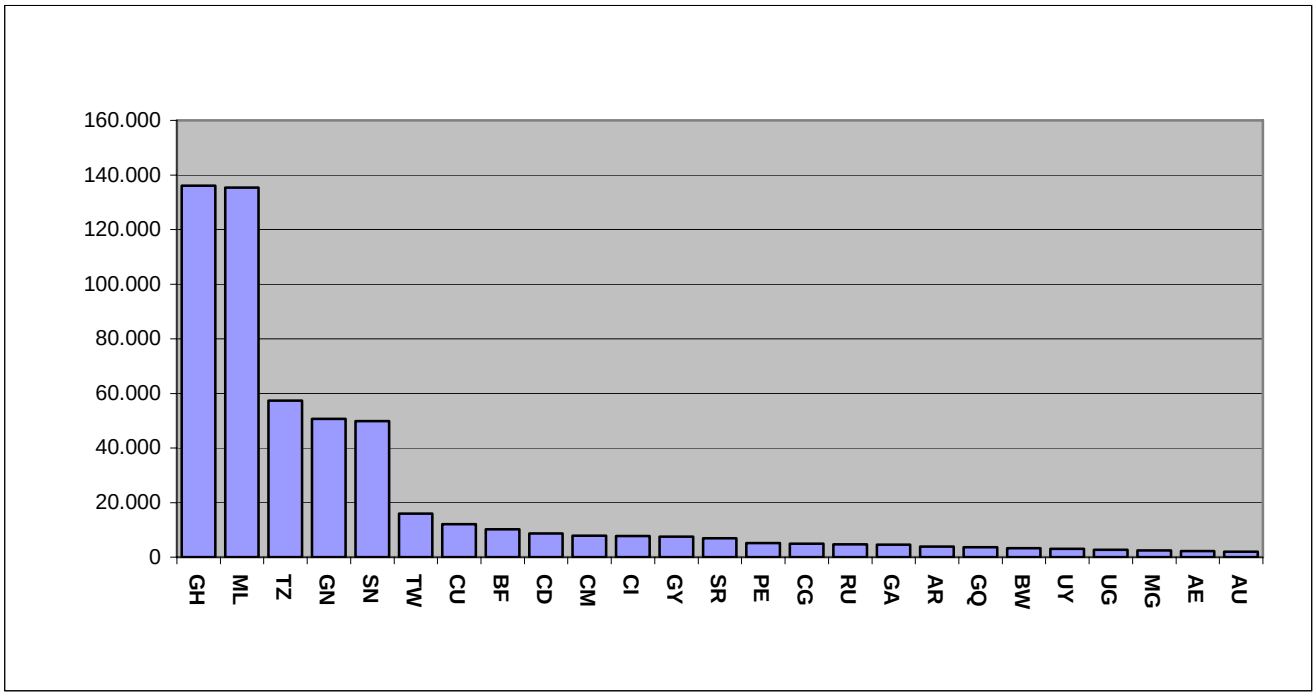


Table 7.7. Total number of birds exported in 2005 from different countries

Ghana	136.065	Guyana	7.504	Madagascar	2.489	Brazil	73
Mali	135.392	Suriname	6.908	U.A.E	2.255	Chad	22
Tanzania	57.349	Peru	5.175	Australia	2.016	Belarus	18
Guinea	50.717	Congo	4.941	Singapore	1.605	Kazakhstan	9
Senegal	49.823	Russian Fed	4.639	US	1.017	Togo	8
Taiwan	15.898	Gabon	4.537	Sierra Leone	450	New Zealand	6
Cuba	12.040	Argentina	3.908	Bahrain	231	Egypt	3
Burkina Faso	10.182	Eq. Guinea	3.688	Kuwait	155	Canada	1
Congo D.R.	8.707	Botswana	3.300	Namibia	152	Andorra	1
Cameroon	7.874	Uruguay	3.000	Philippines	121	Japan	1
Cote D'Ivore	7.786	Uganda	2.684	Jordan	92		

Figure 7.5. Total number of birds imported into the EU in 2005

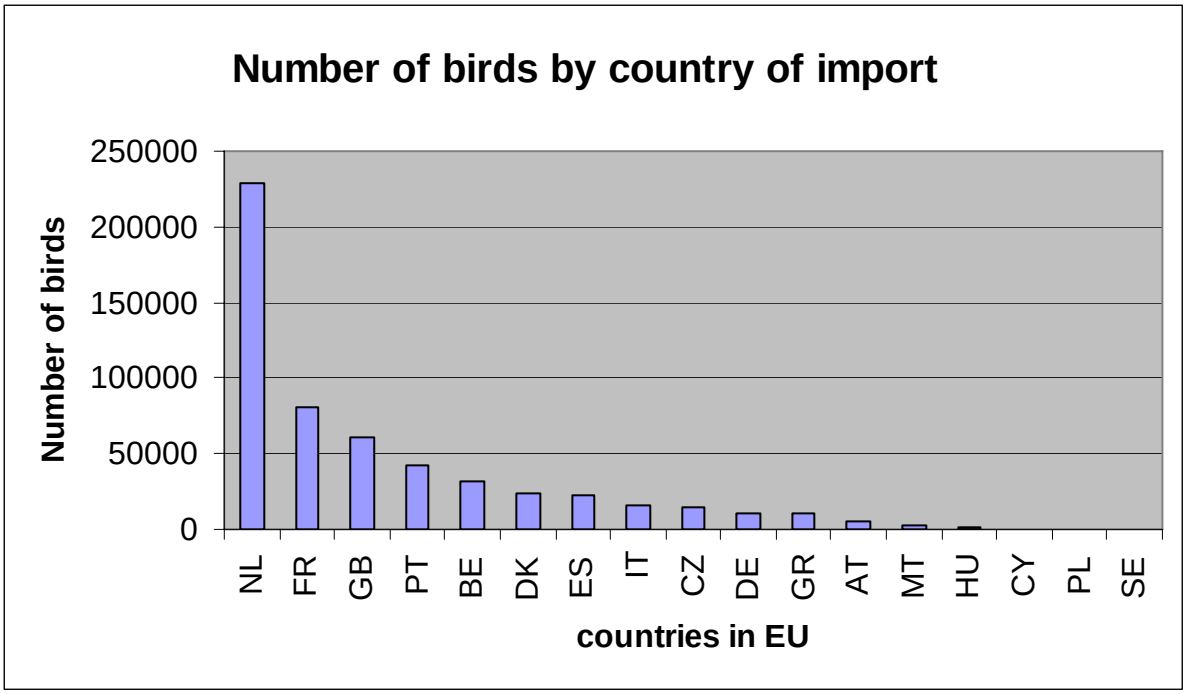


Table 7.8 Total number of birds imported into the EU in 2005

Country	Volume	%	Country	Volume	%
NL	229.470	44,0	DE	10.674	2,0
FR	80.584	15,4	GR	10.600	2,0
GB	61.450	11,8	AT	5.047	1,0
PT	41.861	8,0	MT	2.000	0,4
BE	32.038	6,1	HU	1.553	0,3
DK	24.426	4,7	CY	577	0,1
ES	22.294	4,3	PL	482	0,1
IT	15.588	3,0	SE	3	0,0
CZ	14.195	2,7	**Total**	521.906	0,0

7.2.2. Range and diversity of exported and imported species in 2005

The predominant orders of birds exported in 2005 are displayed in Table 7.9. The largest numbers of birds were Passeriformes and these were exported by 21 countries (= 63,8% of all exported birds), The three predominant orders for export (together 94,9%) were Passeriformes (63,8%), Psittaciformes (16,7%) and Galliformes (14,4%).

Table 7. 9. Predominant orders of birds imported into the EU in 2005 by number of exporting countries and total number of birds (CVEDA Quarantine Data)

	Exp countries	Total numbers
Passeriformes	21	352.925
Psittaciformes	30	92.221
Galliformes	13	79.613
Columbiformes	7	9.203
Anseriformes	2	5.150
Other birds	3	5.207
Piciformes	3	2.660
Coraciiformes	3	1.755
Cuculiformes	2	1.362
Pelecaniformes	2	1.126
Gaviiformes	1	518
Falconiforme	16	411
Ciconiiformes	3	366
Strigiformes	8	254
Coliiformes	1	34
Trogoniformes	1	20
Apterygiformes	1	15
Gruiformes	2	2
Total birds		552842

7.3. Captive breeding

7.3.1. Breeding in country of origin

For imported species, captive breeding may offer an alternative source of birds to those captured in the wild.

Captive breeding is the source of most birds of only a few species; budgerigars (*Melopsittacus undulatus*), cockatiels (*Nymphicus hollandicus*), canaries (*Serinus canaria*), zebra waxbills (*Amandave subflava*), bengalese finches (*Lonchura domestica*), most *Agapornis* lovebirds, several cockatoos (*Cacatua*) and some Australian finches (Anon, 1991). As these birds are bred within the EU and not imported from Third Countries, they are not the subject of this report

Table 7.2 illustrates that there is a substantial amount of trade in captive bred birds. Based on information from the UNEP-WCMC CITES Trade Database between 1999-2003 66% of the total trade of the most commonly imported psittacine genera were captive bred. For Agapornis sp. and Cacatua sp. this was 80% or higher. However for Passeriformes these figures were much lower (average 2% with for some genera 7%). With increasing prices it is that this trend will continue. Most of this breeding, however, is not taking place in the countries of origin, but in the EU.

Birds bred in captivity may be native to the region where they are bred, or not. Furthermore, breeding facilities and conditions can be good, fair or bad. The size and purpose of the breeding centre can vary: there are private breeders, commercial breeders and zoos. Some breeders devote very great care to their attempts to breed birds in captivity whilst others invest little time and energy in attempting to do so.
Some bird species adapt better to captivity than others, but there is a lot of individual variation. Some species still show escape behaviours, whether hatched in captivity or wild caught. Even so, expert experience and opinion indicate that a bird that has been kept with humans since when it was very young, will have more chance to become a good pet, and this is probably independent of the fact that the bird was wild caught very young or simply taken from the nest in a captive breeding centre. For the same reason, with few exceptions, it is unlikely that an adult wild bird will adapt well to captive conditions. There are species differences, but it is generally believed that captive bred birds are better breeders. This seems to be true when they have been naturally raised by their parents, while hand reared birds, especially if they have been raised alone and away from social contacts, make better pets, but are less prone to be good breeding birds (Lennox and Harrison, 2006).

The value of some birds is high and wild-caught birds can easily be, and are, presented for sale as being captive-bred. It is very seldom possible to distinguish between wild-caught and captive-bred birds with certainty. This is true for birds bred in captivity in the country of origin and for birds bred in captivity in the country of sale. Birds that are captive bred may be traded through different commercial channels from those used for wild caught birds.

There are few data on breeding results and methods used in exporting countries. For most species, no breeding occurs except in zoos for those species that will breed in captivity.
There is, however, some breeding of birds of prey. Some birds of prey will breed when kept in a single aviary, but "difficult" species, like the goshawk (*Accipiter gentilis*), may need separate (or separable), aviaries for the male and female. In most cases the breeding aviary will not be accessible to people in the sense that birds will not be able to see people from inside. This can be achieved by several methods, ranging from hidden eye-holes to one-way windows. (Heidenreich, 1997). In Appendix 7.3 more informative data are presented about the requirements of the different orders for breeding in captivity.

7.3.2. Distinguishing captive bred from wild caught birds.

It is very seldom possible to distinguish between wild-caught and captive-bred birds with certainty. This is true for birds bred in captivity in the country of origin and for birds bred in captivity in the country of sale. Methods of marking, such as close-ringing of the leg or implanting an electronic identifier, can be applied to wild-caught as well as captive bred birds. Trust in the exporting establishment is the strongest means of maximising the chance that a bird is captive-bred. However, the value of some birds is high and wild-caught birds can easily be, and are, presented for sale as being captive-bred.

7.4. Imports of eggs

Eggs may be taken from wild birds nests or taken from birds managed in captivity. Bird eggs are commonly smuggled internationally.
The EFSA report on transport (2004) concluded that wasting eggs is in effect wasting animals but that eggs may be exported without any welfare problem as this is normally carried out at an early stage of incubation. Therefore, transport of eggs with extreme care is preferable.
The safest time to transport eggs is before they have been incubated. If this is not possible, chicks in eggs that are pipping or close to hatching are less vulnerable than those transported during the first two thirds of incubation.

The requirements for successful transport of fertile eggs are well documented. A general reference on transporting a variety of birds and eggs can be found in Hawkins, Morton et al. (2001).

7.5. Illegal trade of captive birds in EU

Illegal trade is another mode of import of captive birds in to the EU, which constitutes a possible risk for the importation of exotic infectious agents that may affect the indigenous EU bird populations. This risk is heightened by the fact that by the very nature of illegal trade, no inspection or quarantine of imported birds is applied by the responsible state authorities.
During the period 2000-2003 a total of 2,767,577 wild birds were imported legally in the EU, which constitutes 93% of the world total trade (data supplied by Species Survival Network). On the other hand, the number of wild birds imported illegally in the EU is not known, but the number of bird seizures by customs authorities can appraise, even if imprecisely, the extent of illegal trade.
Table 7.10 shows the number of seizures of live birds by customs authorities for those countries and years for which data were available.

Table 7.10. Number of seized live birds provided by some EU MS customs authorities[1]

Country	2000	2001	2002	2003	2004	2005
Austria			2	10		
Czech Republic			100			
Germany	656	159	62	782	173	11
Italy			46	806	6	10 (Jan-June)
Malta				2		
Netherlands	70	86	5	158	117	18
Portugal			6	8	224	
Spain				5		
Sweden					1	
United Kingdom			508	6	2,323	
Total	**726**	**245**	**729**	**2,177**	**2,844**	**39**

[1]These data are the only available figures provided by some customs authorities. From other MS or other years no data were available. This table is just to illustrate the low numbers of birds that are seized. Blank means 0

For the period 2000-2003 the above countries imported legally 1,850,886 live birds (data supplied by Species Survival Network) that account for 66.88% of the total number of live birds imported in all of EU. The total number of wild bird seizures in the EU countries listed in the table above during the same period was 3,877, which constitutes 0.21% of the total number of wild birds imported in these EU countries for the same period. Therefore, there are documented attempts to import birds illegally in to EU.
In the Netherlands in 6 years the total direct seizures at the borders were 454 individual birds (123 Psittaciformes, 315 Passeriformes and 16 other orders). Of these illegal imports 202 birds (44%) were confiscated due to legislation related to veterinary aspects and/or welfare and the other related to CITES regulations. The Psittaciformes were 35 illegal imports of parrots and 33 of these imports were 1-2 birds.

Three parrots were found on ships coming into the country.
The 315 Passeriformes came into the country in 17 imports, ranging from 1-102 birds (average 19 birds). Of the Passeriformes 135 were birds (Lesser seedfinch or Chestnut-bellied seedfinch (*Oryzoborus angolensis*) and Large-billed seedfinch (*Oryzoborus crassirostris)* originating from Suriname and were confiscated for missing the adequate documents. These birds are very popular with the Surinam people for having traditional song contests and 50% of the Surinam people live in the Netherlands (see Picture). In the Netherlands there was in 2004 one additional seizure of 5,650 passeriformes. This consignment was allowed into the EU by the BIP of import, but was later confiscated because the papers stated that these birds were originating from Mali, but these species were not originally living in Mali at all.

Some North American breeders believe that some parrots selling in the USA for more than $500 are likely to have been imported illegally because they are sold cheaper than specimens bred in captivity in the USA (ANON, 2002). However, there is no evidence of any increase in illegal imports of wild-caught birds since the USA banned this practice. Warchol (2004) found the illegal trade in wild birds in South Africa and Namibia to be well organised and worth about $2 million (US) a month. Birds were usually directed to private collectors. Recently, AIV H5N2 was isolated from one of two red-lored Amazon parrots [Amazona autumnalis autumnalis] that were believed to have been imported illegally into the US [Hawkins et al, 2006].

The incident with smuggled Thai Eagles into Belgium demonstrates that international air travel and smuggling represent major threats for introducing and disseminating H5N1 virus worldwide. Here, the falconer who ordered the birds already owned 4 other eagles of the same species. The 2 birds detected by customs may reflect a much larger underlying problem of bird smuggling. Such birds easily remain undetected because customs officers are essentially focused on metal objects, although airport scanners can theoretically detect bones of animals. Specific methods for systematically detecting live animals (e.g., trained dogs) should be considered at airports and borders. (Borm, et al, 2005).

8. The Captive Wild Bird Pathway

This chapter gathers the available data that describes the traffic in wild birds from the point of capture to their release from quarantine in the EU [see figs 6.1 and 6.2 describing the risk pathway]. Due to the nature of this trade, it is difficult to obtain objective or quantitative data and references for some important parts of the pathway, particularly capture practices and transport, which generally are performed in remote areas in third countries. Only one report is available for the top 5 African states, which are the major source of birds imported to the EU [Clemmons, 2002]. The data for these sectors are necessarily descriptive and rely on expert opinion and experience, apart from a few studies.

8.1. General description

Birds are captured in the wild by a variety of capture techniques, which will differ depending on the target species and the age at which the birds are to be captured.

Some local communities in countries of origin maintain bird habitat in order that they can catch wild birds for export and derive a significant part of their income from such sales. These practices can have a beneficial effect on bird conservation, even if birds are removed from wild populations and there are bad effects on bird welfare.

After capture the birds are shipped to central markets or holding facilities, and then either sold in local markets or transported internationally either legally and openly or illegally and

therefore hidden. The trapper may sell the birds to a middleman and then to a trader who arranges marketing and export. In the country of destination they are quarantined, sold in markets or traded directly to new owners.

The conditions under which the birds are handled and held and the duration of these conditions may vary considerably. For example, birds for export may spend months at dealers premises waiting for a shipment to be made up. They may be held in poor facilities, held in abnormal social groups, perhaps with many species close together, overcrowded, handled, and transported often in poor conditions, including inappropriate food or inadequate water supply. In contrast, other birds that are caught on request [for example, from a wholesaler in the EU or their client] will follow the quickest route, but this should still contain a quarantine period of at least 21 days in the exporting country. Birds are then shipped or flown to their destination either a further holding country or the country of final sale. All birds imported legally to the EU are transported by air.

They may be exposed to abnormal climatic conditions, e.g. tropical birds shipped to temperate climates may spend time in large airport sheds and experience transport delays, although generally they will be taken to the BIP, where the first inspection is conducted, for collection by the importer. Because larger birds are often more valuable, they may be managed more carefully than small less valuable species.

The possible consequences of the procedures used during this long pathway are that the birds may be injured, develop disease or even die at any step. Death might be instantaneous but usually it will be preceded by a period of poor welfare. This may sometimes be caused by disease. Hence mortality at the various stages of the pathway from first attempts at capture in the country of origin to sale in the E.U. can be a useful and objective indicator of welfare. Figures for mortality during segments of the pathway are mentioned, where available, in the appropriate sections below. During the early stages of the pathway, mortality figures can be difficult to obtain or are unreliable; for example, McGowan [2001] noted that trappers knew how many birds they had sold but were not interested in birds that had died as they had earned no income from these.

8.2. Practice of capture

The methods of capturing wild birds vary from country to country and species to species. Small species may be trapped in bulk and larger birds caught individually. Non-target species may be caught and killed or allowed to remain in nets or traps while the trapper waits for the wanted species.
The responses of birds to humans vary according to species and age of first exposure but all birds are likely to show some fear as a result of capture.

8.2.1. Fledglings

Many species, especially parrots, are captured in the nest. In some countries where species use the same nesting site each year, they are harvested for nestlings on a yearly basis. This is a common practice in West Africa where grey parrots are taken each year from the same nest sites. The age and stage of development of the nestling at capture varies between species and countries. Some birds are tied into the nest to stop them leaving. In South America parrots are often taken from nests in trees which are cut down to allow access or nesting holes are broken into and destroyed to allow access to nestlings.

A high proportion of birds in an area may be affected; for example, one study in Thailand (Archawaranon, 2003) reported that more than 60% of hatchlings of the hill Mynah were

taken by humans for the pet trade. Although Thailand is not a major exporter of Mynah birds to the EU, this example illustrates the local impact that may arise from wild bird capture.

Two methods have been described for the collection of parrot nestlings in the Peruvian Amazon (Gonzalez, 2003); for species that nest high, the nesting trees are cut down and for lower nesters the nest cavity is hacked open. The cutting down of trees may result in the death of other nestlings from unwanted species and tree and nest cavity destruction reduces the available nesting options. Gonzalez (2003) found that the mean mortality rate for nestlings was 0-8% in Amazon parrots and 14.3-48.4% in macaws. Species that nested higher had higher mortality rates. Mortality rates for blue and yellow macaws (*Ara ararauna*) were particularly high with 48.4% dying during harvesting (see table 8.1). In a review of 23 studies of nesting success of parrots the mean poaching rate was 30% across all studies and ranged from around 90% to zero depending on species. The price paid for parrots influenced the rate of nest poaching (Wright et al., 2000). Nesting cavities were not destroyed during capture of grey parrots in Central Africa but were visited annually and the nestlings taken (Juste, 1996). However in a CITES and IUCN supported study Clemmons (2002) reported that in Guinea-Bissau some trappers took African grey parrots nestlings either by cutting down the tree, or climbing up to the nest and removing the birds manually or using a stick with bird lime on it. Some tied the nestlings into the nest and came back later to remove the birds. The preferred age of capture was one month. In Guinea trappers captured adult and juvenile birds using three methods; (1) trapping sleeping birds over rivers using a flashlight and knocking the bird into the water and then retrieving it, (2) glue on sticks with a decoy parrot, (3) snares placed on trees between landing spot and food. They also took nestlings (Clemmons, 2002) but preferred to take adults as mortality rates were lower in the latter.

Table 8.1. Nestling mortality rates recorded during capture of parrots (Gonzalez, 2003)

Name	latin name	Living nestlings	Dead nestlings [% of total]
blue and yellow macaw	*Ara araruana*	162	152 [48]
scarlet macaw	*Ara macao*	42	7 [14]
chestnut fronted macaw	*Ara severa*	18	11 [38]
red-bellied macaw	*Ortopsittaca manilata*	31	6 [16]
orange-winged parrot	*Amazona amazonica*	586	51 [8]
festive parrot	*Amazona festiva*	61	2 [3]
yellow-crowned parrot	*Amazona ochrocephala*	13	0 [0]

On Principe grey parrot nestlings are taken at the end of the nesting period (Juste, 1996). Both McGowan (2001) and Juste (1996) reported that because of the competition between trappers some nestlings are taken earlier and this may result in higher mortality. In one small sample, the mortality rates of African grey parrots captured in Nigeria were about 43% with the trapper (22/51) and about 3 or 4 birds died from every 10 received by the dealer (McGowan, 2001). McGowan (2001) concluded that about 2/3 of all African grey parrots trapped would die before reaching a market. Capturing fledgelings for the pet trade is a threat to the

endangered Ouvea parakeet (*Eunymphicus cornutus uvaeensis*) in New Caledonia (Robinet and Salas, 1999).

8.2.2. Adults

Adult birds are caught using a wide variety of techniques. These include nets, such as mist nets erected in flight pathways and hand held nets. Nets may be placed above the tree canopy or around a target tree. Conspecific decoy birds may be tied to specific trees and be used to lure target species into nets. Handheld nets are used to capture raptors attracted to decoy prey birds tethered to a branch or on the ground. Glue (bird lime) coated on branches is used to capture a wide variety of species including large parrots and small finches. Traps with a compartment to hold a decoy bird and other compartments to hold the attracted target birds are used to capture a range of species. Traps may be placed in trees or on the ground.
In the Lesser Antilles adult parrots are wing shot so as to enable capture. Several birds may be killed for every one captured alive (Christian et al., 1996).

In Nigeria houbara bustards (*Chlamydotis undulate macqueeni*) are traded from Pakistan and Central Asia to the Middle East (Bailey et al., 2000), and about 4000-7000 are shipped from Pakistan to the ME each year. Bustards are often caught using snares set in gaps in brushwood fences adjacent to mustard fields and birds are frequently injured (18%) during capture including injuries or fractures to limbs and wing tip damage (Bailey et al., 2000). The bodyweight of houbara bustards arriving at quarantine facilities were 20-25% below normal range (Bailey et al., 2000).

8.2.3. Nets

Small birds such as Indian finches are caught in mist nets during flight or in traps. Mist nets may result in high casualty rates and non-target species may be left hanging in nets until target birds are caught. These may die from dehydration or be predated upon or be injured while being removed by the trapper. However mist nets placed above the canopy were a safe technique for capturing parrots and captured few non-target birds. The playback of conspecific calls acts as an attractant (Meyers, 1994). Mist nets (7.3 m high) placed around a tree with live decoys within the circle of nets were a safe and efficient method of capturing parrots especially if the calls of foraging conspecifics were played (Meyers, 1994). Very low mortality rates are expected with expert mist net trappers and Kaiser et al. (1995) had one dead marbled murrelet from 223 (0.4%) caught in mist nets. However Brooks (2000) reported the predation of 74 birds from 3707 (2%) birds caught in mist nets in a Kenyan study. Being caught in a mist net is certainly distressing as shown by the corticosterone response of birds caught in mist nets but the response is unpredictable (Romero and Romero, 2002).

Sparrowhawks (*Accipiter sp*) are caught in Georgia using a red backed shrike (*Lanius collurio*), which has been caught and trained as a decoy bird, and a net (Van Maanen et al., 2001). The sparrowhawk dives on to the shrike and is caught in the net. Some hawks are injured and these are always killed. Trappers can catch up to 30 birds each day. Birds die due to the stress of capture and handling and heat exhaustion from storing the birds in bags can lead to fatality. Stress, malnutrition, physical abuse can all result in death (van Maanen et al., 2001). It has been estimated that 10,000 sparrowhawks die in north-east Turkey each year. CITES database does not record export of raptors from Turkey to the EU.

Saker falcons (*Falco cherrug*) are captured in the Himalayan areas of China. The mortality rate of these birds is high during capture and transport and local forestry officers often find dead birds among confiscated shipments (Yi-Ming et al., 2000). Luggar (*Lagger*) falcons

(*Falco jugger*) are trapped in Pakistan for trade to the Middle East. They are often injured during capture with foot injuries being common (Bailey et al., 1998 cited by Bailey et al., 2000). Lugger, saker and peregrine falcons are usually managed better than the smaller falcons (Bailey et al. 2000).

Snares made from fishing line are used to trap tanibar corellas (*Cacatua goffini*) in Indonesia (Jepson et al., 2001). The snares are placed around maize heads or around a lure bird tethered on the ground . A team of 2 people could catch 30 – 50 birds each day.

Painted buntings are caught using traps with as many as 8 compartments with a lure bird in a central or lower compartment (Inigo-Elias et al., 2002).

Marsden et al (2001) describes how glue (bird-lime) painted on tree branches was used to capture cockatoos, parrots and lorikeets in Papua New Guinea and Yom-Tov (2003) described a glue trap used to catch a kestrel (*Falco tinnunculus*); a live mouse was caught on the glue trap and the kestrel attracted to the mouse got caught on the glue trap. Bird lime may get into the birds feathers and damage the plumage making birds less weather proof.
Great horned owls (*Bubo virginianus*) were used as a lure for 11 species of raptors. They were particularly effective with territorial pairs during breeding when there were suitable locations to place nets (Bloom et al., 1992).

Adult Audubon's crested caracas can be captured in walk-in traps but territorial birds can be encouraged by an apparently invading adult caracara to a location where they can be caught with a Q-net, a large bow net (Morrison and McGehee, 1996).

The welfare of decoy or lure birds will depend on whether they are expendable and therefore of little value or whether they are kept as pet birds for ongoing decoy activity.

8.3. Transport from capture to holdings and markets to point of export

Although the conditions under which the birds are handled and held and the duration of these conditions may vary considerably, after capture, all birds (adults and nestlings) are likely to be stressed. When transported from the field to the home of the trapper, they will be confined, for example, held in boxes, bags or cages,often with inadequate space [Duplaix, 2001; McGowan, 2001] and their diet may differ from that to which they had previously been used. They may be held with birds of different species or with conspecifics. The presence of humans may cause significant stress. They can then be held for weeks before transport to a dealer, although for some species this can be quite short.

Much bird capture is done in remote areas and transport of birds to towns and cities for further marketing may take time and the means of transport may be primitive and slow. Death in the period after capture and initial transport to market may be due to deprivation, malnutrition, aggression, social stress, stress caused by close proximity to humans and climatic and environmental factors.

In Peru the trade in parrots is through middlemen and commercial dealers and catchers transport fledglings to city markets in boats and by road. Birds are transported in wooden boxes in groups of 50 to 150 birds and they are soaked with water to keep them quiet when approaching control blocks (Gonzalez, 2003).

Houbara bustards are crowded into small boxes for transport to the Middle East and mortality rates on arrival range from 22 to 100% usually due to disease but poor husbandry, insufficient food and water were also important (Bailey et al., 2000). Hill mynahs (*Gracula religiosa*) are trapped in Thailand for the pet trade – more than 50% die of starvation and exhaustion during transport (Archawaranon, 2003). Holding passerines after capture and before handing was unsatisfactory for birds to be placed in long term captivity and Bocelli (1994) found that using a dark quiet environment, the prompt provision of water and food, and little handling time resulted in 90 of 98 Nashville warblers (*Vermivora ruficapilla*) living as opposed to previous experience when 43 of 54 (80%) birds died. The use of branches and leaves as a visual screen and cover for birds at holding premises in Tanzania lowered mortality in wild birds during holding at a middleman, showing that biologically relevant enrichment could have a positive effect on bird welfare (Steinmetz et al., 1998). This same report presented other examples of overcrowded transport of finches that resulted in high mortality or injury and weakness.

Estimates of capture-related and pre-export mortality vary greatly and are difficult to obtain; some publications report ranges from 0 to 2% for cockatoos and 5% for Indian species and 2 to 60% for certain African finches (Meyers, 1998; Maas, 2000).

Falcons are often bound during transport and die as a result (Bailey et al., 2000; Van Borm et al., 2005). They may also starve when kept in large groups competing for common food source so that weaker birds die (Bailey et al., 2000).

8.4. Point of Export

8.4.1. Requirements imposed by the EU on third countries that wish to export live birds

All birds that are intended for legal export from a third country to any MS are subject to EU legislation [Decision 2000/666/EC] that is intended to protectthe EU poultry populations. The Decision imposes these requirements as one measure to reduce the risk of introduction of diseases to the EU from Third Countries.
Briefly, these requirements are that

i) the exporting country must be a member of the OIE and
ii) the consignment is accompanied by an animal health certificate [valid for 5 days only], signed by an official veterinarian, guaranteeing that :-

- the birds have been kept for at least 21 days or since hatching on a holding registered by the competent authority of the exporting country
- AI, ND and AC [psittaciformes only] are notifiable diseases and the birds have come from a holding that is not under restrictions due to these diseases
- AI and ND outbreaks have not been notified at the holding of origin or within an area with a radius of 10Km surrounding the holding within at least 30 days prior to export
- AC [psittaciformes only] has not been notified at the holding of origin within at least 60 days prior to export
- The birds have been examined on the day of loading and show no clinical signs of disease and are fit to travel
- The birds have not been vaccinated against ND
- The crates or cages
    - ♦ bear the name, address and registration number of the holding of origin and a specific identification number for each crate/cage
    - ♦ contain only birds from the same establishment

- ♦ contain only birds of the same species
- ♦ are constructed to preclude loss of excrement and feathers during transport
- ♦ allow visual inspection of the birds
- ♦ allow cleaning and disinfection
- ♦ are being used for the first time or have been cleaned and disinfected as instructed by the competent authority. This requirement also applies to all vehicles in which they are loaded and transported

- air transport must comply with the latest IATA rules
- transport of CITES listed species must comply with the latest CITES guidelines

A minimum distance from other bird holdings, use of sentinel birds or testing of the birds intended for export do not appear to be requirements. Surveillance appears to be based on recognition of clinical signs and reporting of these to the government authorities.
Clearly, strict enforcement of the above measures would make a large contribution to reduce the risk of introduction of diseases to the EU from Third Countries. However, there is only sporadic data on how these are implemented and no systematic studies. Duplaix (2001) reported poor inspection for non-CITES species by exporters and the most recent account [RSPCA/Eurogroup, 2006] presented a case study for Ghana (one of the major African exporters) in which only one of 13 holding centres passed inspection by the government inspector (RSPCA/Eurogoup, 2006). The inspections recorded poor disease control, untrained staff, poor records and high mortality rates. They further report that exporters may mix birds that have been inspected by a veterinarian with unchecked birds. Other reports record export of bird species that must have originated from a country other than the exporting country [Duplaix, 2001] Further, many non-poultry species may not express clinical signs of disease when infected by AI, ND and AC and therefore may be infected when they leave the holding [see chapter 9].

8.5. Export to BIP

8.5.1. International transport

Previously, international transport of captive birds was associated with high deaths on arrival (Ashton and Alexander, 1980; Ashton, 1984). More recent data have indicated an improvement. Studies in Belgium, Denmark, France, Germany, the UK and the USA showed a decline in mortality from 7.2% in 1982 to 1.4% in 1996 (Meyers, 1998). Mortality rates were lower for psittacines and large birds and remained at about 1% for 10 years (Meyers, 1998). On the basis of an extensive sample of more than 6 million birds, Schütz (2003) showed that the average transport mortality of birds transported by air was 1.36% but that this varied between species and five families (Alcedinidae, Nectariniidae, Aegithaldidae, Trochilidae and Jacanidae) had mean mortality rates above 5%.

The EFSA Transport Report (2004) concluded that there were more problems before transport than during transport for wild caught birds but that the treatment in the pre-transport period could adversely affect the ability of surviving birds to cope with stressors encountered during and after the transport. Thus, transport mortality could be somewhat higher for wild caught species than for captive bred species (Vinke, 1998). She also reported that all transports fulfilling IATA guidelines could be characterised as good but that deficiencies were identified in most of those that did not meet IATA guidelines. Maas (2000) quoted figures for birds dead on arrival (DOAs) after international transport and showed that DOAs in the various studies varied from 1 to15%.
Transport mortality appeared to be proportional to the number of birds in a container, bird density [floor space and perch space per bird], consignment size and transport time (Jensen,

1991; Lindley, 1995) and there was some indication that larger groups and longer journeys led to a greater mortality than smaller groups and shorter journeys. Country of origin, number of species per consignment and the quality of the post-export quarantine facilities also affected the extent of bird mortality. Schütz (2003) also indicated that mortality rate was higher for smaller bird species of lesser value that were transported in larger groups. This author also found that typically high average mortality rates were due to certain transports with very high mortality (up to 100%) and showed that 0.4% of transports had mortality rates greater than 50%. In 64% of bird transports, the mortality was zero. Transport mortality in CITES species was significantly lower than in non-CITES species (0.90 v. 2.25%) and none of the 28 non-CITES species investigated had a mortality of zero. Even in species with a mortality < 1% there were repeated cases of shipments > 15% dead individuals on arrival. The same author showed that average transport mortality was halved, if shipments complied with IATA standards (2002).

The 29th edition of IATA's Live Animal Regulations (2002) gives figures for cage sizes and design for birds of different species and at the CITES website are specific directions for i) water birds and large birds of non perching habit, ii) parrots, pigeons, passerines, near-passerines and iii) birds of prey and owls [http://www.cites.org/eng/resources/transport/index.shtml accessed 06OCT06]. These requirements incorporate the conclusions of Joslin and Collins (1999) and further note that birds should be transported in semi-darkness and disturbed as little as possible.

8.6. Border inspection points (BIPs)

The EU has created legislation to establish a network of Border Inspection Posts [BIP] in the MS to undertake veterinary checks of all birds that are introduced to the EU This has been summarised in the annex to "General guidance on EU import and transit rules for live animals and animal products from third countries (DG Sanco, 2006). BIPs therefore represent a critical point in the chain of events for importation of birds and are the first key control point within the EU.

BIPs are placed under the authority of the official veterinarians appointed by the Competent Authority of the MS and it is mandatory that each consignment of birds from a Third Country is subject to veterinary checks (Directive 91/496/EEC); These checks include verification of the relevant documents, an identity check to verify that the documents accurately describe the contents of the consignment and a clinical examination, which may include sampling and laboratory testing. The need for sampling and laboratory testing may be relaxed, depending on the perceived risk of the consignment (DG Sanco, 2006] and, where a consignment contains a large number of animals, only a proportion of the consignment may be examined. Exporters are required to notify BIPs of live animal consignments 24hrs before arrival by supplying the common veterinary entry document [CVED] or electronically via TRACES.

However, the robustness of these procedures and checks has been questioned as veterinary control may not be applied to all bird species, a physical examination was not always conducted and not all animals entered the EU through a BIP, thereby by-passing an important safeguard [Van Liere and Teesing, 2000]. This view was echoed by an independent review of quarantine in the UK [Dimmock et al., 2005].

The performance of MS in implementing the veterinary controls at BIPs is evaluated by the FVO [Decision 2001/881/EC], which regularly inspects the facilities, equipment and procedures at all BIPs on a rotating basis. The most recent general review of veterinary

checks in BIPs, covering the period 2002-2003, reported that a system for import control was in place in all MS that were inspected [DG (SANCO)/8508/2004-GR].

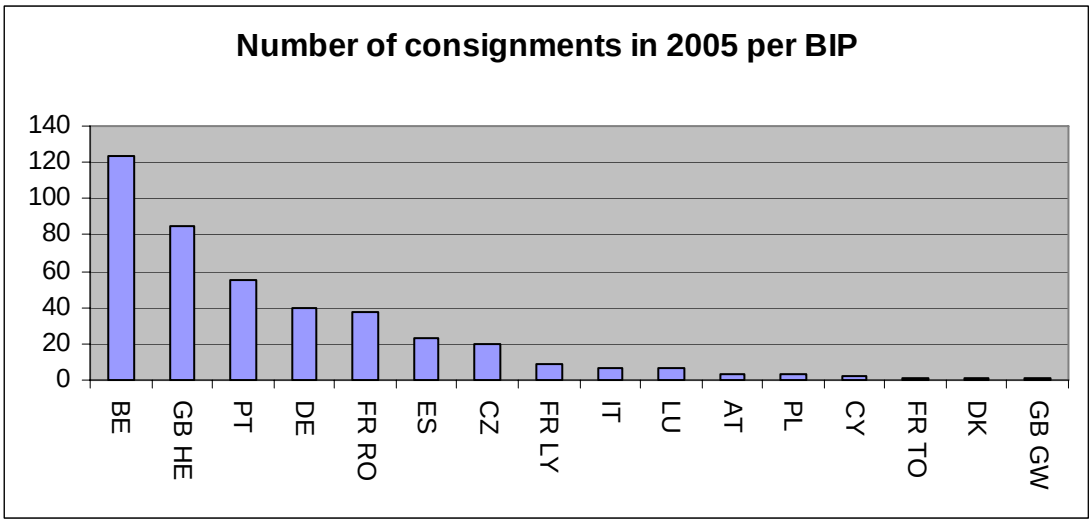
Although findings specific to BIPS that handled birds were not identifiable in this report, the report identified general major and minor shortcomings in the operation of BIPs, such as supervision, training, selection and identification of consignments. Further, no assurance could be given that all relevant veterinary consignments arrived in approved BIPs, thus agreeing with the above views that animal and public health could be compromised. Importantly, the report noted that control systems and their implementation have continued to evolve and these will be reviewed in the next report, particularly the need for more intelligence on consignments arriving at BIPs and improved veterinary checks.

Several factors impact on the risks associated with potential mixing and partitioning at BIPs, such as

1) the amount of consignments passing through each BIP
2) the number of third countries from which consignments of birds arrive at each BIP,
3) the number of countries within the EU to which consignments of birds are disseminated from each BIP.
4) the number of different orders passing through the BIP;
5) the volume of birds passing through the BIP
6) infrastructure and processes within the BIP, which are subject to regular inspection by the Food and Veterinary Office [FVO] of the European Commission.

In 2005 there were only 16 BIPs in 13 countries active in receiving captive wild birds. These birds were distributed over quarantines in 17 EU MS, resulting in 5 EU countries importing all birds (total 243.626 birds = 47% of all birds) through BIPs in another MS. Figure 8.4. shows, for each BIP, the origins of birds entering the facility and those of birds leaving the facility. In addition, the thickness of the line presented represents the number of contacts between a particular pair of countries. This is useful from the point of view of identifying BIPs that might be viewed as “high risk” as they receive birds from a large number of points of origin, which they then disseminate to a wide variety of destinations. The 2005 data suggest that BIPs divide into two groupings; those that are intensely active, with a large variety of bird movements and those that report minimal avian traffic. In figure 8.1 the number of consignments per BIP is presented.

Figure 8.1. Number of consignments received in the different BIPs in the EU in 2005



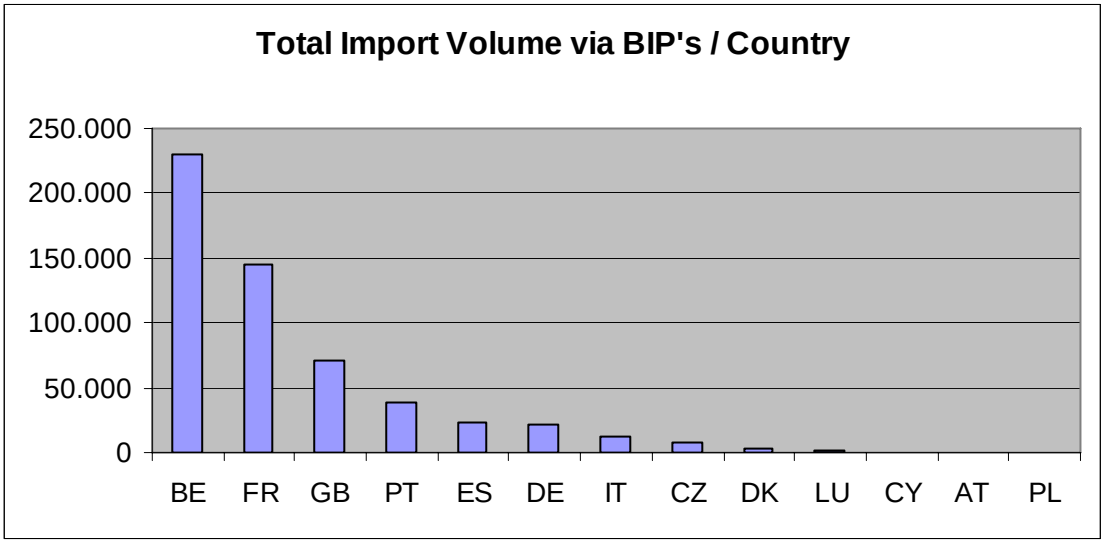
In 2005 three BIPs (Brussels-Zaventem in Belgium (124), Heathrow in the UK (85) and Lisboa in Portugal (55) received the largest number of consignments. However, Heathrow in the UK, Brussels-Zaventem in Belgium and Frankfurt Main in Germany receive

consignments from the greatest numbers of countries of origin and also send birds to the largest number of destinations (quarantine station within other EU MS).

These BIPs also imported the greatest number of different orders; Heathrow and Brussels-Zaventem BIPs each imported at least 10 different orders in this period and Frankfurt at least 7 orders.
In contrast, Toulouse-Blagnac – FR (one shipment of 3.070 passeriformes), København-DK (one shipment of 2.700 galliformes) and Kukuryki-Koroszczyn - PL (18 galliformes in 3 shipments) only had dealings with one country of origin and one destination, and dealt with only one species of bird. But Denmark imported in 2005 additionally 21.726 birds via non-DK BIPs) and Poland imported 464 psittaciformes through Belgium).

The total volume that was imported through the different BIPs is presented in Figure 8.2 and Table 8.2.

Figure 8.2. and Table 8.2. Total number of birds and number of consignments that have arrived in the different BIPs in the EU in 2005



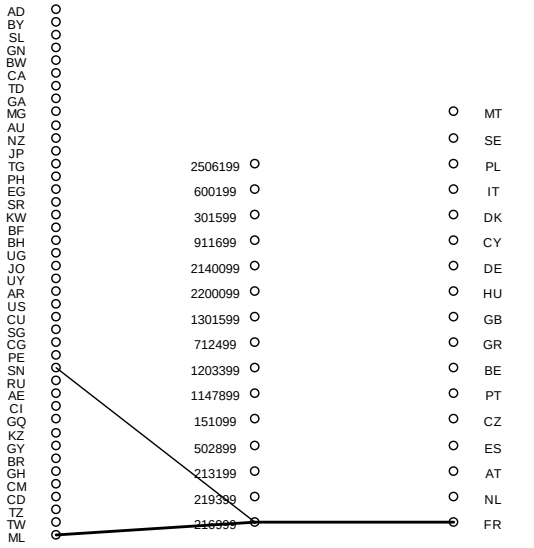
	BIP	Total[2]	% N own[3]	% volume[4]	% total[5]	N imports
BE	0502899	229.829	19%	10%	42%	124
FR[1]		144.622	30%	56%	26%	47
GB[1]		70.328	62%	86%	13%	86
PT	1203399	38.997	87%	97%	7%	55
ES	1147899	22.379	78%	86%	4%	23
DE	0151099	22.283	43%	34%	4%	40
IT	0301599	12.916	71%	93%	2%	7
CZ	2200099	7.363	100%	100%	1%	20
DK	0911699	2.700	100%	100%	0%	1
LU	0600199	775	0%	0%	0%	7
CY	2140099	577	100%	100%	0%	2
AT	1301599	55	33%	4%	0%	3
PL	2506199	18	100%	100%	0%	3
Total		552.842				418

[1] Data from 3 BIPs in each country. [2] Total number of birds imported via this BIP. [3] Percentage of consignments that stay in the country of this BIP. [4] Percentage of bird volume that stay in the country of this BIP. [5] Percentage of the total import via the BIPs into the EU.

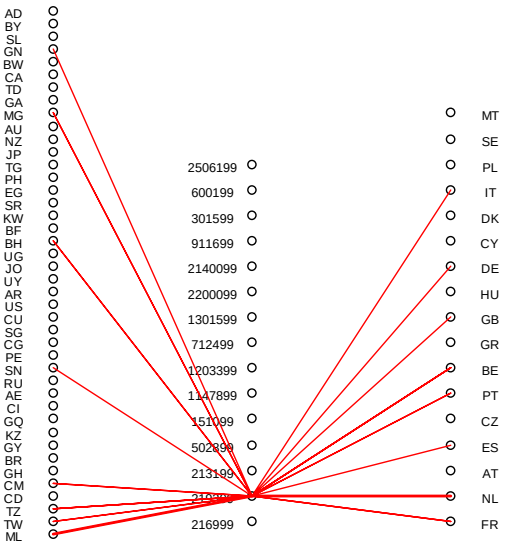
It is not known how accurate are the data on country of origin, particularly as some birds may have come via another third country with or without a holding period in that country during which some mixing of birds could have occurred.

Figure 8.3: Avian traffic from countries of origin to countries of import via BIPs (CVEDA Quarantine Data, 2005)

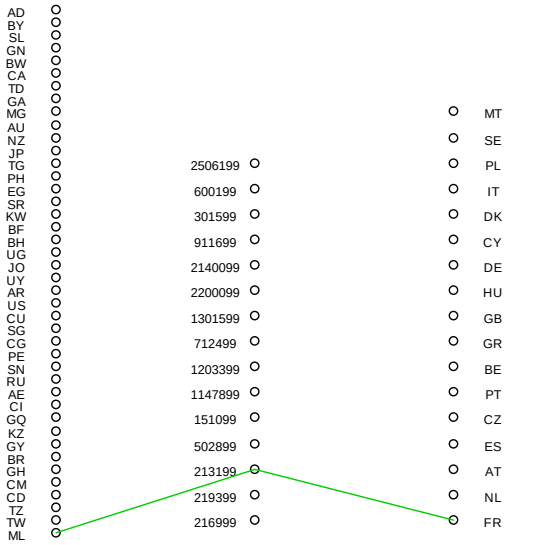
Legenda: Name BIP (Country code EU MS) total volume of imported birds (number of shipments)



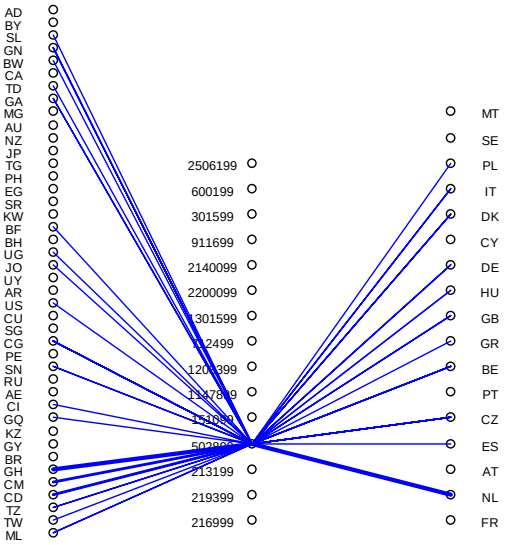
Lyon-Saint-Exupéry (FR) 68.536 (9)



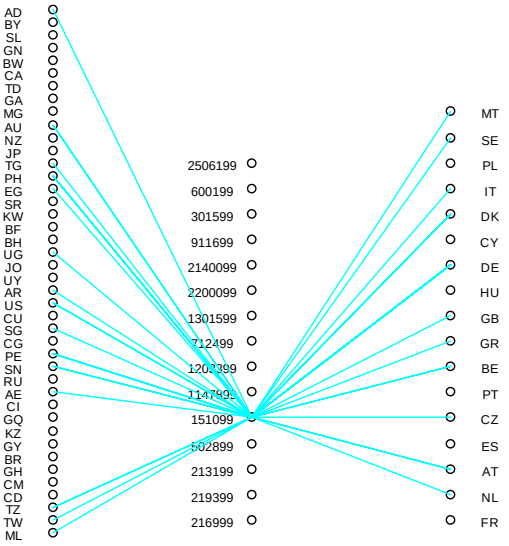
Roissy Charles-de-Gaulle (FR) 73.016 (37)



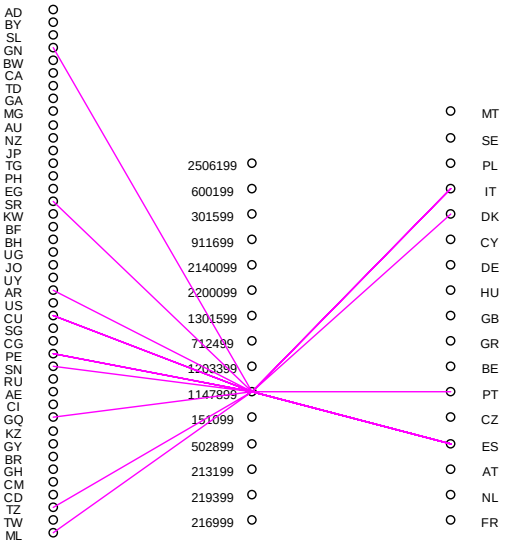
Toulouse-Blagnac (FR) 3.070 (1)



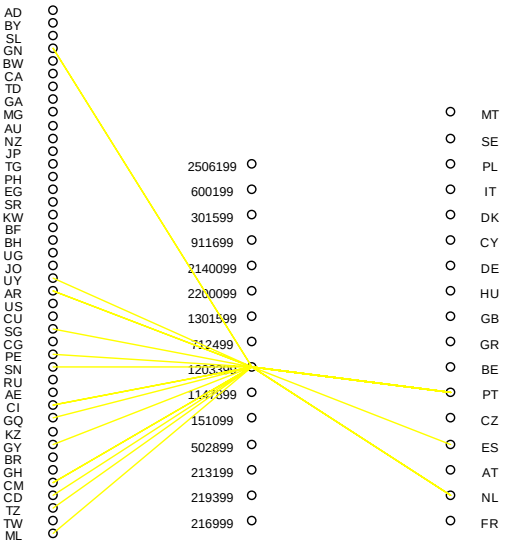
Brussel-Zaventem (BE) 229.829 (124



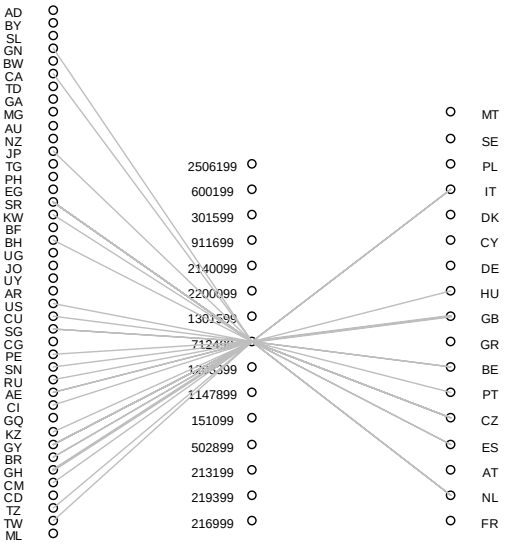
Frankfurt/Main (DE) 22.283 (40)



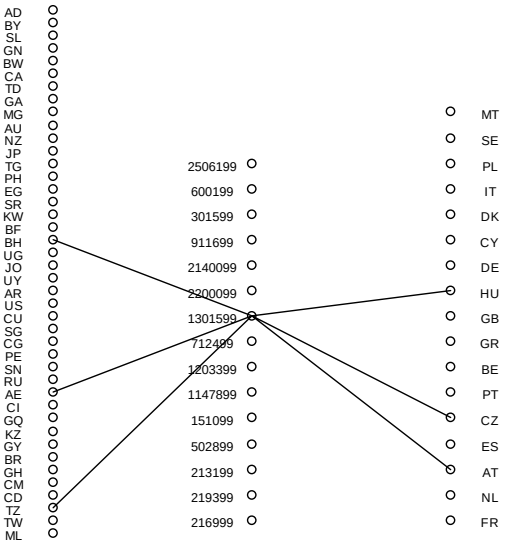
Madrid (ES) 22.379 (23)



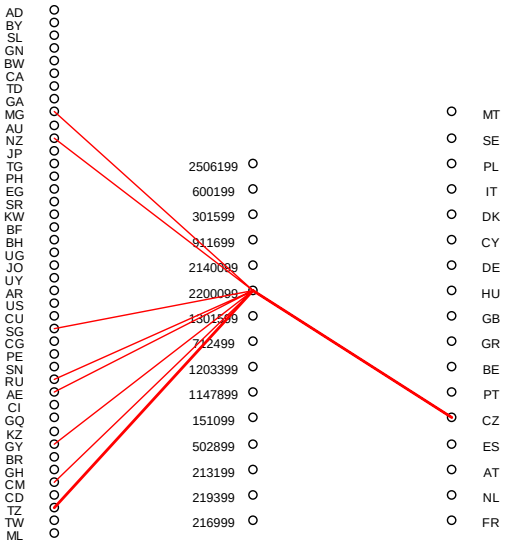
Lisboa (PT) 38.997 (55)



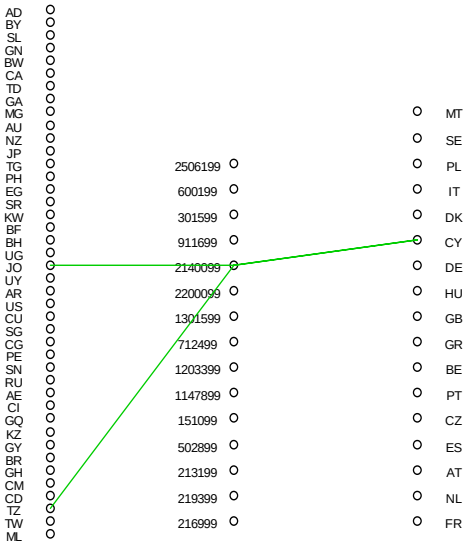
Heathrow (GB) 70.241 (85)



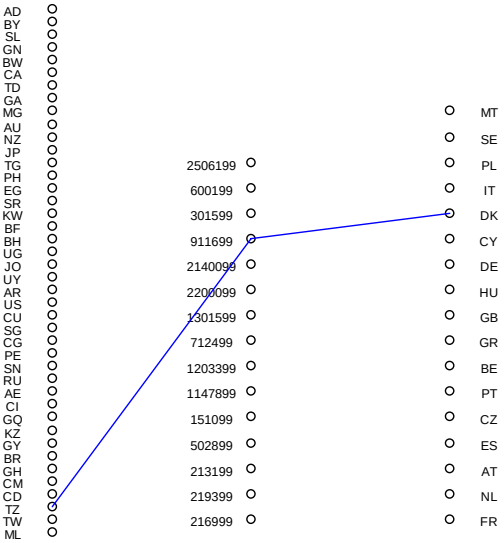
Wien-Schwechat (AT) 55 (3)



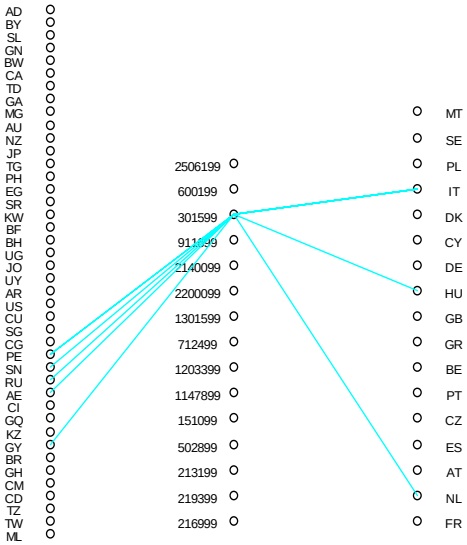
Praha-Ruzyně (CZ) 7.363 (20)



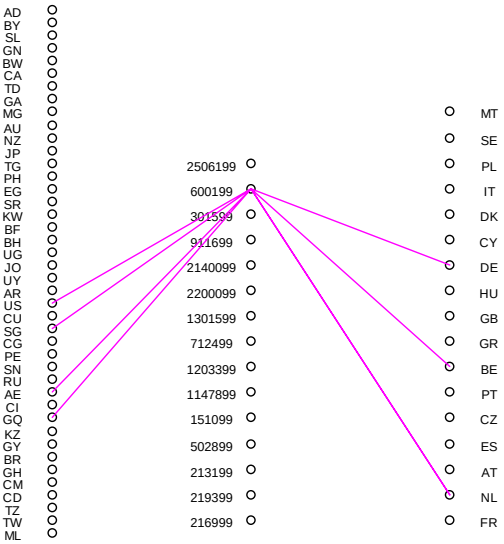
Larnaka (CY) 577 (2)



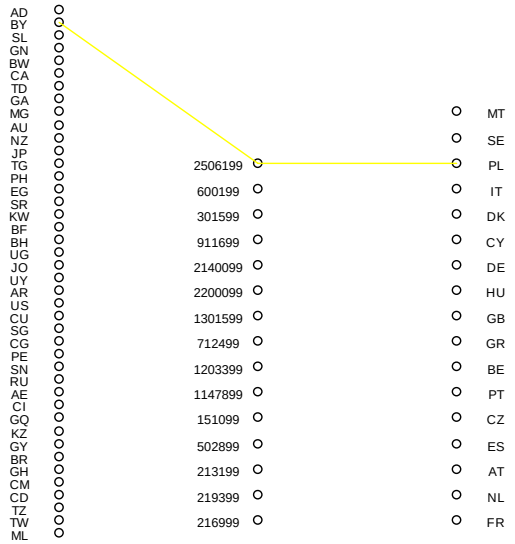
København (DK) 2.700 (1)



Milano — Malpensa (IT) 12.916 (7)



Luxembourg (LU) 775 (7)



Kukuryki-Koroszczyn (PL) 18 (3)

8.7. Transport from BIP to quarantine

Only a few BIPs in the EU receive captive wild birds.

The common practice is that all imports of birds arrive in the EU as air cargo and are transferred to the BIP, where the first inspection of the consignments takes place. Consignments for different importers (and sometimes different countries) arrive, often with the same plane, and are distributed to the different importers. The importers often come with private transport means (lorries, vans, and cars), for which there are no technical or hygienic requirements. Following inspection, an official at the BIP seals the crates/cages or vehicles to avoid possible substitution of birds during transport to the quarantine facility. The consignments are transported directly from these BIPs to a quarantine station, usually by road, without any prevention of material (infectious agents, air, dust) escaping from or contaminating the vehicle. Upon arrival at the quarantine station the MS veterinary and trade inspecting authorities will come within 24 hours to inspect the birds in quarantine and are responsible for ensuring that the seals on the crates or cages are intact and have not been tampered with.

These quarantine stations are not necessarily located in the same MS as the importing BIP (Fig 8.4). For example, the BIPs in Belgium, Germany and France acted as transit points, as not all birds received were retained in those countries and were for transport to many other EU MS. This traffic is further illustrated by the case of The Netherlands (the largest importing MS in 2005), which has no operating BIP in the country itself. Some consignments (approx 25% in 2005) were transported over long distances, sometimes for more than 24 hours, through several MS, to reach the quarantine station in The Netherlands (Table 8.3 and figure 8.4). From these data it can be seen that inside the EU birds are transported for instance from Milan and Lisbon to The Netherlands.

Figure 8.4 The originating BIPs in the EU that transit birds to quarantine stations in the Netherlands

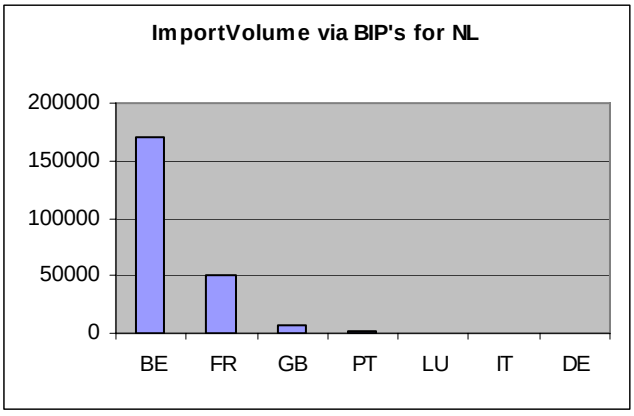


Table 8.3 The originating BIPs in the EU that transit birds to quarantine stations in the Netherlands

BIP	Volume	%	Country	Shipments	%
0502899	169788	74%	BE	61	60%
0219399	50122	22%	FR	16	16%
0712499	6520	3%	GB	12	12%
1203399	1190	1%	PT	5	5%
0600199	762	0%	LU	4	4%
0301599	724	0%	IT	1	1%
0151099	364	0%	DE	2	2%
	229470	100%		101	100%

8.8. Quarantine

The EU has created legislation [Decision 2000/666/EC] that requires all birds other than poultry to be placed in quarantine after their entry on to the territory of the EU, in accordance with Directive 92/65/EC. Imported birds are generally held in quarantine before release partly to prevent the introduction of avian diseases and partly to ensure against zoonoses such as psittacosis. Quarantine therefore represents another critical point in the chain of events for importation of birds into the EU.

Decision 2000/666/EC lays down the minimum conditions for the construction, equipment and management of quarantine facilities and centres.
Briefly, these requirements are that

- The facility or centre must
    - ♦ Be under the control of the official veterinarian appointed by the Competent Authority, who conducts an inspection at the beginning and end of quarantine for each consignment, including clinical inspection of the birds and examination of mortality records
    - ♦ Be a separate secure building that is separated from poultry and other bird holdings by a reasonable distance [unspecified other than to account for airborne transmission of AI and ND] and have a separate air space for each unit within the centre
    - ♦ Be bird, fly and vermin-proof and sealable to permit fumigation, including secure container storage of litter
    - ♦ Store all litter and waste in the secure container and treat this before disposal to avoid spread of infectious agents
    - ♦ Operate an 'all in, all out' policy
    - ♦ Have appropriate protocols to prevent introduction of infections or cross contamination between incoming and outgoing consignments
    - ♦ Clean and disinfect all transport crates/cages in the quarantine facility, unless destroyed to avoid spread of infectious agents
    - ♦ Examine carcases of all dead birds in an official laboratory and the necessary analyses and treatments performed under the control of the official veterinarian
- The person operating the facility must keep records, for at least one year, of each consignment, copies of all legal documentation, individual identification of psittaciformes, daily observations of illness and deaths, treatments
- Psittaciformes must be identified individually on arrival by a leg-ring or microchip with the ISO of the MS and a unique serial number
- All imported birds must be quarantined for at least 30 days in an approved facility
- Sentinel chickens [see below] may be used by placing them so that they are exposed to the excrement of the quarantined birds. A minimum of four sentinels is stipulated for each facility or unit within a centre.
- Where sentinel chickens are used, blood samples are examined serologically not less than 21 days after the consignment has entered quarantine and at least 3 days before the end of the quarantine period
- If sentinel chickens are not used, cloacal swabs or faeces from the imported birds must be examined during the first 7-15 days of quarantine using virological techniques [**NOT** serological techniques]. Samples must be taken from all birds if the consignment is <60 birds or 60 birds from larger consignmnets.

- If illness or deaths occur in quarantine, virological examinations are conducted on specified samples from clinically ill birds or sentinels, dead birds and dead sentinels
- All virological procedures are conducted in an official laboratory using diagnostic procedures according to Directive 92/66/EEC and 92/40/EEC

Other estimates for sample sizes to detect at least one infected bird in an epidemiological group if the prevalence is 1% or greater, with a 95% certainty and a 99% certainty, indicate a minimum of 70 birds for consignments up to 70 birds ie 100% of the imported birds. Larger numbers of birds are required for larger consignments (Table 8.4).

Table 8.4. Sample sizes for a 95% certainty and a 99% certainty to sample at least one infected bird in the epidemiological group if the prevalence is 1% or greater.

No. birds in the epidemiological group	95% Probability	99% Probability
10	10	10
20	20	20
30	30	30
40	40	40
50	50	50
60	60	60
70	70	70
80	79	80
90	87	90
100	96	100
120	111	118
140	124	135
160	136	151
180	146	166
200	155	180
250	175	210
300	189	235
350	201	256
400	211	273
450	218	288
500	225	300
600	235	321
700	243	336
800	249	349
900	254	359
1000	258	368

8.9. Sentinel Birds

Birds infected by viruses usually are detected directly by standard virological procedures as stipulated in the OIE Manual (OIE, 2004) or Decision 2000/666/EC. The excretion of viruses by naturally infected birds can be highly variable and virus may be excreted by some birds only, or intermittently or at such low levels that isolation is difficult or even impossible. However, direct and prolonged exposure of naïve birds [sentinels] to virus excreting birds may result in infection of sentinel birds. Therefore, the presence of a virus circulating in a population can be revealed by placing sentinels in contact with the test population and monitoring these sentinels for the development of clinical signs, excretion of virus or the development of specific immune responses e.g antibodies.

Sentinels have been used effectively in epidemiological studies to monitor virus infections of wild bird popoulations [Halvorson et al, 1982; Sinnecker et al.,1982; Reisen et al, 2000]. Seroconversions in sentinel birds was reported to be more sensitive than other methods [Reisen et al, 2000], more cost effective [Scott et al, 2001] and monitoring of sentinels correlated with observations in wild birds at the same location [Halvorson et al, 1982; Reisen et al, 2000]. Sentinels also have been used in commercial poultry operations to monitor the effectiveness of vaccination programmes [Homer et al, 1992], management of premises [McCluskey et a;, 2006] and detection of environmental contamination after removal of infected birds [Kinde et al, 2004].

Although sentinels have been used effectively as described above, their value in detecting infections in quarantine premises is less clear. This view is supported by studies to investigate the horizontal transmission of AIV, which have shown that even under conditions that were more conducive to transmission than a quarantine facility, AIV was frequently not transmitted to sentinel chickens in intimate contact with birds excreting AIV [Defra project SE0776]. Further studies have suggested that other species, such as turkeys [I.Brown, pers.comm.] or quail (Perez et al, 2003) may be more sensitive as sentinels for AIV. However, the welfare of sentinel birds may be compromised in some circumstances (McCluskey et al., 2006), such as when the quarantined birds and the sentinels are of different species. For example, mutual avoidance or aggression may occur if psittacine birds or birds of prey need to be monitored by sentinels (E. Kaleta, personal observation). Other wild bird species may react with fear, attempt to escape or display agonistic behaviour and aggression (Klopfleisch et al., 2006). Thoeretically, there is a possibility that sentinel birds may transmit infections to the imported birds, but there is no data on this point.

As recently as 2003, Schütz drew attention to the general lack of data available on birds that died in quarantine, due to the different recording systems and variations in duration of quarantine that made comparisons difficult. This experience stimulated the working group to initiate a questionnaire [see Annex] that was submitted to the Commission for subsequent distribution to MS, who have responsibility for the operation of each imported bird quarantine facility and centre in the EU**.** The purpose of this questionnaire is to provide current information and statistics on practices, illnesses and deaths associated with quarantine facilities and centres across the EU. No data or analysis is available at the time of completing the report but will be added later as supplementary information.
Despite the paucity of information, Schütz (2003) was able to use a sub-set of her material to show that bird deaths in quarantine [DIQ] accounted for at least 80% of the overall mortality [DOA + DIQ]. In fact, DIQ were nearly five times higher than DOA (9.5% v. 2.0%). Several studies, reported in Maas (2000), showed that there is a direct relationship between DOA levels and deaths in quarantine (DIQs) with DIQs being 6-9% higher than DOAs. Maas concluded that it is reasonable to assume that a significant part of this post import mortality occurs as a result of treatment during the previous stages of the trade. Vinke (1998) also noted

that even though exotic bird species survived the transport process, there could be health problems after sale.

Thus replacement of sentinel birds by repeated cloacal and / or pharyngeal sampling can overcome the disadvantages of virus detection by sentinels and their subsequent examination for viruses (Kinde et al., 2004 and 2005). Hietala et al. (2005) recommend air sampling as an efficient and cost-effective means of sampling flocks for circulating Newcastle disease virus.

Reforms in the USDA quarantine stations at airports reduced mortality rates of birds from 25 to 9.5% and many importers reported losses of less than 4% during transport and quarantine; for many parrot species losses were less than 2% (Meyers, 1998).

Birds may continue to die after release from quarantine due to the stress experience in the time from capture to final sale.

8.10. Post quarantine

There are very few accounts of outbreaks of disease associated with captive caged birds.

Alexander [2005] summarised information from a few reports on AIV or NDV in captive caged birds post-quarantine. He could find no evidence that AIV had spread from the captive caged birds to poultry, but cited two reports of suspected transmission of NDV from psittacine birds to domestic poultry in the 1970s.

The appearance of Salmonella typhimurium DT104 in UK domestic livestock, including domestic poultry is suspected to have originated from imported birds [Hollinger et al, 1998]

9. Animal health aspects – diseases to be considered

9.1. Introduction

The broad phrasing of the Terms of Reference in the mandate can include any infectious disease that can spread after being introduced into the EU, although “exotic” limits the possible infectious agents to those that are not yet present in the EU. The members of the working group (WG) decided to consider any infectious agent that could cause disease problems when introduced in any commercial bird operation (poultry or non-poultry facilities) or could be a hazard for people they were infected (zoonosis). In addition, the presence of disease in animals can itself have a welfare impact ranging from ‘severe’, when animals may die over several days (e.g. pneumonia), to mild when they quickly develop an immunity after infection. Other diseases may have long-term effects with moderate adverse effects.

Any free-living and subsequently captive bird can contract an infection either due to lateral spread from other infected shedding wild birds and from the contaminated environment or as an overspill from infected, mostly virus, shedding poultry. All these modes of spread may happen in the country of origin, during all stages of transport and in quarantine facilities.
Compared with poultry, little is known on the prevalence of infectious, transmissible diseases of wild captive birds in their natural environment. Case reports, anecdotal comments of diseases in poultry and brief notes in the ornithological and veterinary literature strongly suggest that free-living birds are susceptible to infection and to disease development by a variety of mainly viral diseases. The recent outbreaks and spread of avian influenza have highlighted these possibilities (Olsen et al., 2006). Many other viral infections, but also bacterial, fungal and parasitic infections are documented (Cafarchia et al., 2006, Hlinak et al., 2006, Waldenstrom et al., 2002). Vernacular names in a large number of languages and

imprecise descriptions of the detected viral agents complicate assessments of importance and associated potential risks on occasions.

Therefore the WG supplemented the OIE list of notifiable avian diseases as an existing checklist for possible infections by screening the available literature to compile a broader checklist for viruses, bacteria, fungi and parasites, including the newly (re)emerging diseases.

Based on the available information and the experience of the experts, a decision was made to focus on selected pathogens in this Report.

9.2. OIE list of notifiable avian diseases

Most of the OIE list of notifiable avian diseases refers to diseases relevant for poultry, in particular chickens and ducks. Most of the imported wild birds (other than poultry) will not be infected or carrier of these specific infectious agents (Table 9.1).

The most important infectious agents from this list relevant for consideration are the virus infections: Paramyxovirus 1 (Newcastle disease = ND), Avian influenza (AIV) and the bacterial infections: *Pasteurella multocida* (Fowl cholera), *Chlamydophila psittaci* (Avian chlamydiosis) and *Mycobacterium avium* (avian tuberculosis). This is because these infectious agents are able to cross over species barriers and can even be transmitted from birds to mammals (including man = zoonosis). In addition some newly emerging and presently only locally existing viral agents are important zoonoses and may require future attention. These include arboviridae (Western, Eastern and Venezuela encephalitis viruses), flaviviridae (West Nile and St Louis encephalitis viruses), alphaviridae (Sindbis viruses) and some members of the family herpesviridae (duck plague enteritis virus and Pacheco`s parrot diseases viruses).

Table 9.1 OIE list of notifiable avian diseases and the avian orders most susceptible to these infections or diseases.

Name of the disease		**Susceptible order**
Viral agents		
Marek's disease	Herpesvirus	Galliformes
Avian infectious laryngotracheitis	Herpesvirus	Galliformes
Duck plague enteritis virus	Herpesvirus	Anatiformes
Newcastle disease	Paramyxovirus I	Many avian orders
Avian influenza	Influenzavirus A	Many avian orders
Infectious bursal disease (Gumboro disease)	Avibirnavirus	Galliformes
Avian infectious bronchitis	Coronavirus	Galliformes
Duck virus hepatitis	Avihepadnavirus	Anatiformes
Bacterial agents		
Fowl typhoid and pullorum disease	*Salmonella gallinarum and S. pullorum*	Galliformes
Fowl cholera	*Pasteurella multocida*	Many avian orders
Avian chlamydiosis	*Chlamydophila psittaci*	Many avian and mammalian orders
Avian mycoplasmosis	*Mycoplasma gallisepticum*	Galliformes
Avian tuberculosis	*Mycobacterium avium*	Many avian and mammalian orders

It was agreed by all members of the working group (WG) to focus this Report (Scientific Opinion) on three major diseases that may acquire epidemic proportions. These are Newcastle disease (ND), avian influenza (AI) and avian chlamydiosis (AChl). The predominant criteria for focusing on these major three diseases were whether a given pathogen is exotic to EU countries, the ubiquity of such pathogen and its effect on animal health. A clear-cut separation of pathogens that occur in poultry and not in other avian species is desirable but on occasions difficult to achieve. Consequently, the following text concentrates on these three pathogens and the disease they cause and identifies only those that may occur in captive birds.

The rationale of the WG for this approach were that:
i] all AI and ND viruses, and *C. psittaci* occur in free-living birds permanently or intermittently in all continents
ii] AI and ND viruses and *C. psittaci* are shed by natural, mainly faecal routes for prolonged times and high quantities in all avian species
iii] These viruses and *C. psittaci* spread laterally in the natural habitats of birds and also during transport and in quarantine
iv] These agents cause losses following infection by natural routes in free-living, pet birds and poultry.
v] The biological and molecular characteristics of these organisms well known and allow detection by professional personal.
vi] The methods for isolation, characterisation and differentiation from other similar infectious agents available in all countries and these methods are validated, at least for some species.
vii] There are vaccines and methods for application available in all third countries and the legal basis does tolerate vaccination.
viii] Means of decontamination of facilities and equipment by chemical disinfectants (various compounds such as organic acids, aldehydes, quaternary ammonium compounds, phenol and its derivates) or physical methods such as ultraviolet radiation, moist (autoclave) or dry heat (burning or sterilisation) are at hand in all third countries
ix] Avian influenza and *C. psittaci* have a known potential to infect humans and mammals.

9.3. Viral diseases

Amended lists of viruses (families, subfamilies and genera) that can be present in imported birds can be found in the appendix 8, table 1-6.

General comments to these tables:

1.) Using a pragmatic approach, the tabulated viruses represent
- Viruses as taxonomic entities that cause infection and/or disease in known avian species.
- Viruses that are not yet assigned to a virus species but are listed under the virus families or subfamilies.
- Viruses that do not cause disease in imported birds but these imports serve as vectors to other bird species that are present in the 25 MS and are susceptible to these viruses.

2.) The taxonomy used in the tables is based on the *Virus Taxonomy* (Fauquet et al., 2005)
3.) The column “presence of these viruses in the EU (25)” is based on publications and diagnostic work of Kaleta (personal communication).
4.) The columns “zoonotic potential” and “risk for poultry” contain estimates derived from references in the Tables in appendix .

9.3.1. General comments

Among the 1.500 virus species that affect invertebrates and vertebrates only a small fraction of viruses affect birds (Fauquet et al., 2005). Table 9.2 shows the virus species affecting birds assigned to a genus (n=92) plus the number of viruses tentatively assigned either to a virus genus, to a virus subfamily or to a virus family (n=11). The percentage of avian virus species within all listed 1.500 virus species is equivalent to 6.9 %.

Most of these avian viruses are known in domestic poultry (for definition of "poultry" see EU directive 2005/94: chickens ([egg and meat types], turkeys, quails, Pekin and Muskovy ducks, geese, Guinea fowl, pheasants, partridges, ostriches). Free-living and subsequently captive birds may contract a viral infection either due to lateral spread from other infected virus shedding wild birds and from the contaminated environment or as an overspill from infected virus shedding poultry. All these modes of spread may happen in the country of origin, during all stations of transport and in quarantine facilities.

Table 9.2. Virus species affecting birds among the 1500 virus species listed in Fauquet et al. (2005)

Virus family and subfamily	**Virus genus**	**Virus species**	**Tentative virus species**	**Total number of species**
Poxviridae	Avipoxvirus	Canary-, Fowl-, Junco-, Mynah-, Pigeon-, Psittacine-, Quail-, Sparrow-, Starling-, Turkeypox virus	Crow-, peacock-, penguinpox virus	*10 + 3
Herpesviridae Alphaherpes-virinae	Mardivirus Iltovirus	Gallid herpesvirus 2, Gallid herpesvirus 3, Meleagrid herpesvirus 1. Gallid herpesvirus 1	Unassigned viruses in family: 10 candidates None	3 1
Adenoviridae	Aviadenovirus	Fowl adenovirus A, B, C. D, E. Goose adenovirus	Duck, pigeon, tur-key adeno v.	5 + 3
Polyomaviridae	Polyomavirus	Budgerigar fledgling disease v.	BFDV	1
	Etapipillomavirus Thetapapilloma v.	Fringilla coeleps papilloma v. Psittacus erithacus timneh papilloma virus	None None	1 1
Microviridae	Chlamydiamicrov	Chlamydia phage 1, 2, 3, 4	None	4
Circoviridae	Circovirus Gyrovirus	Psitt. Beak and feather disease virus, Canary, goose, pigeon v. Chicken anemia v.	Duck, finch, gull circo v. None	3 + 3 1
Parvoviridae Parvovirinae	Parvovirus Dependovirus	Chicken parvovirus Avian adenoassociated virus Duck, goose parvovirus	None None	1 1 2
Hepadnaviridae	Avihepadnavirus	Duck hepatitis B virus Heron hepatitis B virus Stork hepatitis B virus	 None	1 1 1
Retroviridae Orthoretrovirinae	 Alpharetrovirus Gammaretrovirus	 Avian leukosis virus, Rous sarcoma virus plus 7 other vs. Chick syncytium v., RE-v., Trager duck spleen necrosis v.	 None None	 9 3

Reoviridae	Orthoreovirus Rotavirus	Avian orthoreoviruses (eight strains or types) Rotavirus D (chicken)	None RotaV F, G	1 1 + 2
Birnaviridae	Avibirnavirus	Infectious bursal disease virus	None	1
Paramyxoviridae Paramyxovirinae Pneumovirinae	Avulavirus Metapneumovirus	Newcastle disease virus Avian paramyxoviruses 2-9 Avian metapneumovirus (TRT)	None none	9 1
Orthomyxoviridae	Influenza A	Influenza A virus (16 HA subtypes)	None	1
Picornaviridae	Enterovirus	Avian encephalomyelitis v.	All 12	12
Caliciviridae	Vesivirus Hepevirus	Fowl calicivirus Avian hepatitis E virus	1 1	1 1
Astroviridae	Avastrovirus	Chicken astrovirus 1 and 2 Duck astrovirus Turkey astrovirus 1 and 2	None	5
Coronaviridae	Coronavirus	Infectious bronchitis virus Pheasant coronavirus Turkey coronavirus	None	3
Flaviviridae	Flavivirus	West Nile virus, Israel turkey meningoencephalomyelitis v.	None	2
Togaviridae	Alphavirus Rubivirus	Sindbis virus Eastern equine encephalitis v. Western equine encephalitis v. Venezuelan equine enceph. v. Rubella virus	None none	4 1
* Total number of virus species that <u>are assigned</u> to a genus + number of viruses that <u>are tentatively assigned</u> either to a genus, to a subfamily or family, e.g. 92 + 11				

As compared with poultry, little is known on the prevalence of infectious, transmissible diseases of wild captive birds in their natural environment. Case reports, anecdotal comments on diseases in poultry and brief notes in the ornithological and veterinary literature strongly suggest that free-living birds are susceptible to infection and to disease development by a variety of viruses. Recently, the role of H5N1 AIV in migratory birds and indigenous EU species was described in detail (EFSA, 2006). Vernacular names in a large number of languages and imprecise descriptions of the detected viral agents make the assessment of importance and associated potential risks on occasions difficult.

9.3.2. Avian influenza

9.3.2.1. Current epidemiology in the EU

Whilst AI occurs in the EU there are concerns about possible outbreaks resulting from the introduction of captive birds. The huge number of strains isolated is differentiated into two groups on the basis of their degree of virulence for chickens in high and low virulent strains. A further differentiation is practised using the surface antigens haemagglutinin (HA) and neuraminidase (NA) and their combinations (Kawaoka et al., 2005). Currently, 16 HA s and 9 NA s are known. Not all mathematically possible 16 x 9 = 144 combinations are detected in

birds (Appendix Table A8.7). A detailed retrieval of the literature on AI isolations yielded only 103 of the possible 144 combinations (Kaleta et al., 2005). Not all theoretically possible HA x NA combinations occur at similar numerical frequencies, in all bird species and in all geographic locations (Appendix Table A8.8). The most frequently isolated AI viruses belong to the HA subtypes H3, H4 and H6. The HA subtypes H5 and H7 that contain the highly virulent "fowl plague" viruses are less frequently detected in free-living and domestic birds (Appendix Table A8.7). Also, the NA subtypes differ in frequencies among major orders of birds (Appendix Table A 8.9).

9.3.2.2. Natural avian hosts.

Almost two-thirds of all described AI virus isolates were obtained from anatiform birds (Table A8.9). Within the family Anatidae only two of the seven subfamilies contain species that were positive for AI viruses. These are the subfamily Anserinae and Anatinae (Table A8.11). The abundant mallard (*Anas platyrhynchos*) provided most of the isolates. Second in frequency of isolates within the subfamily anatinae is the North American Blue-winged teal (*Anas discors*).

In decreasing frequencies, birds of the order Galliformes (Table A8.12) are second and third are birds of the orders Charadriiformes (Table A8.14), family Laridae (Table A8.13), that include shore birds and gulls. In contrast, birds of the orders Passeriformes, Columbiformes and Psittaciformes that compose most of the traded wild birds, yielded less often AI viruses (Table A8.9). It should be noted, however, that the majority of AIVs from captive caged birds have been obtained from Passeriformes and less commonly from Psitacciformes. and that most of these were of the H3 or H4 subtypes [Alexander, 2000].
A few reports mention birds of the orders Phoenicopteriformes (flamingos), Falconiformes (birds of prey) and Strigiformes (owls). Rather detailed lists of AIV-susceptible birds are published by Stallknecht et al. (1998) and Kaleta et al. (2005).

9.3.2.3. Horizontal spread.

The faecal-oral route is the most important way of lateral spread of all AI viruses. Egg transmission is of minor significance.
The incubation period and duration of virus excretion are very variable and influenced by the pathogenicity of the AIV and the species of bird. HPAIV has a very short incubation period [a few hours – 3 days] and clinical course [a few days] in Galliformes species leading to high mortality. Large amounts of virus are excreted during this period. At the other end of the spectrum, LPAIV and even HPAIV may not be detected in other orders and can have incubation periods up to 18 days and some birds, such as Anseriformes, may excrete virus for more than 30 days (EFSA, 2006).
Excreted viruses are relatively stable at neutral pH, low temperatures in a moist environment but sensitive to elevated temperatures (Swayne and Beck, 2004), dry surfaces and UV (sunshine) radiation (Stallknecht et al., 1990a, 1990b; Swayne and Halvorson, 2003). Commonly used chemical disinfectants such as chlorine, bleach, aldehydes, organic acids (formic acid and peracetic acid) and quaternary ammonium compounds inactivate the infectivity of AI viruses within short times (Yilmaz and Kaleta, 2004).

Successful horizontal spread is most likely by direct contact between donor and recipient birds. However, experimentally, it has been demonstrated in one study that HPAIV is not very contagious and was frequently not transmitted to naive susceptible chickens in intimate contact with birds excreting AIV [Defra project SE0776].

Indirect spread is also possible with contaminated equipment, egg trays, vehicles and living vectors such as arthropods, rodents etc. (Swayne and Halvorson, 2003). Bird to bird passages are likely in any location in which birds of different species and origin are accumulated such as sites for collection of birds destined for export and along routes of transport to quarantine facilities.

9.3.2.4. Effects on animal health

Only the HA subtypes H5 and H7 contain viruses that are highly virulent for galliform birds but not necessarily for birds of other taxonomic orders [Perkins and Swayne, 2003; EFSA, 2006]. In contrast to earlier experience, the H5N1 viruses currently circulating in Asia and Europe cause severe forms of disease and high rates of mortality not only in chickens but also in swans (*Cygnus olor* and *C. cygnus*) and ducks (*Anas platyrhynchos* and other species of the genera *Anas* spp. and *Aythya* spp.) severe forms of disease and high rates of mortality. Other species appear to be affected only occasionally (EFSA, 2006).

The number of publications on diseases in birds that are heavily traded, such as psittaciformes (Alexander et al., 1974 and 1977; Kawano et al., 1979) and passeriformes (Stünzner et al., 1980;Slemons et al., 1973; Kaleta and Hönicke, 2004), and herons (Alexander et al., 1980) is rather small. The degree of disease expression and lesions in the respiratory and digestive tracts is strongly influenced by concomitant bacterial infections (Rott, 1979; Rott, 1992) and concomitant parasitic infestations (Swayne and Halvorson, 2003).

9.3.2.5. Diagnosis and vaccination

Diagnosis of AIV infection currently requires isolation of the virus and further characterisation by pathogenicity tests in chickens, immunological assays and molecular tests to determine the subtype and virulence of the isolate [OIE, 2004]. Samples for analysis should be taken from the respiratory and intestinal tracts, and additional organs from dead birds. The advent of more rapid systems in recent years has been reviewed [OIE, 2004; SCAHAW, 2003]. Some of these have been used in birds, principally poultry, although their sensitivity and specificity is unknown in many bird species. Recently, the EU-funded AVIFLU project completed a ring trial and recommended that real time RT-PCR and conventional RT-PCR for the detection of AIV. It is intended to include these protocola in the new EU Diagnostic Manual.

Vaccines are not routinely administered to poultry or captive caged birds in the EU. Vaccination can offer control of AI but is not generally employed as it can interfere with control measures. A DIVA approach may be helpful in some circumstances as vaccinated and infected birds can be differentiated by serological tests. The EU-funded AVIFLU project demonstrated that two commercial vaccines against AIV H7 subtypes reduced morbidity and mortality. Vaccination also reduced the spread of virus within the flock, although some transmission still occurred. This project is complemented by another EU-funded project, Fluaid, which will trial candidate vaccines and develop technologies to differentiate vaccinated birds and those infected with wild-type AIV.

9.3.2.6. Zoonotic potential

In humans, almost all epidemics were caused by influenza A viruses of the haemagglutinin (HA) subtypes H1, H2 and H3 (Brugh and Slemons, 1994). These millions and millions of

horizontal infections of humans with these viruses are the dominant cause of epidemics. Definitely the transfer of influenza viruses from swine to humans (Swayne and Halvorson, 2003) has occured less frequently than from birds to humans (Brugh and Slemons, 1994). In contrast, the infection of humans (or mammals) with influenza A viruses of avian origin, that cause HPAI is an extremely rare event. None of the many publications that appeared after the first description of "fowl plague" by the Italian worker Edoardo Perroncito (1878), a disease which is now termed highly pathogenic avian influenza (HPAI) provide a description of infection by avian influenza A viruses (AIV) of chicken attendants or other people. The first notion of a bird-to-human transmission of a H5N1 virus was reported from Hong Kong by Peiris et al. (1999). These cases consisted of a few humans that could be causally related to the avian subtype H5N1. Affected were 18 people and six fatal cases were recorded (Yuen et al. 1998). Given the large number of people who had close and longterm contacts to AI virus infected ducks, chickens and other fowl, the number of 18 people must be considred as very low.
In the following years cases in humans were described in other countries (FAO/WHO/AIDE reports No. 30 to 34). In the Netherlands more than 80 of approximately 1.500 workers who were directly exposed to AIV H7N7 in infected premises aquired a transient unilateral conjunctivitis and occasionally a mild pneumonia due to the subtype H7N7. One veterinarian died following exposure in infected farms and H7N7 virus was detected in his tissues (Fouchier et al., 2004; Koopmans et al., 2004).

The molecular basis for the rare infection of humans by avian influenza A viruses was provided by Ito et al. (1998) and Matrosovich et al. (2004) who proved unequivocally that successful attachment of avian viruses is mediated by a specific receptor on the surface of the respiratory epithelium. Avian influenza viruses bind preferentially to a N-acetylneuraminic acid-α2,3-galactose linkage on sialoligosaccharide receptor and swine and human influenza viruses bind to N-acetylneuraminic acid-α2,6-galactose linkage receptor. Thus, an infection of humans by avian influenza virus remains a rare event. If it occurs, the infection can be mediated in two different ways. The first theoretical possibility consists of transfer of the entire AI virus genome, and secondly the transfer of individual viral gene segments (Swayne and Halvorson, 2003). Consequently, concerns exist that a new AIV might emerge by mutations and / or reassortments during serial bird-to-man passages producing receptors that enable rapid and effective transmission between humans.

As in humans, infection of mammalian vertebrates is seldom documented. A lethal infection (both naturally and experimentally) of domestic cats was first reported from Japan[Nakamura and Iwasa, 1942]. This report was largely overlooked because the publication was in Japanese. Following the outbreaks due to H5N1 viruses in various avian species further reports were published on morbidity and mortality in feline mammals) and infection in dogs (Keawcharoen et al, 2004; Kuiken et al., 2004; Thanawongnuwech et al, 2005; Songserm et al, 2006).

It should be noted that human influenza A viruses occasionally can infect birds. Kovalschuk-Ivayuk et al. (1972) isolated from a turtle dove (*Streptopelia turtur*) two viruses of the subtype H2Nx and Romvary and Tanyi (1975) isolated from a healthy appearing collared dove (*Streptopelia decaocto*) a H3N2 virus. Halvorson et al. (1982) isolated a H1N1 virus from a single domestic pigeon. These reports provide at least circumstancial evidence for the possibility of both, human-to-pigeon and pigeon-to-human transmission.

9.3.3. Newcastle Disease (ND)

9.3.3.1. Current epidemiology in the EU

Whilst ND occurs in the EU there are concerns about possible outbreaks resulting from the introduction of captive birds. NDVs of variable virulence are frequently and almost continually isolated from various birds in many EU member states. Predominantly avirulent strains are probably circulating in wild bird populations virtually all EU member states (especially in waterfowl, gulls and shore birds) and less so in pet and commercial birds. However, new genotypes and emerging new pathotypes are likely to be introduced into EU member states by trade with third countries in which ND viruses of variable virulence are endemic (Kaleta, E. F. and Baldauf, C., 1988; Alexander, D. J., 2003; Telbis, C. et al., 1989; Lomniczi, B. et al.,1998; Herczeg et al.,1999)

All Newcastle disease viruses (NDV) are members of the genus paramyxovirus type 1 (PMV-1) of the family paramyxoviridae. In addition to avian PMV-1 free-living captured birds suffering from respiratory distress may contain PMVs of type 2, especially passerine birds and PMV-3, mainly in psittacine birds (Alexander, 2003). PMVs of types 4 to 9 are rather rare and have minor relevance as causes of disease.

Newcastle disease viruses can be differentiated into many genetic lineages using monoclonal antibodies (Russel and Alexander, 1983; Alexander et al., 1999; Collins et al., 1998) and molecular techniques (Seal and Bennett, 1995; Lomniczi et al., 1998; Herczeg et al., 1999; Barbezange and Jestin, 2002; Park et al., 2002; Wehmann et al., 2003). These studies provide powerful tools to trace the emergence and the origin of viruses and contribute significantly to the understanding of the epidemiology of ND viruses.

9.3.3.2. Natural avian hosts.

Avian paramyxoviruses type 1 has a very wide host range. By conventional virus isolation in chicken embryos or cell cultures of avian origin, a large number of ND viruses were detected in an abundance of different bird species (Kaleta and Baldauf, 1988). These avian hosts comprise 241 avian species from 27 of 50 orders of birds and it is likely that this number of affected avian species will probably increase in the future as surveillance continues. The most relevant species for trade in captive birds are included in the detailed list of NDV affected birds such as

- Psittaciformes (Lüthgen & Wachendörfer, 1970; Pohl, 1971; Wachendörfer & Lüthgen, 1971; Grausgruber, 1972; Walker et al., 1973; Ehrsam et al., 1975; Eaves & Grimes, 1978)
- Passeriformes (McFerran et al., 1974; Kida et al., 1982; Tumova et al., 1984)
- Gulls, shore birds (Ottis & Bachmann, 1983; Telbis et al., 1989; Weingartl et al., 2003)
- Birds of prey (Keymer, 1958; Heidenreich, 1995)
- Galliformes (Brandly et al., 1946; Weidenmüller & Osthof, 1953; Spradbrow, 1992)
- Anatiformes (Page, 1958; Rosenberger et al., 1975; Kessler et al., 1979; Shortridge et al., 1980; Abenes et al., 1982; Yamane et al., 1982; Deibel et al., 1985; Telbis et al., 1989)
- Other birds (White stork – Kaleta et al., 1981; Penguins – Alexander et al., 1989; Tawny owl – Telbis et al., 1989).
- Noteworthy is also the transmission of NDV by mice (Johnson et al., 1974).

9.3.3.3. Horizontal spread

Virus can be shed from most epithelial surfaces but the faecal-oral route is the most important means of transmission. Inhalation and ingestion are the predominant ways of infection. Evidence for this mode of spread was accumulated over many decades in many parts of the world (Lancaster, 1963, 1966, 1975; Burridge et al., 1975; Alexander, 2003). Consequently, repeated multiple introductions of NDV strains with imports of captive birds are very likely. The citations in the reference list demonstrate that ND viruses have been repeatedly introduced into European and other countries with imports of various species of captive birds. An outbreak of ND in chickens and free-living house sparrows in Germany was associated with imports of live farm-raised pheasants from Hungary (Wagener, 1941). At least circumstantial evidence suggests that the outbreak of a highly pathogenic form of ND in Southern California in 1972 was due to imported psittacine birds from South America (Walker et al., 1973). Heavy losses in African psittacine birds in a quarantine station were initially explained on the basis of prolonged transport and transit times and subsequently clarified by isolation of virulent ND virus from brain and internal organ tissues (Jäger, dissertation in preparation).

9.3.3.4. Effect on animal health.

The incubation period and duration of virus excretion are very variable and influenced by the pathogenicity of the NDV and the species of bird. NDV viruses may cause only silent infections or highly pathogenic epidemic forms of disease with high mortality. Identical viruses induce a wide spectrum of different signs in different avian species, a wide spectrum of different signs and losses ranging from no signs to high morbidity and mortality. Importantly, NDV can establish carrier state in several species of wild birds, and excretion for many months has been documented in Psitacciformes (Erickson et al., 1977; Kaleta and Baldauf, 1988). Detailed and up-to date reviews on clinical signs, epidemiology, gross and histopathological lesions, viral properties, methods for diagnosis and differential diagnosis, possible means for prophylaxis and prevention of Newcastle disease in birds and man, are widely available in various text books that are published in the national languages of the EU Member States and in scientific journals. For a comprehensive review see Alexander (2003).

9.3.3.5. Diagnosis and vaccination

The preferred method of diagnosis NDV infection currently follows the same general approach as that used for AIV. It requires isolation of the virus and further characterisation by means of pathogenicity tests in chicks or chickens, immunological assays and molecular tests to determine the subtype and virulence of the isolate [OIE, 2004] Diagnosis is not straightforward due to the variable virulence of the virus and intercurrent infections.
The introduction of more rapid discriminatory molecular and antigenic techniques to overcome some of the current problems has been reviewed [SCAHAW, 2003]. A real time RT-PCR to detect NDV made a major contribution to the control and eradication of this virus from California during an outbreak in 2002-2003 (Crossley et al., 2005; Hietala et al., 2005).

Effective vaccines are available and used in several countries but this interferes with subsequent serological diagnosis.

9.3.3.6. Zoonotic potential

Since the first description of the disease in the city of Newcastle on Tyne (Doyle, 1927 and 1935) numerous reports have been published on accidental transmission to man of both live

vaccine and highly virulent ND viruses. The progression of the disease in humans is not influenced by the virulence of the infecting virus strain. Thus, strains that are highly virulent for chickens induce signs in man quite similar to avirulent vaccine strains. Infected persons were: laboratory personnel who handled virus suspensions, farmers and veterinarians who were about to apply live ND vaccine to poultry and captured wild birds and persons who were handling infected birds in quarantine stations with captured birds. Irrespective of the virulence of the infecting ND virus, signs in man consist of mainly unilateral painful conjunctivitis, headache and occasional low levels of fever and depression that last for one to two weeks. Late sequellae were never reported. ND virus can be isolated from the affected conjunctiva but not from the unchanged conjunctiva of the same person (Schemera et al., 1987). A serologic response, as measured in the haemagglutination inhibition, cannot be demonstrated in these patients. These results are indicative of a local infection that does not become systemic.

9.3.4. (Re)emerging viral diseases

It should be added here, that some newly emerging and presently only locally existing viral agents are important zoonoses and may require future attention. These include arboviridae (Western, Eastern, Venezuela encephalitis viruses) flaviviridae (West Nile and St Louis encephalitis viruses), alphaviridae (Sindbis viruses) and some members of the family herpesviridae (duck plague enteritis virus, Pacheco`s parrot diseases viruses). For references see Hubálek (2004) and Fauquet et al. (2005).

9.3.4.1. West Nile Virus (WNV)

WNV infects many different free-living birds, especially large passerines such as several species of crows, jays, but also birds of prey and doves (Work et al., 1955; Malkinson et al., 1998; Steele et al., 2000; Guy and Malkinson, 2003; Fitzgerald et al., 2003; Wuenschmann et al., 2004) geese (Komar et al., 2003) waders (Malkinson et al.,1999), flamingos (Nusbaum et al., 2003) and domestic chickens (Senne et al., 2000). Once infected, these birds serve as (i) local carriers and shedders (ii) long-distance virus transmitters especially migrating species and (iii) source for infections of various species of mosquitoes as has been shown in the Israel and the USA (Guy and Malkinson, 2003).

There is general agreement for the fact that the major route of transmission of WNV is by the bite of mosquitos of the genus *Culex*. In the USA, most virus isolates were obtained from *Culex pipiens* and *Culex retrans*. Other *Culex* species act as vectors in Africa and Europe (*C. pipiens* and *Culex modestus*). It has been shown that vertical (trans-stage) transmission of WNV occures under natural conditions in some mosquitos of the genus *Culex* (Miller et al., 2000).

At least ten different species of ticks (genera *Amblyomma, Dermacentor, Hyalomma, Rhipicephalus, Argas, Ornithodorus*) were identified as virus carriers (Bernkopf et al., 1953; Guy and Malkinson, 2003).

Circumstantial evidence suggests that direct transmission from bird to bird of the same or different avian species by virus excretion with faeces is also possible (Anderson et al., 1999; Steele et al., 2000). Infected diseased birds excrete large amounts of WNV with faecal droppings (Guy and Malkinson, 2003).

The zoonotic potential of WNV has been known for a long time (Goldblum et al., 1954). Application of an experimental conventional killed vaccine did not induce a humoral antibody response in Chilean flamingos (*Phoenicopterus chilensis*) and Red-tailed hawks (*Buteo jamaicensis*) as determined by Nusbaum et al. (2003). At least in mice and horses a recombinant DNA vaccine protects from virus challenge (Davis et al., 2001). Also, an attenuated vaccine was tried that induced a serological response in vaccinees (Lustig et al., 2000).

The predominant clinical signs in WNV infected birds comprise central nervous system disorders (Bernkopf et al., 1953; Malkinson et al., 1998; Senne et al., 2000; Steele et al., 2000; Fitzgerald et al., 2003; Wuenschmann et al. 2004). Consequently, spontaneous WNV encephalopathies comprise a major differential diagnosis for prolonged cases of Newcastle disease and avian influenza. Disease manfestations in domestic and free-living birds and WNV detection is not notifiable in any of the EU member states.

9.3.4.2. Other potential (re)emerging diseases

Many viruses are either of minor relevance and / or occur only locally in captive birds. Some might be imported with live captured birds from some third countries:

Picornaviridae

Genus Picornavirus – avian encephalomyelitis (AE): endemic in EU MS and in some Asian countries. Hosts are Phasianiformes, e.g. chickens, grouse, pheasants

Astroviridae

Genus Astrovirus – duck astrohepatitis type 1, turkey astrovirus type 2, not detected in EU MS, present in North America

Reoviridae

Genus Reovirus – severe disease in Muscovy ducks, present in EU MS
African grey parrot, amazons, present in coutries of origin
less frequently in some passeriform birds, present in countries of origin
Genus Rotavirus – seen occasionally in gallinaceous birds (chicken, turkey, ring-necked pheasant, Guinea fowl and pigeons with enteritis, present in EU MS

Togaviridae

Genus Alphavirus – Eastern, Western, Venezuela Encephalitis viruses´, causing encephalitis in chicken, turkey, ring-necked pheasant, japanese quail, present in Americas

Flaviviridae

Genus Flavivirus – meningo-encephalitis in turkey, detected so far in Israel only
Usutu virus – not seen outside the African continent, but involved with outbreaks in indigenous wild birds in Austria and Switzerland

Coronaviridae

Genus Coronavirus – respiratory, urogenital and enteric forms in chickens, pigeon, turkey, ring-necked pheasant, recently also in an amazon, present in EU MS

Retroviridae

Genus Alpharetrovirus (leukosis and Rous sarcoma and osteopetrosis osteoporosis viruses) –
tumorous lesions in chickens, present in EU MS
Genus Gammaretrovirus – three species: chick syncytium virus (in USA only), reticuloendotheliosis virus in turkey, chicken, Pekin duck and Trager duck spleen necrosis virus, all present in EU MS and in USA

Parvoviridae

Genus Parvovirus in goose and Muscovy duck causing hepatitis and high losses, present in EU MS

Adenoviridae

Genus 1: Aviadenovirus: three groups in avian species: Group I: fowl adenovirus – serotypes1-12, duck adenovirus – 2 serotypes, turkey adenovirus 1 serotype, goose adenovirus – 3 serotypes, all group 1 viruses do not cause disease but on occasions hepatitis with aneamia, present in EU MS
Genus 2: Egg-drop syndrome virus – relevant for many avian species (birds of prey, pigeons, turkeys, chickens) due to egg-shell defects, poor hatches, present in EU MS
Genus 3: haemorrhagic enteritis of turkey, present in EU MS

9.4. Bacterial diseases

9.4.1. Introduction

Many bacteria species can be found in wild birds (Hubarek, 2004), but almost all of them are present in the EU (25). Some of these have zoonotic potential or have been isolated from poultry (Table A8.15, Annex). However, when these bacteria are pathogenic they may cause disease in quarantine, and appropriate measures (treatment with antibiotics and hygienic measures) will be taken. There are only few documented cases where bacterial infections have been introduced into a country by importation of exotic (wild) birds, other than poultry. The best-documented case is the outbreak of psittacosis in the 70s in the US. Psittacosis was first described as a human disease in Europe in 1879, but was rarely reported in the United States before a pandemic that occurred in 1929-1930. This U.S outbreak was traced to parrots imported for the 1929 Christmas trade and resulted in the first ban on the importation and interstate shipment of psittacine birds in the United States (Potter et al, 1983). For a more complete review on bacterial infections in non-poultry birds see Gerlach (1994).

The most commonly discussed bacterial zoonotic diseases directly associated with wild birds are chlamydiosis (an airborn infection), salmonellosis, campylobacteriosis (both mainly food-born infections from poultry meat) and mycobacterial infections (Dorrestein and hage, 1999). Salmonellosis is the second in line of zoonoses in many European and often related to birds. It is the most important zoonosis in developed countries, and it is perhaps the most widespread zoonosis in the world (Carpenter and Gentz, 1997). It is predominantly to be considered as a food borne disease. There are approximately 2000 different serotypes of salmonella, all of which have variable pathogenicity in birds and humans. In the Netherlands over 900 different serotypes are ever isolated from human and non-human material and every year almost 300 different types are found (in 1997 2557 isolates from humans). S. *Typhimurium* (30.7% in 1997) and *S. Enteritidis* (45.5% in 1997) are the most commonly encountered serotypes in humans. These serotypes are already since many years 70% of all isolates from humans in the Netherlands; these serotypes are distributes over 23 and 139 phage types, which are relatively species specific (Leeuwen and Pelt, 1998). The *S. Enteritidis* ft 1, 3, and 12 (91% of all *S.*

Enteritidis cases in humans) are strongly associated with poultry; *S Typimurium* ft 506, 510, 401, and 60 are associated with swine and bovine origins. In the period 1981 to 1998 209 salmonella isolates were cultured from Columbiformes in the department of Pathology (Utrecht University). Of these 94% were typed as *S. Typhimurium*, predominantly ft 2 (var Copenhagen) and 690. Only 6 isolates were considered "known human pathogens" and these were isolated from doves recently acquired in zoo collections from the wild. In pet parrots *S. Enteritidis* is more common, suggesting an association with infections in humans.

Salmonella infections have been documented in domestic, wild and zoo birds. Human cases of salmonellosis have involved phage types found in wild birds. Salmonella is transmitted to humans via food and fomites. Wild birds can be an important part of the "salmonella cycle" by contracting salmonellosis from contaminated "human" feed or faeces and than contaminating new environments. Herring gulls have been demonstrated to be carriers of a range of Salmonella serotypes similar to that causing infection in man, and they likely ingest these serotypes at untreated sewage outfall (Butterfield, et al., 1983).
In humans, gastroenteritis is the most common clinical syndrome caused by Salmonella. Those most seriously affected are infants, children, and the elderly. Antibiotics are generally contraindicated for human salmonellosis, except in cases of prolonged fever or septicaemia, because they may prolong the carrier period and cause antibiotic-insensitive strains to emerge.

Campylobacter jejuni has a worldwide distribution and is the most commonly reported bacterial cause of foodborne infection in in humans (Altekruse, et al., 1999). Complications are rare, although septicaemia in humans have occurred. Chronic sequelae associated with *C. jejuni* infection are Guillian-Barre syndrome and reactive arthritis. Healthy birds of many species, particularly poultry, have a high rate of intestinal infection with *C. jejuni.* The high carrier rate in many different avian species is often considered to represent a health hazard for people (Carpenter and Gentz, 1997). Out of the wide range of suitable animal hosts for *C. jejuni*, the greatest similarities to human clinical isolates are poultry strains, followed by strains of wild birds. Free-living birds may act as significant reservoirs for the maintenance and dissemination of *C. jejuni* in nature. However, there must be a certain species specificity like we know in *Salmonella* sp. because the high infection rate in finches in captivity (>40%) was not reflected in a higher incidence of campylobacteriosis in the breeders (Dorrestein et al., 1984). Mishandling of raw poultry and consumption of undercooked poultry are the major risk factors for human campylobacteriosis (Altekruse, et al., 1999).

The *Mycobacterium avium* complex (MAIC) consists of *M. avium, M. intracellulare,* and *M. scrofulaceum.* Recently *M. genavense* has been added to the potential zoonotic mycobacteria commonly found in birds and other animals (Kiehn et al., 1996). Human *M. avium* infections have considerably gained in importance in the last two decades, mainly in HIV-infected patients. Although *M. avium* complex has over 20 distinct serotypes, only serovars 1, 2, and 3 commonly cause disease in birds. The serovars isolated most commonly from human beings are 1, 4, and 8. Additionally, serovars 4 and 8, which are mostly isolated from tuberculous swine, are commonly isolated from humans affected with AIDS. Avian tuberculosis occurs most frequently in north temperate-zone birds, but its prevalence is low. It has been reported in a wide array of birds of all kinds. The natural hosts of avian tuberculosis, both poultry and wild birds, are able to act as reservoirs for human infection.
Recently, strains of the serovars 1, 2 and 3 (bird-type strains) could be defined as a taxon on its own right among MAIC by using molecular-biological methods for MAIC typing (RFLP--restriction fragment length polymorphism and PFGE-pulsed field gel electrophoresis). In exceptional cases only, strains of this character have been isolated from humans. Consequently, bird-to-man transmission of *M. avium* appears to be a very improbable event.

In contrast, extensive conformity has been found to exist between *M. avium* isolates of human origin and isolates from pigs. In summary, it can be stated that *M. avium* infection of birds is hardly of any importance for poultry production as well as for human disease (Martin and Schimmel, 2000).

9.4.2. Avian Chlamydiosis

9.4.2.1. Current epidemiology in the EU

A detailed description of avian chlamydiosis and means for control was reviewed recently (SCAHAW, 2002). It is evident from this document and from additional published work that chlamydia are widespread in EU MS in domestic livestock including poultry.

The causative organism of chlamydiosis is predominantly *Chlamydophila psittaci*. In rather rare instances infections by *Chlamydophila pneumoniae* are possible. Siemers (1999) detected by isolation, immunofluorescence using a monoclonal antibody and by multiplex PCR *Chlamydia pneumoniae* in faecal samples from a Senegal parrot (*Poicephalus senegalis*), African Grey parrot (*Psittacus erithacus*), Goffini cockatoo (*Cacatua goffini*), domestic fancy breed pigeon (*Columba livia* forma domestica) Mollucan cockatoo (*Cacatua moluccensis*), Blue-fronted amazon (*Amazona aestiva*), budgerigar (*Melopsittacus undulatus*) and a Pennants's Parrot (*Platycercus elegans*). All these birds originated from one pet bird holding facility. Strauss-Theis (2005) detected by immunofluorescence *Chlamydophila abortus* in swab samples from pharynx and cloaca of a Blue-fronted amazon (*Amazona aestiva*). The positive samples were also positive in a nested multiplex PCR. The amplification product was identified as *Chlamydophila abortus* by DNA-sequencing and BLAST search. More recently, Sting at al. (2006) described *Chlamydophila abortus* by the isolation, amplification and sequencing of the *omp*A region of chlamydia derived from swabs of apparently healthy domestic fattening turkeys.

Chlamydiosis is the most common and the most well-known direct zoonosis from birds (Dorrestein and Hage, 1999). Up to the year 2000 almost 30% of the publications in PubMed were related to chlamydiosis. *C. psittaci* is endemic worldwide, where it is distributed liberally among free-ranging birds. As a rule, the organism is well adapted to avian hosts and causes few, if any, clinical signs or pathologic lesions. Clinical disease is precipitated mainly by human-induced conditions and procedures. Chlamydiosis has been documented in at least 160 avian host species, nearly a quarter of which are psittacines. From the 114 species of free-living wild birds that are proven to carry chlamydia, 23% were Charadriiformes, 22% Passeriformes and 16% Anseriformes (Brand, 1989). A survey of imported and domestically bred Psittaciformes as well as free-ranging and captive raptors and owls from Germany indicate that between 30 and 70% of the birds tested are positive (Gerlach, 1994). *C. psittaci* strains from Psittaciformes, domesticated ducks (in Europe) and turkeys (in USA) appear to cause the most severe disease in humans. It appears that the host animal in which chlamydial passage occurs prior to the human infection influences the pathogenicity of the agent for humans. Parrots and other psittacine birds still are regarded as the major reservoir of the infectious agent and most recognized cases are associated with owing pet birds or working in a pet store. It was once thought that birds imported from abroad, often illegally, were a principal source, but many domestic breeder flocks of pet birds now have become infected (Gregory and Schaffner, 1997). Pigeon strains of chlamydia are considered less virulent for humans. Reports of psittacosis in man related to wild birds are rare.

9.4.2.2. Natural avian hosts for *Chlamydophila psittaci*

Kaleta and Taday (2003) reviewed the avian host range and demonstrated that all domestic avian species (chickens, turkeys, Pekin and Muscovy ducks, geese, pigeons, Guinea fowl, pea fowl Japanese and bobwhite quail) can be carriers of chlamydia. In addition, at least 460 other avian species of free-living and pet birds were positive for Chlamydia, including all species that are currently imported into the EU. It appears that chlamydia infected birds do not necessarily suffer from disease. Many sampled breeding tits were found to be infected but continued to breed successfully (Holzinger-Umlauf et al., 1999). Clements (2000) lists a total of 27 orders that comprise altogether 9.748 avian species. These include 3.967 non-passerine species and 5.781 passerine species. Among the existing species only rather few of them are targets for capture and subsequent export. The total number of birds within each species is unknown. Also unknown is the number of chlamydial isolations per species because these are not published. Therefore, the exact proportion of chlamydia-positive birds per species remains undetermined. It is, however, obvious that chlamydia were detected in birds of 19 of the 27 orders which illustrate the widespread prevalence of these bacteria in free-living and captured birds.

It should also be noted that some bird groups are more tested than others which biased the given percentages. Also, not all publications provide exact scientific species names; vernacular names are frequently misleading.

Table 9.3 lists the orders (plus some vernacular names), the number of species per order and the number and percentage of species that were found positive for *Chlamydophila* spp. by various laboratory methods.

Table 9.3. Detection of chlamydia as it relates to different orders of birds

Order / vernacular names[1)]	No. of species per order[1)]	No. of avian species pos. for Chlamydia[2)]	
		Number	Percentage
Struthioniformes: ostrich, rhea, cassowary, emy, kiwi	10	4	40
Tinamiformes: tinamous	47	-	-
Sphenisciformes: penguins	17	4	24
Gaviiformes: loons	5	-	-
Podicepiformes: grebes	19	2	11
Procellariiformes: albatrosse, shearwaters, petrels	110	5	5
Pelecaniformes: tropicbirds, pelecans, cormorants, frigatebirds	66	8	12
Ciconiiformes: herons, storks, shoebill, ibis	117	13	11
Phoenicopterygiformes: flamingos	5	-	-
Anseriformes: screamers, ducks, geese, swans	160	33	21
Falconiformes: vultures, osprey, hawks, secretary bird, falcons, caracaras	307	41	14
Galliformes: chickens, megapodes, guans, turkeys, grouse, quail, partridges, guineafowl	282	14	5
Opisthocomiformes: hoatzin	1	-	-
Gruiformes: mesites, buttonquail, cranes, rails, coots, sungrebe	204	2	1
Charadriiformes: jacanas, snipes, plover, oystercatcher, lapwings, skuas, jaegers	348	44	13
Pterocliformes: sandgrouse	16	-	-

Columbiformes: pigeons, doves	308	17	6
Psittaciformes: cockatoos parrots and allies	352	153	44
Cuculiformes: turacos, cuckoos	161	3	2
Strigiformes: barn owls, typical owls	204	12	6
Caprimulgiformes: oilbird, nightjars, potoos	118	-	-
Apodiformes: swifts, treeswifts, hummingbirds	437	3	1
Coliiformes: mousebirds	6	-	-
Trogoniformes: trogons	39	-	-
Coraciiformes: kingfishers, todies, motmots, bee-eaters, rollers	152	1	1
Upupiformes: hoopoes, woodhoopoes	10	2	20
Coraciiformes: hornbills	57	1	2
Piciformes: jacamars, puffbirds, barbets, woodpeckers	391	8	2
Passeriformes: many passerines	5.781	90	2
Totals	**9.748**	**460**	**4.7**

1) data from Clements (2000); 2) data from Kaleta and Taday (2003)

9.4.2.3. Horizontal spread.

C. psitacci produces a systemic infection in birds, the outcome of which depends on a number of variables, including strain of organism and host species, so that virtually all avian species can be any of (i) healthy latently infected non-shedders, (ii) healthy latently infected shedders via pharynx and cloaca, (iii) diseased shedders showing hepatitis, splenitis, respiratory signs, conjunctivitis and diarrhoea, (iv) dying of chlamydiosis or concomitant infections. Most frequent is the latent stage without clinical signs and in wild birds *C, psittaci* tends to produce persistent infections with periods of shedding [SCAHAW 2002]. Environmental and endogenous stress may activate latent infections.
The incubation period also can vary and may range from a few days to months or years.

The predominant way of transmission is horizontal spread of the organisms. Egg transmission is a rare event under natural conditions. Elementary bodies of chlamydia are highly resistant in a dry environment and survive for prolonged times in dust, dander, feathers etc. All of these materials from infected birds may serve as a source for spread. Horizontal transmission may occur at any step during capture, transport and in quarantine facilities.
Disinfection is difficult to perform in a dusty environment.

9.4.2.4. Effect on animal health

A more recent account of chlamydia in various captive birds that were to be sold in pet shops showed that most of the isolated or otherwise detected chlamydia were not associated with disease or losses in domestic pet birds, domestic poultry and free-living birds (Tonnies, 2006). It is notable that the proportion of infected Psitacciformes was much lower than the Passeriformes in this one study.

Disease manifestations are frequent in young birds, stressed adults and pairs during mating and feeding of their offspring.
Treatment of these birds with tetracyclines or guinolones may ameliorate general health but does not necessarily clear the birds from chlamydia. Recovered birds can still be latently infected and shedders. Since immunity is either absent or short-lived, recurrence is likely.

Table 9.4. Detection of *Chlamydophila psittaci* in pet birds (faeces and swabs from pharynx plus cloaca) following inoculation of BGM cell cultures and identification by immuno-fluoresce (Tönnies, 2006, pers. com.)

Species of birds or group	**Total No. tested**	**Faeces Positive**	**Pharynx + cloaca Positive**	**Total number of positive**	**% positive**
Budgerigar, *Melopsittacus undulatus*	497	73	22	95	19
Cockatiel, *Nymphicus hollandicus*	70	6	1	7	10
Conures	63	5	4	9	14
Lovebirds, *Agapornis* spp.	80	8	3	11	14
Amazons, *Amazona* spp.	10	0	0	0	0
Afric. Grey parrot, *Psittacus erithacus*	11	0	0	0	0
Cockatoos, *Cacatua* spp.	3	0	0	0	0
Macaws, *Ara* spp.	4	0	0	0	0
Exotic finches	274	74	8	82	30
Canaries, *Serinus canaria*	141	67	4	71	50
Weavers	7	2	0	2	29
Soft billed passerines	37	4	1	5	14
Diamond dove, *Stictopeleia cuneata*	10	4	0	0	0
Quail, *Colinus* spp.	26	0	1	1	4
Total	**1.233**	**243**	**44**		

It should be noted that none of the examined chlamydia-positive birds shown in Table 9.4 displayed any signs of disease or suffered from recorded losses. Permanent and close contact to healthy appearing shedders is likely which enhances the risk of transmission.

9.4.2.5. Zoonotic potential

Many different resident and migrating avian species are carriers and shedders of chlamydia (Kaleta and Taday, 2003). Thus, transmission of chlamydia to humans, especially professional personal, bird keepers, veterinarians and families is likely to happen.
All early reports provide circumstantial evidence that chlamydiosis in man can be traced to recently aquired psittacine birds, many psittacines from south-american countries (Andersen and Vanrompay, 2003). More recently, cases of human chlamydiosis were seen in workers in poultry or duck farms and in workers in abattoirs that process Pekin ducks or turkeys (Lederer and Muller, 1999; Bennedsen and Filskov, 2000). Some additional reports indicate that also street and domestic pigeons can be a source of human chlamydiosis (Davis, 1955; Suess, 1996).

9.4.2.6. Diagnostic tests.

Diagnosis of *C. psitacci* in birds can be problematic due to the frequency of subclinical persistent infections. Although isolation of the organism is well-established, in the veterinary field, diagnosis is currently based on detection of genes by multiplex PCRs. Serologic tests are regarded as obsolete and are only used occasionally for the detection of antibodies in pigeons. Further developments to improve diagnostic tests for *C. psitacci* were identified by SCAHAW [2003]
Only some diagnostic laboratories make use of ELISA systems for the detection of species-specific, early appearing IgM and the late appearing Ig G.

10. Risk Assessment

The health and welfare risk assessments presented in this chapter address the exposure pathways (figs 6.1 and 6.2) described in chapter 6. These describe the importation process in a schematic form from the point of capture through to the point of release in the EU, and highlight the important parameters and processes involved. No RA has been done for the non-target species, such as decoy birds and mammals used to trap target birds. However, when target birds are trapped, it is likely that the welfare of these non-target animals will be poor as they are restricted from moving freely by glues (lime) or tethers, and so are unable to fulfil their needs, particularly to escape.

10.1. Welfare risk assessment

The welfare risk assessment is based on a novel tabular approach developed in conjunction with representatives of the EFSA working group on "The risks of poor welfare in intensive calf farming systems". For release assessment a simple approach was adopted and states whether or not a given hazard is likely to occur at a given stage. For exposure assessment and consequence assessment, the following definitions and terminology were used:

Table 10.1 Risk Assessment terminology and abbreviations

Exposure assessment				**Consequence assessment**	
Frequency	**Code**	**Duration**	**Code**	**Consequence**	**Code**
Very rare	VR	Short	S	Slight Adverse Effect	SA
Rare	RA	Moderate	M	Adverse Effect	AE
Moderately frequent	MF	Long	L	Moderately Serious Effect	MS
Frequent	FR	Very long	VL	Serious Effect	SE
Very frequent	VF			Very Serious Effect	VS

In the subsequent tables, a separate table is used for each stage of the importation pathway, and within each table the likely occurrence of the hazard at a given stage X is assessed; if it does occur, the probability of the event is assessed at importation stage X in a hypothetical captive bird population, and for how long a random bird might be exposed to the hazard at stage X; the information is combined qualitatively to assess the severity of the consequences.

In the subsequent tables, the reader may observe that for a given hazard sometimes an equivalent exposure, duration and frequency are observed at two different stages of the captive bird importation pathway, but the resultant estimate of the consequences is different. This apparent discrepancy arises because the qualitative assessments at each stage are based on expert opinion that reflect a range of values, so it becomes plausible that two apparently equivalent sets of inputs can yield different outputs. Also, because this RA is a general

assessment of the captive bird pathway, that covers all species and methods of capture,etc, a range of values is given in places, particularly for duration and consequence.

Some of the various causes of poor welfare, in birds that may or may not die prior to arrival at point of sale to those who will keep them as pets, are as follows; fear during capture; pain during capture; pain etc. as a result of injury during attempted capture; starvation of young birds whose parents have been captured or killed; fear, frustration and extreme discomfort in birds trapped with glue; dehydration, starvation and extremes of temperature in trapped birds; fear, pain, dehydration, starvation and extremes of temperature during holding after capture and transport in the country of origin; inability to fulfil needs during housing in inadequate conditions if captive bred; fear, pain, dehydration, starvation and extremes of temperature during transport to the E.U., holding on arrival in the E.U., transport within the E.U. and holding prior to sale.

10.1.1. Welfare risk assessment tables

Stage of pathway (S = 0.5 hour; M = 12h; L = 24-48h; VL = > 48h).

Process of capture	Hazards	Hazard potentially present?	Exposure									Consequences				
			Frequency					Duration								
			VR	RA	MF	FR	VF	S	M	L	VL	SA	AE	MS	SE	VS
	(1) Inappropriate air condition	NA														
	(2) Inappropriate conditions for rest/sleep	Yes					X	X	X				X			
	(3) Inappropriate opportunity for movement	Yes				X	X	X	X				X	X	X	
	(4) Inappropriate handling	Yes					X	X					X	X	X	X
	(5) Inappropriate access to water	Yes					X	X	X			X				
	(6) Inappropriate access to nutrients	Yes					X	X	X			X				
	(7) Inappropriate opportunity to carry out normal feeding behaviour	Yes					X	X	X			X				
	(8) Lack of appropriate opportunity to explore or to locate hiding place or escape route	Yes					X	X	X					X	X	X
	(9) Inappropriate social contact (for example social isolation or unwanted proximity)	Yes					X	X	X			X				
	(11) Inappropriate opportunity to preen	Yes					X	X	X			X				
	(12) Inappropriate opportunity for thermoregulation	Yes					X	X	X				X			
	(13) Inappropriate presence of chemical agents (e.g.**)	NA														
	(14) Inappropriate (high) density (*crowding*) of birds	NA														
	(15) Inappropriate mixing of species	NA														
	(16) Inappropriate hygiene conditions	YES				X	X	X	X			X				

Stage of pathway (S = 0.5 hour; M = 12h; L = 24-48h; VL = > 48h).

Transport from capture to holding station	Hazards	Hazard potentially present?	Exposure									Consequences				
			Frequency					Duration								
			VR	RA	MF	FR	VF	S	M	L	VL	SA	AE	MS	SE	VS
	(1) Inappropriate air condition	YES		X					X	X		X				
	(2) Inappropriate conditions for rest/sleep	YES				X			X	X			X			
	(3) Inappropriate opportunity for movement	YES				X			X	X		X	X	X	X	X
	(4) Inappropriate handling	NA														
	(5) Inappropriate access to water	YES		X	X				X	X				X		
	(6) Inappropriate access to nutrients	YES		X					X	X			X			
	(7) Inappropriate opportunity to carry out normal feeding behaviour	YES					X		X	X		X				
	(8) Lack of appropriate opportunity to explore or to locate hiding place or escape route	YES					X		X	X			X			
	(9) Inappropriate social contact (for example social isolation or unwanted proximity)	YES					X		X	X		X	X			
	(11) Inappropriate opportunity to preen	YES					X		X	X		X				
	(12) Inappropriate opportunity for thermoregulation	YES		X	X				X	X			X	X		
	(13) Inappropriate presence of chemical agents (e.g.**)	NA														
	(14) Inappropriate (high) density (*crowding*) of birds	YES				X			X	X			X	X		
	(15) Inappropriate mixing of species	YES				X			X	X		X				
	(16) Inappropriate hygiene conditions	YES					X		X	X			X			

Stage of pathway (S = 0.5 hour; M = 12h; L = 24-48h; VL = > 48h).

At holding station in third country	Hazards	Hazard potentially present?	Exposure									Consequences				
			Frequency					Duration								
			VR	RA	MF	FR	VF	S	M	L	VL	SA	AE	MS	SE	VS
	(1) Inappropriate air condition	YES	X							X	X	X				
	(2) Inappropriate conditions for rest/sleep	YES	X							X	X	X	X			
	(3) Inappropriate opportunity for movement	YES	X							X	X	X				
	(4) Inappropriate handling	YES				X	X	X						X		
	(5) Inappropriate access to water	YES	X							X	X	X				
	(6) Inappropriate access to nutrients	YES			X					X	X		X			
	(7) Inappropriate opportunity to carry out normal feeding behaviour	YES			X					X	X	X	X			
	(8) Lack of appropriate opportunity to explore or to locate hiding place or escape route	YES				X				X	X		X	X	X	X
	(9) Inappropriate social contact (for example social isolation or unwanted proximity)	YES				X				X	X		X			
	(11) Inappropriate opportunity to preen	YES			X					X	X	X				
	(12) Inappropriate opportunity for thermoregulation	YES		X						X	X	X				
	(13) Inappropriate presence of chemical agents (e.g.**)	YES			X					X	X		X			
	(14) Inappropriate (high) density (*crowding*) of birds	YES				X				X	X			X		
	(15) Inappropriate mixing of species	YES		X						X	X	X	X			
	(16) Inappropriate hygiene conditions	YES				X				X	X			X		

Stage of pathway (S = 0.5 hour; M = 12h; L = 24-48h; VL = > 48h).

Transport btw HS & point of export	**Hazards**	**Hazard potentially present?**	**Exposure**									**Consequences**				
			Frequency					**Duration**								
			VR	RA	MF	FR	VF	S	M	L	VL	SA	AE	MS	SE	VS
	(1) Inappropriate air condition	YES		X						X	X	X				
	(2) Inappropriate conditions for rest/sleep	YES					X			X	X		X			
	(3) Inappropriate opportunity for movement	YES					X			X	X		X	X	X	
	(4) Inappropriate handling	NA														
	(5) Inappropriate access to water	YES		X						X	X		X			
	(6) Inappropriate access to nutrients	YES			X					X	X	X				
	(7) Inappropriate opportunity to carry out normal feeding behaviour	YES					X			X	X	X				
	(8) Lack of appropriate opportunity to explore or to locate hiding place or escape route	YES					X			X	X		X	X	X	
	(9) Inappropriate social contact (for example social isolation or unwanted proximity)	YES					X			X	X		X			
	(11) Inappropriate opportunity to preen	YES					X			X	X	X				
	(12) Inappropriate opportunity for thermoregulation	YES				X				X	X			X		
	(13) Inappropriate presence of chemical agents (e.g.**)	NA														
	(14) Inappropriate (high) density (*crowding*) of birds	YES				X				X	X			X		
	(15) Inappropriate mixing of species	YES		X						X	X	X				
	(16) Inappropriate hygiene conditions	YES				X				X	X			X		

Stage of pathway (S = 0.5 hour; M = 12h; L = 24-48h; VL = > 48h).

At point of export	Hazards	Hazard potentially present?	Exposure									Consequences				
			Frequency					Duration								
			VR	RA	MF	FR	VF	S	M	L	VL	SA	AE	MS	SE	VS
	(1) Inappropriate air condition	YES		X						X	X	X				
	(2) Inappropriate conditions for rest/sleep	YES			X					X	X		X			
	(3) Inappropriate opportunity for movement	YES		X						X	X		X			
	(4) Inappropriate handling	YES				X		X						X		
	(5) Inappropriate access to water	YES		X						X	X	X				
	(6) Inappropriate access to nutrients	YES			X					X	X		X			
	(7) Inappropriate opportunity to carry out normal feeding behaviour	YES			X					X	X	X	X			
	(8) Lack of appropriate opportunity to explore or to locate hiding place or escape route	YES				X				X	X			X		
	(9) Inappropriate social contact (for example social isolation or unwanted proximity)	YES				X				X	X		X			
	(11) Inappropriate opportunity to preen	YES		X						X	X	X				
	(12) Inappropriate opportunity for thermoregulation	YES		X						X	X	X				
	(13) Inappropriate presence of chemical agents (e.g.**)	YES	X	X	X	X	X			X	X		X			
	(14) Inappropriate (high) density (*crowding*) of birds	YES				X				X	X		X			
	(15) Inappropriate mixing of species	YES		X						X	X	X				
	(16) Inappropriate hygiene conditions	YES		X	X					X	X			X		

Stage of pathway (S = 0.5 hour; M = 12h; L = 24-48h; VL = > 48h).

Transport between point of export and BIP	**Hazards**	**Hazard potentially present?**	**Exposure**									**Consequences**				
			Frequency					**Duration**								
			VR	RA	MF	FR	VF	S	M	L	VL	SA	AE	MS	SE	VS
	(1) Inappropriate air condition	YES	X							X	X	X				
	(2) Inappropriate conditions for rest/sleep	YES		X						X	X		X			
	(3) Inappropriate opportunity for movement	YES					X			X	X		X			
	(4) Inappropriate handling	NA														
	(5) Inappropriate access to water	YES	X							X	X	X				
	(6) Inappropriate access to nutrients	YES	X							X	X	X				
	(7) Inappropriate opportunity to carry out normal feeding behaviour	YES				X				X	X	X				
	(8) Lack of appropriate opportunity to explore or to locate hiding place or escape route	YES		X						X	X	X				
	(9) Inappropriate social contact (for example social isolation or unwanted proximity)	YES		X						X	X	X				
	(11) Inappropriate opportunity to preen	YES		X						X	X	X				
	(12) Inappropriate opportunity for thermoregulation	YES	X							X	X	X				
	(13) Inappropriate presence of chemical agents (e.g.**)	YES	X							X	X	X				
	(14) Inappropriate (high) density (*crowding*) of birds	YES		X						X	X			X		
	(15) Inappropriate mixing of species	YES	X							X	X	X				
	(16) Inappropriate hygiene conditions	YES	X							X	X	X				

Stage of pathway (S = 0.5 hour; M = 12h; L = 24-48h; VL = > 48h).

At BIP	Hazards	Hazard potentially present?	Exposure									Consequences				
			Frequency					Duration								
			VR	RA	MF	FR	VF	S	M	L	VL	SA	AE	MS	SE	VS
	(1) Inappropriate air condition	YES	X						X			X				
	(2) Inappropriate conditions for rest/sleep	YES					X		X			X				
	(3) Inappropriate opportunity for movement	YES					X		X			X				
	(4) Inappropriate handling	YES		X					X				X			
	(5) Inappropriate access to water	YES	X						X			X				
	(6) Inappropriate access to nutrients	YES		X					X			X				
	(7) Inappropriate opportunity to carry out normal feeding behaviour	YES					X		X			X				
	(8) Lack of appropriate opportunity to explore or to locate hiding place or escape route	YES					X		X			X				
	(9) Inappropriate social contact (for example social isolation or unwanted proximity)	YES					X		X			X				
	(11) Inappropriate opportunity to preen	YES					X		X			X				
	(12) Inappropriate opportunity for thermoregulation	YES		X					X			X				
	(13) Inappropriate presence of chemical agents (e.g.**)	YES	X						X			X				
	(14) Inappropriate (high) density (*crowding*) of birds	YES		X					X			X				
	(15) Inappropriate mixing of species	YES	X						X			X				
	(16) Inappropriate hygiene conditions	YES	X						X			X				

Stage of pathway (S = 0.5 hour; M = 12h; L = 24-48h; VL = > 48h).

Transport between BIP and quarantine	**Hazards**	**Hazard potentially present?**	**Exposure**									**Consequences**				
			Frequency					**Duration**								
			VR	RA	MF	FR	VF	S	M	L	VL	SA	AE	MS	SE	VS
	(1) Inappropriate air condition	YES		X					X	X	X	X				
	(2) Inappropriate conditions for rest/sleep	YES					X		X	X	X		X			
	(3) Inappropriate opportunity for movement	YES					X		X	X	X		X			
	(4) Inappropriate handling	NA														
	(5) Inappropriate access to water	YES	X						X	X	X	X				
	(6) Inappropriate access to nutrients	YES		X					X	X	X	X				
	(7) Inappropriate opportunity to carry out normal feeding behaviour	YES					X		X	X	X	X				
	(8) Lack of appropriate opportunity to explore or to locate hiding place or escape route	YES					X		X	X	X		X			
	(9) Inappropriate social contact (for example social isolation or unwanted proximity)	YES					X		X	X	X		X			
	(11) Inappropriate opportunity to preen	YES					X		X	X	X	X				
	(12) Inappropriate opportunity for thermoregulation	YES		X	X				X	X	X		X			
	(13) Inappropriate presence of chemical agents (e.g.**)	YES	X						X	X	X	X				
	(14) Inappropriate (high) density (*crowding*) of birds	YES		X					X	X	X		X			
	(15) Inappropriate mixing of species	YES	X						X	X	X	X				
	(16) Inappropriate hygiene conditions	YES		X					X	X	X	X				

Stage of pathway (S = 0.5 hour; M = 12h; L = 24-48h; VL = > 48h).

In MS quarantine facility	Hazards	Hazard potentially present?	Exposure									Consequences				
			Frequency					Duration								
			VR	RA	MF	FR	VF	S	M	L	VL	SA	AE	MS	SE	VS
	(1) Inappropriate air condition	YES	X								X	X				
	(2) Inappropriate conditions for rest/sleep	YES	X								X	X				
	(3) Inappropriate opportunity for movement	YES	X								X	X				
	(4) Inappropriate handling	YES		X							X	X				
	(5) Inappropriate access to water	YES	X								X	X				
	(6) Inappropriate access to nutrients	YES		X							X	X				
	(7) Inappropriate opportunity to carry out normal feeding behaviour	YES			X						X		X			
	(8) Lack of appropriate opportunity to explore or to locate hiding place or escape route	YES			X						X		X			
	(9) Inappropriate social contact (for example social isolation or unwanted proximity)	YES			X						X		X			
	(11) Inappropriate opportunity to preen	YES		X							X	X				
	(12) Inappropriate opportunity for thermoregulation	YES		X							X	X				
	(13) Inappropriate presence of chemical agents (e.g.**)	YES	X								X	X				
	(14) Inappropriate (high) density (*crowding*) of birds	YES	X								X	X				
	(15) Inappropriate mixing of species	YES	X								X	X				
	(16) Inappropriate hygiene conditions	YES		X							X	X				

Stage of pathway (S = 0.5 hour; M = 12h; L = 24-48h; VL = > 48h).

Transport between MS quarantine and point of import	**Hazards**	**Hazard potentially present?**	**Exposure**									**Consequences**				
			Frequency					**Duration**								
			VR	RA	MF	FR	VF	S	M	L	VL	SA	AE	MS	SE	VS
	(1) Inappropriate air condition	YES		X					X			X				
	(2) Inappropriate conditions for rest/sleep	YES					X		X			X				
	(3) Inappropriate opportunity for movement	YES				X			X			X				
	(4) Inappropriate handling	NA														
	(5) Inappropriate access to water	YES		X					X			X				
	(6) Inappropriate access to nutrients	YES		X					X			X				
	(7) Inappropriate opportunity to carry out normal feeding behaviour	YES					X		X			X				
	(8) Lack of appropriate opportunity to explore or to locate hiding place or escape route	YES				X			X			X				
	(9) Inappropriate social contact (for example social isolation or unwanted proximity)	YES				X			X			X				
	(11) Inappropriate opportunity to preen	YES				X			X			X				
	(12) Inappropriate opportunity for thermoregulation	YES		X					X				X			
	(13) Inappropriate presence of chemical agents (e.g.**)	YES	X						X			X				
	(14) Inappropriate (high) density (*crowding*) of birds	YES			X				X				X			
	(15) Inappropriate mixing of species	YES	X						X			X				
	(16) Inappropriate hygiene conditions	YES		X					X			X				

Stage of pathway (S = 0.5 hour; M = 12h; L = 24-48h; VL = > 48h).

Point of import	Hazards	Hazard potentially present?	Exposure									Consequences				
			Frequency					Duration								
			VR	RA	MF	FR	VF	S	M	L	VL	SA	AE	MS	SE	VS
	(1) Inappropriate air condition	YES	X							X	X	X				
	(2) Inappropriate conditions for rest/sleep	YES		X						X	X		X	X		
	(3) Inappropriate opportunity for movement	YES		X						X	X		X	X		
	(4) Inappropriate handling	YES		X	X					X	X		X	X	X	
	(5) Inappropriate access to water	YES	X							X	X	X				
	(6) Inappropriate access to nutrients	YES		X						X	X		X	X		
	(7) Inappropriate opportunity to carry out normal feeding behaviour	YES	X	X	X					X	X	X	X	X		
	(8) Lack of appropriate opportunity to explore or to locate hiding place or escape route	YES	X	X	X					X	X	X	X	X		
	(9) Inappropriate social contact (for example social isolation or unwanted proximity)	YES		X	X	X				X	X		X	X		
	(11) Inappropriate opportunity to preen	YES	X							X	X	X				
	(12) Inappropriate opportunity for thermoregulation	YES		X						X	X		X			
	(13) Inappropriate presence of chemical agents (e.g.**)	YES		X						X	X		X			
	(14) Inappropriate (high) density (*crowding*) of birds	YES		X						X	X		X	X		
	(15) Inappropriate mixing of species	YES	X							X	X	X				
	(16) Inappropriate hygiene conditions	YES		X	X					X	X		X	X		

10.2. Risk of introducing infectious agents through import of captive birds

The following pathway summarises the sequence of events which would have to take place for a generic agent X to become established within the EU as a direct result of the importation of captive birds.

- Wild bird infected at point of capture
- Undetected infected wild bird retained for export
- Uninfected bird becomes infected during transport from point of capture to holding station
- Undetected infected bird introduced into holding station
- Uninfected bird becomes infected at holding station
- Undetected infected bird released from holding station
- Uninfected bird becomes infected during transport from holding station to point of export
- Undetected infected bird introduced into point of export
- Uninfected bird becomes infected at point of export in third country
- Undetected infected bird released from point of export into transportation to BIP
- Uninfected bird becomes infected during transport between point of export and Border Inspection Point (BIP)
- Undetected infected bird introduced into BIP
- Uninfected bird becomes infected at BIP
- Undetected infected bird released from BIP
- Uninfected bird becomes infected during transport between BIP and quarantine
- Undetected infected bird introduced into quarantine
- Uninfected bird becomes infected during quarantine
- Undetected infected bird released from quarantine
- Uninfected bird becomes infected during transport between quarantine and point of distribution
- Infected bird released into EU
- Agent becomes established within EU poultry and/or wild bird populations

10.2.1. Hazard definition

In the animal health context, there are three hazards of interest; avian influenza virus, chlamydiae and Newcastle disease virus.

10.2.2. Hazard characterisation

The next step of the risk assessment is the characterisation of each of the hazards of interest. We adopt an equivalent terminology to that used in the assessment of the welfare hazards:

HAZARD CHARACTERISATION:
SA: Slightly Adverse;
A: Adverse;
MS: Moderately Serious;
S: Serious;
VS: Very Serious.

In characterising the hazard we must consider the consequences of each of the agents under study being introduced into and subsequently becoming established in the EU.

10.2.3. Avian Influenza

The implications of the importation of Avian Influenza virus into the EU are highly strain dependent. Some strains are highly pathogenic to poultry. We adopt a pessimistic approach

and implement our risk assessment on the basis of these highly pathogenic avian influenza (HPAI) strains. In keeping with this approach, the hazard must be characterised as **very serious** (VS).

10.2.4. Chlamydiosis

Chlamydia are widespread in avian species. Virtually all avian species can be any of (i) healthy latently infected non-shedders, (ii) healthy latently infected shedders via pharynx and cloaca, (iii) diseased shedders showing hepatitis, splenitis, respiratory signs, conjunctivitis and diarrhoea, (iv) dying of chlamydiosis or concomitant infections (section 8.3.3.2). Most frequent is the latent stage without signs. Chlamydiae are already present in birds within the EU, but as they represent a serious public health problem (not least as a result of its high zoonotic potential), any importation of these organisms add to the present disease burden. This hazard is therefore categorised as **very serious** (VS).

10.2.5. Newcastle disease

As with avian influenza, there is a large degree of variation in the ability of Newcastle disease strains to cause disease in avian hosts. For those strains which are the most virulent (and which therefore represent a pessimistic scenario) (eg **) the hazard must be characterised as **very serious** (VS).

10.3. Health Risk assessment

The three case study agents have been considered in turn.

10.3.1. Avian influenza

Note that we have to consider all avian influenza A viruses, in particular AIVs of the haemagglutinin subtypes H5 and H7 – not only the current H5N1 AIV.

Pre-point of export

Probability that a caught bird is infected with AIV at the point of capture

The probability that a wild bird is infected at the point of capture is influenced by a number of factors. First, there are identified risk areas for diseases in third countries; Secondly, susceptibility to disease and mortality due to AI is highly species-dependent, with the majority of reported virus detections in healthy appearing wild birds occurring in Anseriformes. Passeriformes and Psittaciformes, for example, are susceptible to infection and may die on AI but do not play a major role in the epidemiology of AI. The same is probably true for birds of the orders Falconiformes and Columbiformes. Free-living birds of this order are known to be of minor susceptibility to AIVs but may act as mechanical vectors and on rare occasions as shedders. Importation data from 2005 suggests that non-domestic Anseriformes are imported from a few countries only. In that year, imports of Anseriformes were reported only from Mali and Tanzania, and both of these countries exported birds from a variety of other orders. Surveillance data for the groups of birds which are routinely captured for export in third countries is sparse, and so there is little information on the naturally occurring prevalence of AI (or indeed other diseases) in the third countries. Given, however, the species specificity of AI and the relatively small number of third countries from which birds within this order are imported.

Conclusions

- Captured birds other than Anserifornes are less likely to be infected by avian influenza viruses of any HA subtype..
- The probability of captured Anseriformes in a third country being positive for AI is uncertain.

Probability that an undetected AIV-infected wild birds is retained for export

Formal testing of infection and/or disease status at this stage of the import process is unlikely to take place, and captors will be largely reliant on clinical signs to determine whether a bird should be retained for export. This is likely to be true at all stages up until the point of export. Furthermore, AI is not pathogenic to most of the species of birds exported as captive and hence clinical signs will not be observed.

Conclusions

- Although there are few data on the selection criteria at the point of capture, it is expert experience that most captured birds are retained and enter the captive bird pathway sale.
- Clinical signs which might result in captured birds being rejected are species and AI virus subtype dependant. In some species (e.g. galliform birds) clinical signs may be observed and the probability of retention is low; in most other species (e.g. psittaciformes) shedding without clinical signs may occur and the probability of retention is high.

Probability that a bird is infected with AIV during transport to holding station

The probability that an uninfected bird becomes infected during transport from point of capture to holding station is dependent on a number of factors; the species of bird (different susceptibilities), the contagiousness of the agent in question and the transportation process and whether it allows for mixing of species. Data at this stage of the pathway are sparse, but transport conditions in the third country are likely to be primitive and a number of birds may be transported to the holding station at the same time, hence the opportunity for mixing. Transmission of AI between birds can occur as a result of direct contact, or as a result with faecally contaminated surfaces or objects, and in a cramped transport environment the opportunity for both types of transmission occurs.
As compared to NDV, AIVs in faecal material are sensitive to inactivation by UV-radiation (sunlight), dry environment (many passerine birds originate from steppe-like countries), pH below 5.o and above 12.o and cleaning / disinfectant solutions. AIVs are present in the pharynx of infected birds. Since the beak is extensively used by birds for pruning, AIV is spread over all feathers and can be detected subsequently on feathers and feather dust for up to two to four days. The rate of survival of AIV on feathers depends on the amount and composition of fat that birds derive from the uropygeal gland. Virus survival is particularily high in waterfowl that perform more frequently pruning than terrestrial birds do. In contrast, AIVs retain their infectivity for weeks and month in frozen material (blood, meat, bone marrow) that is used as source for food for day- and night-raptors, vultures and other carnivorous birds. The port of entry is mainly the epithelium of the upper respiratory tract and much less the digestive tract – due to the hydrochloric acid and consequently low pH in the gizzard.

Conclusions

- During transport from capture to the holding station the probability that a bird which is a member of a susceptible order becomes infected with AI is uncertain and a pessimistic

approach suggests that could be **moderate to high**, dependent upon transport conditions and duration;
- During transport from capture to the holding station the probability that a bird which is a member of a non-susceptible order becomes infected with AIV is **low to negligible**.

Probability that an undetected AIV-infected bird is introduced in the holding station

The probability that an undetected infected bird is introduced into the holding station is determined by the same factors as the probability that an undetected infected bird is retained for export.

Conclusions
- Given a random bird infected with AI, the probability that the bird is released undetected into the holding station is **high**.
- Tests to detect AIV either by virus isolation or by PCR are not done

Probability that an AIV-infected bird infects other birds at holding station

The probability that the bird then infects other birds at the holding station is dependent on a number of factors; contagiousness (see above), contact between birds at the holding station, the different susceptibility of birds being accommodated at the same time. An exporter is likely to hold birds until he has a large enough number to export and so crowded conditions at this point in the chain may result. In Guinea, for example, dealers claim that birds are sometimes retained for six months or longer while waiting for exportation (Clemmons, 2003). Also, African grey parrots that were removed as young fledglings from their nests are kept for some months until grown-up and "ready" for transport (Graeber, M. 1994, vet. dissertation, Univ. Giessen). It is plausible that smaller birds, as a result of their lesser monetary value, will receive less stringent care and therefore may be exposed to greater risk. Again, the bird in question being a member of a susceptible family is also a factor. The transmissibility of avian influenza virus is influenced by a number of factors (see section 9.3.2.3); transmission is likely to be via the faecal/pharyngeal oral route, with a moist, cool, neutral pH environment favouring survival. If a susceptible bird [permissive for AIV replication], therefore, is placed in such a favourable environment, transmission has the opportunity to occur. Recent experimental data using chickens (Brown, 2006, pers. com.) suggests that transmission of AIV in a fairly closed environment was relatively ineffective (see section on sentinel birds); this is the only transmission data which has been identified and does not completely reflect the conditions which might be experienced at a holding station in the third country.

Conclusion
- At the holding station the probability that a bird which is a member of a susceptible family/order becomes infected with AI in the presence of an infected bird could be **low to moderate**, although considerable uncertainty exists around this estimate as a result of sparse data.
- At the holding station the probability that a bird which is a member of a non-susceptible family/order becomes infected with AI in the presence of an infected bird is **low to negligible**.

Probability that a bird is infected at a breeding colony

An important consideration in assessing risks related to breeding colonies is the fact that the country of export of a bird may not necessarily be the country of origin.

Probability that an AIV-infected bird is released undetected from a holding station

Again, the probability that an infected bird is released undetected from a holding station is dependent on the detection of clinical signs, as a result of the fact that formal testing for disease is rarely employed. Furthermore, with the exception of H5 and H7 strains, AIV does not create clinical signs in its principal carriers (chapter 9). Worthy of note is the fact that although the contemporaneously circulating H5N1 HPAIV causes clinical signs in some birds, it does not in many others (EFSA, 2006).

Conclusion:

- The probability that an AIV-infected bird is released undetected from a holding station is species dependent; for some bird groups which do not experience clinical signs it will be **high.**

Probability that a bird becomes infected with AIV during transport from the holding station to the point of export

Similar observations as for the assessment of the probability of infection during transport to the holding station apply here; issues such as combinations of species, mixing and duration of transport are relevant. Again, this is an area where data are sparse. Time in transit is important from the point of view of exposure, and the journey from the trapper's home to the exporter can take many days. The issue related to the fact that birds may not always be exported from their country of origin may be indicative of large distances travelled – and therefore indicative of potentially lengthy exposure (Clemmons, 2003; Duplaix, 2001)

Conclusion

- The probability that a bird becomes infected during transport from the holding station to the point of export is subject to **great uncertainty**, as it depends on journey length, species and mixing.

Probability that a new AIV infection is introduced at the point of export

Influential here will be the mixing of birds from different source countries at the point of export. It is known that birds can be exported from a different country to their country of origin, and so it is clear that, should this occur, birds from high-risk countries for AI have the possibility to meet with birds from low-risk countries. Gilardi (pers. com.), for example, suggests that 50,000 African grey parrots per year are exported from Senegal, despite the fact that they are not indigenous to this country; further information on mixing of birds from different third countries at this point in the chain has not been forthcoming.

Conclusion

- The probability that a new infection is introduced at the point of export is **uncertain** resulting from a number of factors related to both the mixing of species and mixing of birds from different third countries.

Summary conclusions on the pre-export chain

The probability that a randomly selected captive bird reaches the point of export infected with AI is:

- **low** in birds (predominantly anseriformes but also Columbiformes and Charadriiformes) originating from countries with a low level of naturally-occurring AI and which do not export birds from third countries with a higher risk profile;
- **uncertain** in birds (predominantly Anseriformes, Columbiformes and Charadriiformes) originating from countries with a low level of naturally-occurring AI which export birds from third countries with a higher risk profile due to potential for mixing
- **high** in birds (predominantly anseriformes) originating from countries with a high level of naturally-occurring AI.

Probability that an AIV-infected bird is detected at point of export

According to EU Decision 2000/666/EC, birds must "come from a holding in which avian influenza has not been diagnosed in the 30 days preceding the dispatch", which indicates that, testing prior to export should take place and some certification of this and other disease criteria is provided post-export, pre-import. (Dimmock report suggests 21 days) Knowledge of the reliability of the certification procedures applied in third countries at the point of export can be variable (Dimmock et al., 2005).

Given that a bird is tested pre-export, a number of considerations must be made in determining whether a positive test result in an infected bird is likely to be obtained. Some manufacturers (e.g. in the Republic of South Korea) produce and sell rapid and cheap ELISA test kits. Such kits have a high specifity (for H5 or H5 subtypes) but are of low sensitivity (more that 5 log 10 embryo infective dose (EID) 50 % are needed to obtain positive results. In comparison, the minimal infective dose for susceptible chickens is in the range of log 10 = or < 1.o EID50.
PCRs on swabs or virus isolation attempts on swabs in embryonated chicken eggs are currently the methods of choice and recommended by EU regulation 2005/94 EC. Such tests are performed within the Eu but – to my knowledge - not in exporting countries.

Conclusions

- The probability that an infected bird is detected at the point of export is highly variable and heavily dependent on testing capabilities in the third country. The exact nature of testing in third countries is uncertain, but the probability of detection via this route is likely to be low as a consequence of inherent infrastructures.
- Pre-export testing of exported captive birds is not a legal requirement currently (Dimmock report).
- Where testing does not take place, the probability that an infected bird is detected at the point of export is **low**
- If the bird displays clinical signs (possible for HPAI in certain host species) the probability that an infected bird is detected at the point of export is **high**.

Post-point of export

Probability that an uninfected bird becomes infected with AIV during transport between point of export and Border Inspection Point (BIP)

An important factor in determining whether a bird becomes infected during transport between point of export and BIP is the duration of travel. In turn duration of travel will be influenced by mode of transport. Of the 110 BIPs within the EU, 60% (n = 66) are at airports which in most cases will imply the shortest possible journeys from the point of export. Of the

remaining BIPs, 19% (21%) are accessed by road, 8% (n = 9) are ports and 3% (n = 3) are rail terminals. Each of these last three may necessitate lengthier transportation from the point of export. Some information concerning BIPs through which imports were made in 2005 is available (Figure 8.3) and from these we summarise the following:

- The three BIPs which both receive birds from and send birds to the greatest number of countries (Heathrow, Brussels Zaventem and Frankfurt Main) are all air terminals.
- Most of the transport in 2005 took place via airport-based BIPs.
- The only BIP accessed by road which reported traffic in 2005 was number 2506199 (Kukuryki-Koroszczyn, Poland).
- None of the port-based or rail terminal-based BIPs recorded data in 2005. This none-reporting is probably due to the import ban imposed on AI-H5N1-pos. countries.

The care taken in transporting birds is believed to be influenced by their commercial value, their rareness in nature and their position on the CITES list, and so it is possible that smaller, less valuable birds may be transported in less favourable conditions and hence that there may be greater opportunity for transmission of AIV to birds which are susceptible to infection. The exact nature of this relationship is, however, uncertain.

Conclusions

- Based upon 2005 data, most transportation from point of export to BIP take place via an air route, and their duration is hence as short as it can be over a given fixed distance. Depends also on direct flights and transits.
- Despite this, some transportation will have duration of a moderate to high number of hours as a consequence of physical distance between point of export and BIP.
- There may be a relationship between value of bird and probability of infectious disease transmission, but the nature of this is uncertain.
- The probability that a bid becomes infected with AIV during transport from a point of export to a BIP may be **low** for short journeys.
- A pessimistic approach suggests that this same probability could be **high** for longer journeys, but the exact nature of the probability is both **uncertain** and **variable** as a result of dependence upon factors such as mixing, transmission efficacy of AIV in this environment and length of travel.
- The applicability of the data upon which these conclusions have been based to a randomly selected year is uncertain.

Probability that an undetected AIV-infected bird introduced into BIP

Birds arriving at a Border Inspection Point (BIP) must carry with them certification to comply with Directive 92/65. However, there have been historical cases where birds have arrived at the BIP either without or with incomplete health certification (Dimmock et al., 2005). An absence of knowledge in this area clearly conveys a greater likelihood of an undetected infected bird being admitted to the BIP.

The cause of morbidity and mortality are not routinely investigated at the BIP and given the likelihood that some birds which are dead on arrival (DOA) may have died of infectious disease, it may not be unreasonable to assume that AIV could exist asymptomatically amongst other birds in the consignment.

Conclusions

- AIV could be present in birds that arrive at a BIP and may be more likely in some species [Anseriformes]
- Absent or incomplete documentation accompanying consignments of birds leads to a greater likelihood of an undetected AIV-infected bird being admitted to the BIP. Incomplete and obviously false documentation results in longer periods of time at BIP. The longer time enhances the chance of lateral spread.

Probability that a bird becomes infected with AIV at a BIP

The facilities which can act as BIPs in EU member countries are listed in the Commission Decision 2001/881EC. Registered BIPs are subjected to frequent EC inspection. Inspection frequency is determined on the basis of inspection history, information concerning Member State trade patterns, information concerning possible illegal imports and the possibility of introduction of disease, information provided via the Rapid Alert system, and any other information which might be relevant.
Good information (currently for 2005) exists concerning which BIPs are supplied by which third countries (Figures 8.1 and 8.2; see also Table 8.3). Some BIPs only imported birds from a few host countries in this period (Toulouse Blagnac only imported from Mali; Kobenhavn from the United Republic of Tanzania; Kukuryki Koroszczyn from Belarus), whereas Heathrow, Brussels Zaventem and Hamburg imported from 21, 19 and 15 third countries respectively over the same period. Volume of traffic may have implications for mixing and potential contact (bird-to-bird, or indirect via faecal material or other waste); however no splitting of consignments within the BIP occurs and furthermore the time spent at the BIP by a given random bird will be short given that a BIP is not a holding facility. Given this information in combination with the fact that the predominant route of transmission of AI between birds is faecal-oral, we conclude that

Conclusions
- The probability that a bird becomes newly infected with AIV at a BIP is negligible.

Probability that an infected bird is released from the BIP to the quarantine

Given the short timescale spent at a BIP (i.e. in Frankfurt/Main in cases with satisfactory documentation few hours to less than one day), then if a bird arrives with a sublinical AI infection it is likely to leave the BIP infected. Formal diagnostic testing at this point is unlikely i.e. in Frankfurt diagnostic testing is only done in cases of enhanced losses or obvious signs of disease). It is unclear whether mixing between import and export consignments takes place within BIPs (i.e. No mixing between imports and exports in Frankfurt due to separated space / rooms)

Conclusion
- The probability that an AIV infected bird is released from the BIP is **high**

Probability that a captive bird is infected with AIV during transport from BIP to quarantine

A batch of birds (constituting one shipment, which may be of mixed species) arriving from the same point of export is transported from the BIP very soon after its arrival. Distance travelled from BIP to quarantine is likely to be highly variable and expert opinion suggests that much of the transport at this level takes place by road in especially designed/constructed

vehicles that are equiped with heating/cooling devices and separate air space between loading place and driver cabinet. Similar points to those highlighted in the section discussing transport from point of export to BIP regarding mixing apply. In addition, there is a suggestion (Dimmock report) that a consignment of birds might on occasion arrive at a different quarantine station from its original destination; a recent example of a consignment of birds arriving at the Heathrow BIP in the UK but subsequently being shipped to another member state is cited. Such transit situations mean that the BIP is not physically involved. Crates are directly moved from one cargo plane to the next plane.
The health certificate which must accompany a consignment of birds is shown in EC Directive 2000/666 and provides useful information concerning the likelihood of transmission of AIV in "ideal conditions". First, birds must come from the same establishment. Individual bird species must be restricted to the same compartment within the transporting vehicle (hopefully reducing the risk of transmission of disease agents), a number of identifying criteria of the originator must be present; crates and cages for transport must be constructed so that the opportunity for faecal and feather shedding during transport is minimised, birds can be seen and containers can be cleaned and disinfected; are either new or satisfactorily clean/disinfected; and comply with various CITES and IATA regulations. The rigour with which these certificates are checked at different BIPs, however, is uncertain.

Conclusions

- When criteria specified in the health questionnaire which must be presented on arrival at a quarantine are strictly enforced, the probability of infection during transport from BIP to quarantine should be **low**.
- The rigour with which health certificates are examined at different BIPs is **uncertain** and likely to be **variable**.
- The probability in general of becoming infected during transport from BIP to quarantine is **highly variable** and is **uncertain** as a result of combination of a number of uncertain and variable factors.

Probability that a captive bird during transport between BIP and quarantine infects indigenous EU birds with AIV

EU Directive 92/65 states that consignments of birds must be "sealed" during transit from BIP to quarantine station. However, there is a clear need for ventilation so that the birds in transit can breathe; any openings in the consignment might create an opportunity for transmission to EU birds, either through the leaking of waste products or by direct bird-to-bird contact. Given that the primary route of AIV transmission is faecal-oral, the former seems more likely to present an opportunity for transmission, but it is unlikely that significant amounts of faecal material from captive birds would be able to pass out into the environment via ventilation holes. In addition, recent data to which reference has already been made (Ian Brown) suggests that transmission via the faecal-oral route even in a fairly forced environment was relatively ineffective.

Conclusions

- Given the most likely routes of transmission and the opportunity of exposure of EU wild birds via these routes, we conclude that the probability of a captive bird during transport from BIP to quarantine station infects indigenous EU birds with AIV is **Negligible**.

Probability that an undetected infected bird is introduced into a quarantine station

A veterinary inspector is responsible for breaking the seal on a consignment of birds and subsequently checking the birds on arrival at the quarantine station; no samples to be subjected to microbiological or serological analysis are drawn at this stage, but inspection is based upon examination of health certificate, observation of general health appearance and the counting (but not testing) of dead on arrivals. If health is deemed to be adequate the birds are unloaded into the quarantine. Faecal samples or swabs are taken between days 7 and 15 of the quarantine period.

Current practice dictates that the only microbiological and/or serological testing of imported captive birds during quarantine takes place between days 7 and 15 of the quarantine period and no diagnostic tests are applied on arrival. Furthermore, AIV infection in many imported captive bird species may be subclinical.

Conclusions

- Given that many AIV infections in captive birds are subclinical and formal testing does not generally take place until at least one week into the quarantine period, there is a **high** probability of a subclinically infected being introduced into the quarantine station.

Probability that a bird becomes infected during quarantine

Many conditions for the construction, equipment and management of quarantine facilities are laid down in EC directive 2000/666. Dimmock (2005), however, makes the observation that there is "a great deal of scope in the interpretation of the EU rules, which leads to possible variation in the standards applied between and within member states". No data on the practices employed in member state quarantine stations has been able to be identified.

Conclusions

- The possibility of variation in the interpretation of the EU directive governing the construction of quarantine stations means that the probability that a captive bird becomes infected during quarantine remains **low** (**uncertain)**.
- Data on the practices employed in quarantine stations, coupled with information from EC Directive 2000/666, would prove valuable in informing our estimates of the likelihood of disease transmission.

Release of infected birds from quarantine

As discussed, following their initial clinical examination, samples are taken between 7 and 15 days after admission from all birds if a consignment contains less than 60 birds, and from 60 birds if the consignment is larger than this. In larger consignments, therefore, some birds will inevitably not be subjected to a microbiological or serological diagnosis procedure. A practice of housing sentinel birds (commonly chickens) within the same broad environment as the captive birds is employed, the theory being that these birds will become infected if AIV infection is present. Sentinel birds are tested via blood serology at least 21 days after the imported birds entered quarantine and not less than three days before they are due to be released.
Dimmock (2005), however, highlights the fact that the role of sentinel birds in diagnosing AIV infection in captive birds is unclear, as a result of, amongst other things, the fact that transmission is predominantly faecal-oral and that there are difficulties posed by housing

chickens in the same physical environment as the captive birds (which would be necessary for effective transmission via this route). A recent Defra report in the UK highlighted, for example, the fact that despite a captive bird being found to be infected with HPAI H5N1, four sentinel chickens kept at the same premises tested negative. A final examination of the birds takes place between days 28 and 30 of the quarantine period, prior to their release.

Conclusions

- Reliance on clinical signs for diagnosis of AIV infection in captive birds is potentially misleading and unreliable.
- The usefulness of using sentinel chickens to diagnose AIV infection in captive birds is uncertain, as a consequence of problems in ensuring adequate levels for AIV transmission of faecal-oral contact between captive bird and sentinel.
- Given the short incubation period, a bird which either arrives with AIV infection or becomes infected during the quarantine period and is to become clinically ill as a result of AIV infection should display clinical signs within the quarantine period. The probability of such a bird being released undetected from quarantine is hence **negligible** to **low**.
- The fact that all birds are tested in consignments of 60 birds or less means that the probability of an undetected subclinically infected bird being released from quarantine is **low**.
- There is a risk that some birds which are prone to sub-clinical infection may become infected post-microbiological and serological testing and hence may be released infected.
- The fact that a maximum of 60 birds is tested irrespective of consignment size coupled with the possible inefficacy of sentinel bird-based diagnosis in the captive bird environment means that the probability of an undetected subclinically infected bird in a consignment of 60 birds or more being released from quarantine is **higher than that for small consignments**, with probability increasing with consignment size.

10.3.2. Chlamydiosis

Probability that a caught bird is infected with AC at the point of capture

The probability that a wild bird is infected with AC at the point of capture is first influenced by whether the third country represents a high or low risk area for AC.
It has been demonstrated that all domestic avian species can be carriers of Chlamydia (Section 9.4.2.2). Furthermore, a variety of states from carrier through to clinical infection are possible.

Considerable uncertainty around the naturally occurring levels of AC in third countries exists, largely due to the fact that in many countries AC has never been reported. The countries which have reported the greatest numbers of AChl cases and outbreaks are countries which are likely to have more developed surveillance systems (Europe and the Americas) and this suggests the presence of reporting bias. We cannot assume that AChl does not occur in countries which have never or have not recently reported the presence of AChl. The reporting bias problem is potentially more severe than that for AIV and NDV, as AChl is not currently on the list of OIE notifiable diseases.

Again using the "Handistatus II" system provided by the OIE (http://www.oie.int) we draw the following summaries:

- For many African countries in the OIE (n = 31; 74%) there is either no information regarding AC (n = 19) or the date of the last outbreak is unknown (n = 12). Exceptions in 2004 are Angola, South Africa and Namibia which are known to have AC. Cote D'Ivoire (1995), Egypt (1997), Sao Tome and Principe (2001) and Zimbabwe (1987) are known to have had cases historically (no information regarding number of outbreaks and/or cases). Only Libya and Madagascar have never reported AC.
- In the Americas, in 2004 only Canada, Jamaica, Martinique, the USA and Uruguay were known to have AC. Brazil (1956), the Cayman Islands (1999), Chile (1990), the Falkland Islands (1989) and Jamaica (1997) have had documented evidence of AC historically; however a large proportion of the countries in the Americas (n = 16; 42%) have never reported AC.
- In Asia a similar situation prevails; for many countries (n = 17) no information as to the date of last outbreak exists; for a number of countries (n = 11) no information is available; and for a few countries (n = 8) AC has never been reported. The only countries with historically documented outbreaks are Israel (2003) and Kuwait (1994), and there was a known problem in 2004 in Indonesia (number of cases not known).
- In many European countries, AC is known to be present (18 of the 47 member countries reported outbreaks in 2004, and 13 of these were able to provide at least some numerical data concerning the number of outbreaks/number of cases). In addition to this, a further 7 countries have reported outbreaks historically. 7 countries have never reported AC (Belarus, Finland, Georgia, Iceland, Latvia, Moldavia, Ukraine)
- In Oceania, Australia, New Caledonia and New Zealand reported outbreaks in 2004, with no numerical data available. Western Samoa and Vanuatu have never reported outbreaks.

Conclusions

- Most of the wild birds imported into the EU to be kept as captive can be infected with AC and can act as carriers.
- AC is widespread throughout many of the countries from which captive birds are imported into the EU.
- AC already exists in the EU with outbreaks occurring sporadically and largely unquantified; information on the numbers of deaths is sparse.
- The probability of a captured bird being positive for AC is country dependent and is likely to be higher in those countries which have a high naturally occurring prevalence of AC.
- Reporting bias and the fact that the summaries presented here are based on outbreak data means that the naturally occurring prevalence in third countries remains uncertain. In particular, the fact that the best available data comes from developed countries makes us confident that the data presented should **in no way be regarded as representative of naturally-occurring prevalence**. No outbreaks evidenced in a given third country does not equate to AC being absent from this country. Outbreak data is not a substitute for surveillance data.

Probability that an undetected AC-infected wild bird is retained for export

Formal diagnostic tests of disease status at this stage of the import process are unlikely to take place, and captors will be largely reliant on clinical signs to determine whether a bird should be retained for export. A range of manifestiations of infection, from subclinical infection through to clinical signs is possible, but most frequent is the latent stage without signs

(Section 9.4.2.2). It is known in particular that the carrier state is common in psittacines (Section 9.4.2.7). An exception to this is in young birds, stressed adults and pairs during mating and feeding of their offspring, where clinical disease may be observed.

Conclusions

- The probability that an AC-infected wild bird is retained for export is likely to be influenced by the stress induced by its capture, as stressed birds may be more inclined to show clinical disease.
- The probability that an AC-infected wild bird is retained for export is likely to be **lower** for young birds than for older birds, as clinical signs are more frequent.

Probability that a bird is infected with AC during transport to holding station

Again the reader is referred to Section 10.3.1 (AI RA) for a description of the kinds of conditions one might anticipate in transport between point of capture and the holding station. The predominant mode of spread for AC is horizontal and it is known that AC can survive in a dry environment for prolonged times in dust, dander, feathers etc. (Section 9.4.2.3).

Conclusions

- Given the likely lack of clinical signs of infected birds coupled with transport conditions and the robustness of AC, a pessimistic approach suggests that the probability that a bird becomes infected with AC could be **high**, though this is dependent upon transport conditions and duration.

Probability that an AC-infected bird is introduced into the holding station

The probability that an AC-infected bird is introduced into the holding station is influenced by equivalent factors to the probability that an undetected infected bird is retained for export. Again formal testing is unlikely to take place here.

Conclusions

- Given that many wild birds (particularly psittacines) do not display clinical signs and that latent carrier status is common, the probability that an AC-infected bird is released undetected into the holding station could be **high** for some species and age groups.
- Stress increases the likelihood that birds will go on to show clinical signs, and the levels of stress encountered prior to this point may be influential in determining whether the bird is introduced into the holding station.

Probability that an AC-infected bird infects other birds at holding station

Many factors common to those described in Section 10.3.1 (AIV) relating to mixing of both birds of different species and birds from different sources are important in influencing this probability. In common with NDV, a diversity of bird species is susceptible to AC infection. Furthermore, survival of the organism in the environmental is possible, which could promote bird-to-bird transmission if disinfection between groups is insufficiently thorough (and indeed it has been noted that adequate disinfection is difficult in a dusty environment (Section 9.4.2.3)).

Conclusions

- At the holding station the probability that a captive bird becomes infected with AC in the presence of an infected bird could be **high** as a consequence of the contagious nature of this agent and mechanisms by which it is spread.

Probability that a bird is infected at a breeding colony

It has been stated that breeding pairs and pairs feeding offspring are more likely to display clinical signs. This might increase the likelihood that infected birds will be removed from the proximity of other birds in the breeding colony, thereby reducing the risk of infection.

Conclusions

- The probability that a bird is infected at a breeding colony is **low** to **moderate**.

Probability that an AC-infected bird is released undetected from a holding station

The same factors which influence the probability of an AC-infected bird being retained for export are relevant here. Formal testing for disease is rarely employed. Reliance upon clinical signs for diagnosis could be misleading as a consequence of the fact that latent carrier status is common, though it is also the case that stressed birds may be more likely to demonstrate clinical evidence of disease.

Conclusions

- The probability that an AC-infected bird is released undetected from a holding station is variable; in birds prone to latent carriage without clinical disease manifestation it may be **high**, but in younger birds or birds subjected to stress it could be **lower**.

Probability that a bird becomes infected with AC during transport from the holding station to the point of export

Again we refer the reader to Section 10.3.1 (AIV) for a discussion of the factors common to all organisms which are likely to influence the probability that a bird becomes infected with AC during a transportation stage. The facts that the principal mode of spread for AC is horizontal and that AC can survive in a dry environment for prolonged times in dust, dander, feathers etc. (Section 9.4.2.3) are again influential.

Conclusions

- As in the transportation between capture and holding station, the probability that a bird becomes infected with AC may be **high**, again dependent upon transport conditions and duration.

Probability that a new AC infection is introduced at the point of export

Again, analogous arguments to those presented for AIV in Section 10.3.1 regarding the mixing of birds from different third countries apply here.

Conclusions

- Given the host-species diversity and the fact that AC may well be widespread throughout much of the world (exact distribution unclear due to reporting bias issues), the probability that a bird arriving from one of these countries brings an infection to the point of export may be **high**; an exception to this may exist for either particularly

young, or stressed birds which may have a greater likelihood of demonstrating clinical disease and should hence be rejected prior to export.

- Given the fact that an unknown number of birds may already be infected with AC upon arrival at export, the probability of a new infection being introduced at the point of export is **uncertain**.

Summary conclusions on the pre-export chain

The probability that a randomly selected captive bird reaches the point of export infected with NDV is

- Uncertain in captive birds originating from third countries for which no documentary evidence of AC status exists. This includes many countries which regularly export large numbers of captive birds.
- A pessimistic approach and a comparison with developed countries which have a more solid reporting infrastructure suggests that, taking all other factors into account, AC is likely to be present (though undetected) in these countries, and hence the probability that a randomly selected captive bird reaches the point of export infected with AC could be **high.**
- An exception may be present for very young or stressed birds, which may have demonstrated clinical disease at some point in the import chain up to this point and may hence have been rejected. For these birds, the probability that a randomly selected captive bird reaches the point of export infected with AC could be **low**.

Probability that an AChl-infected bird is detected at point of export

Pre-export certification in the third country of origin is regulated by Directive 92/65/EEC which specifies that psittacidae must "not come from a holding nor have been in contact with animals from a holding on which psittacosis (Chlamydia psittaci) has been diagnosed", "The period of prohibition since the last recorded case and the period of treatment under veterinary supervision recognized under the procedure provided for in Article 26 must be at least two months", and "The methods for identifying psittacidae, and in particular sick psittacidae, shall be established under the procedure provided for in Article 26". This suggests that diagnosis of AC infection at this stage may rely on clinical signs. We have already noted that AC carrier status can exist (though clinical disease is seen in some subgroups of birds).

<u>Conclusions</u>

- The probability that an infected bird is detected at the point of export is highly variable and dependent on species, age of bird, bird's stress levels and testing capabilities in the third country. The exact nature of testing in third countries is uncertain, but the probability of detection via this route is likely to be low as a consequence of infrastructures which do not support detailed evaluation.
- Sub-clinical carriage of AChl is possible in many avian species, and the probability of birds which fall into this category but are not tested prior to export being detected is **low**. Exceptions to this might be young or severely stressed birds **(**see next point).
- In younger birds or stressed birds the probability that the bird is detected at the point of export may be **higher.**

Probability that an uninfected bird becomes infected with AC during transport between point of export and Border Inspection Point (BIP)

We refer the reader to Section 8.5 for a discussion of the issues surrounding transport between point of export and BIP, and the conclusions which emerge from this are broadly similar.

Conclusions

- Based upon 2005 data, most journeys from point of export to BIP take place via an air route, and their duration is hence as short as it can be over a given fixed distance.
- Despite this some journeys will take a moderate to high number of hours as a consequence of physical distance between point of export and BIP.
- There may be a relationship between value of bird and probability of infectious disease transmission, but the nature of this is uncertain.
- The probability that a bid becomes infected with AC during transport from a point of export to a BIP may be **low** for short journeys, though the potential for spread via the environment and the difficulties in achieving adequate disinfection in a dusty environment suggests that this probability may be higher than the equivalent for AIV.
- A pessimistic approach suggests that this same probability could be **high** for longer journeys, but the exact nature of the probability is both **uncertain** and **variable**.
- The applicability of the data upon which these conclusions have been based to a randomly selected year is uncertain.

Probability that an undetected AC-infected bird introduced into BIP

We refer the reader to Section 8.6 for a discussion of BIPs and the issues which are likely to influence the probability that an undetected AC-infected bird is introduced into a BIP.

Conclusions

- AC could be present in birds that arrive at a BIP. Younger birds and stressed birds have a greater predisposition towards showing clinical signs, but the commonest state is one of latent sub-clinical carriage.
- Absent or incomplete documentation accompanying consignments of birds leads to a greater likelihood of an undetected AC-infected bird being admitted to the BIP.

Probability that a bird becomes infected with AC at a BIP

Again we refer the reader to Section 8.6 for a discussion of BIPs. The fact that environmental routes of transmission (via feathers, dust etc.) are possible may create transmission probabilities in birds which are housed in the same physical environment. The fact that the complete disinfection is difficult to achieve might also lead to a risk that a new consignment of birds has a non-zero probability of acquiring an AC infection as a consequence of the presence of a consignment of infected birds in the same physical space previously. Time spent in a BIP, however, is brief, and this may serve to limit the opportunities for transmission.

Conclusions

- The probability that a captive bird becomes newly infected at a BIP is **low**.
- Inadequate cleaning and disinfection between consignments of birds may convey a greater risk.

Probability that an AC-infected bird is released from the BIP to the quarantine

As we have previously observed, given the short timescale spent at a BIP and the common latent sub-clinical status, then a bird which arrives with a non-apparent AC infection is likely also to leave with the infection. Exceptions to this might be young birds or stressed birds who

might begin to develop clinical signs at the BIP, dependent upon the stage of incubation which they occupied on arrival, and birds which are for some reason delayed in transit.

Conclusions

- The probability that a sub-clinically AC infected captive bird is released from the BIP is **high;**
- The probability of a stressed or young bird with an AC infection being released from a BIP might be **lower**.

Probability that a captive bird is infected with AC during transport from BIP to quarantine

We refer the reader to Section 8.7 for a discussion of issues relevant to the transportation of captive birds between BIP and quarantine station. Our conclusions are broadly analogous to those for AIV and NDV, with an extra necessary consideration concerning disinfection and cleaning limitations as a result of difficulties posed by a dusty environment.

Conclusions

- When criteria specified in the health questionnaire which must be presented on arrival at quarantine are strictly enforced, the probability of infection with AC during transport from BIP to quarantine should be **low**.
- Disinfection of vehicles between consignments may prove difficult and this may convey a greater risk.
- The rigour with which health certificates are examined at different BIPs is **uncertain** and likely to be **variable**.
- The probability in general of becoming infected during transport from BIP to quarantine is **highly variable** and is **uncertain** as a result of combination of a number of uncertain and variable factors.

A discussion of the requirements for vehicles transporting birds within the EU is given in Section 10.3.1 (AI RA). It seems unlikely that significant amounts of detritus from captive birds would be able to pass out into the environment via ventilation holes; this contrasts with NDV, where airborne transmission is possible.

Conclusions

- Given the likely horizontal routes of transmission and the limited opportunity for exposure of EU wild birds via these routes, we conclude that the probability of a captive bird during transport from BIP to quarantine station infects indigenous EU birds with AC is **low**.

Probability that an AC infected bird is introduced into a quarantine station

We refer the reader to Section 8.8 for a discussion of the practices which the quarantine regulations dictate should be implemented during the 30 day quarantine period. Microbiological testing for AIV and NDV takes place between days 7 and 15 of the quarantine period, but there is no indication that formal testing for AChl in the quarantine station takes place.

- AC infections in captive birds can sometimes be subclinical; when this is the case there is a **high** probability of a subclinically infected being introduced into the quarantine station.

- When a clinical infection is present, either as a result of the age of the bird or stressed status, the probability that an AC infected bird is introduced into a quarantine station is **low.**

Probability that a bird becomes infected during quarantine

We refer the reader to Section 10.3.1 (AI RA) for a discussion of the issues surrounding quarantine, and draw similar conclusions.

Conclusions

- The possibility of variation in the interpretation of the EU directive governing the construction of quarantine stations means that the probability that a captive bird becomes infected during quarantine remains **uncertain**.
- Data on the practices employed in quarantine stations, coupled with information from EC directive 2000/666, would prove valuable in informing our estimates of the likelihood of infection transmission within this environment.

Probability that an AC-infected bird is released from quarantine

Procedures employed during quarantine are described at length in Section 8.8. From these and our understanding of the dynamics of AC, conclusions were drawn.

Conclusions

- Some birds (those which are very young or very stressed) may display clinical signs of AC during the quarantine period. However this cannot be relied upon as a diagnostic in isolation, as latent carriage of AC in captive birds does occur, particularly in psittacines.
- The usefulness of using sentinel chickens to diagnose AC infection in captive birds is unclear. Sentinels were introduced as a means of diagnosing AIV and NDV, and so their relevance in the context of AC remains **uncertain**.
- Even when implemented, serological testing for AChl is not always reliable. Hence there is a possibility that infected birds which are subjected to this may be missed.
- There is a risk that some birds which are prone to sub-clinical infection may become infected post-testing (if it occurs) and hence may be released infected.
- The fact that the testing of birds for AChl is not routinely implemented in quarantine, coupled with the unknown capability of sentinel bird-based diagnosis of AChl in the captive bird environment, means that the probability that a subclinically AChl infected bird remains undetected and is subsequently released from quarantine, though **uncertain**, could be high.

Probability of establishment of AIV/NDV/AC in the EU

For NDV, it seems misleading to discuss the probability of establishment of the agent within the EU, since it is known that NDV is already responsible for intermittent outbreaks within poultry within the EU (Handistatus II), but interest here concerns the extra burden which may be brought into the EU as a direct result of the importation of captive birds. A similar point applies for AC, which is known to be established in many EU countries.

For each of the three agents, there is potentially a risk from captive birds placed in nature parks and zoos, as they may have a greater opportunity to make contact with the indigenous wild bird population, or, perhaps more significantly, to generate waste products (for AIV and

NDV faecal material and for AC feathers, dust, dander) which may be accessible to the indigenous wild bird population. Contact between indigenous wild birds and captive birds which are placed in a domestic environment indoors seemsm less likely (excepting in the event of an escape of an indoor-housed captive bird, where direct contact immediately becomes a possibility). Captive birds placed in a domestic environment outdoors (perhaps in an aviary or a breeding colony) might convey a transmission risk; the level of likely contact between birds housed in this manner and the indigenous EU population of wild birds is uncertain.

10.3.3. Newcastle disease

Pre-point of export

Probability that a caught bird is infected with NDV at the point of capture

The probability that a wild bird is infected with NDV at the point of capture is first influenced by whether the third country represents a high or low risk area for NDV. Unlike AIV which can be very host-specific, however, NDV has a very broad host range (psittacines, passerines, gulls, birds of prey, galliformes, anatiformes and others having had NDV isolated from them historically (Section 8.2.)).

ND is a notifiable disease under the OIE regulations (OIE covers only member states, not states that have an observer status and non-member states – these are very few states only). Some data on the epidemiology of NDV are available via the "Handistatus II" system provided by the OIE (http://www.oie.int). This details the reported number of outbreaks and resultant number of cases and deaths of Newcastle Disease by country throughout the world, by year. Taking the most recent 2004 data as an example it is possible to make the following summaries:

- NDV is widespread throughout Asia. Large numbers of outbreaks were reported in India (n = 323), Iraq (n = 422) and the Philippines (n = 9299); in contrast, Nepal, China and the Korean Republic reported fewer outbreaks (n = 48, 7 and 29 respectively) but relatively larger numbers of birds per outbreak overall were affected. In Vietnam the number of outbreaks is not recorded, but close to 100,000 birds are listed as cases.
- NDV is also known to exist in the majority of countries in Africa. Generally the numbers of outbreaks and average numbers of cases per outbreak are lower than the figures presented for Asia, but relatively large numbers of birds (more than 20,000) were nevertheless affected in outbreaks in Uganda, Tanzania, Republic of South Africa and Nigeria.
- NDV has historically occurred throughout much of the Americas, but in 2004 there were reports only of outbreaks in only Venezuela, Mexico, Bolivia and Colombia. In Colombia there were 172 outbreaks during this period with a total of 585767 birds being affected. A number of other countries (Brazil, Canada, Dominican Republic, Ecuador, Guatemala, Honduras, Nicaragua, Saint Kitts and Nevis and the USA) have experienced outbreaks since the year 2000.
- Small numbers of ND outbreaks were reported in Europe in 2004. With the exception of Belgium (n = 5), the Former Yugoslave Republic of Macedonia – FYROM - (n = 2) and Russia (n = 7) affected countries (Austria, Bulgaria, Cyprus, Finland, Greece, Switzerland and Turkey) reported a single outbreak only. Azerbaijan, Belarus,

Denmark, Georgia, Italy, Kosovo, Norway and Serbia and Montenegro have experienced outbreaks since the year 2000.
- No outbreaks were reported during 2004 in the countries of Oceania. For French Polynesia and New Zealand no information exists, and Australia last experienced an outbreak (following which 300 million birds were vaccinated) in 2002.

Conclusions
- Most of the wild birds imported into the EU to be kept as captive can be infected with ND virus and can be virus shedders and act as carriers.
- NDV is widespread throughout many of the countries from which captive birds are imported into the EU.
- NDV already exists in the EU, albeit with sporadic outbreaks, often involving small numbers of cases and associated deaths.
- The **probability** of a captured bird being positive for NDV is **country dependent** and is likely to be higher in those countries which have a high naturally occurring prevalence of NDV.
- Countries in Africa and Asia have reported the most cases, which may suggest a greater risk in birds imported from countries in these continents.
- Reporting bias and the fact that the summaries presented here are based on outbreak data means that the naturally occurring prevalence in third countries remains uncertain. No outbreaks evidenced in a given third country does not equate to NDV being absent from this country. Outbreak data is not a substitute for surveillance data.

Probability that an undetected NDV-infected wild bird is retained for export

Again, we observe that formal diagnostic tests of disease status at this stage of the import process are unlikely to take place, and captors will be largely reliant on clinical signs to determine whether a bird should be retained for export. It is known that psittacines and other wild birds can act as carriers of NDV without exhibiting clinical signs (AVMA "Exotic Newcastle Disease Backgrounder"), and indeed it has been suggested that wild birds can act as reservoirs in some areas and some psittacine birds can shed NDV for long periods (Lüthgen, W., 1981)

Conclusions
- The probability that a NDV-infected wild bird is retained for export is **high**.

Probability that a bird is infected with NDV during transport to holding station

We refer the reader to Section 10.3.1 (AIV) for a discussion of the factors which are likely to influence the probability that a bird becomes infected with NDV during transport and note that many of the factors are common to both of these viral agents. A separate consideration concerns the transmissibility of NDV. The faecal-oral route is the most notable route of transmission, but in principle the virus can be shed from most epithelial surfaces, so that inhalation and ingestion are the predominant modes of infection (Section 8.2.). NDV therefore differs from AIV in the potential for effectively air-borne spread.

Conclusions
- Given the contagiousness of NDV coupled with the potential for air-borne spread and the fact that airspace will probably be shared by birds in the same consignment, a pessimistic approach suggests that the probability that a bird becomes infected with NDV could be **high**, dependent upon transport conditions and duration.

Probability that a NDV-infected bird is introduced into the holding station

The probability that a NDV-infected bird is introduced into the holding station is determined by the same factors as the probability that an undetected infected bird is retained for export. Again formal testing is unlikely to take place at this stage.

Conclusion

- Given that many wild birds do not display clinical signs and may act as reservoirs for NDV, the probability that a NDV-infected bird is released undetected into the holding station is **high**.

Probability that a DNV-infected bird infects other birds at holding station

Many factors common to those described in Section 10.3.1 (AIV) relating to mixing of both birds of different species and birds from different sources are relevant here. The main areas in which there are differences are (i) the fact that a greater breadth of bird species are susceptible to NDV infection; (ii) NDV has the potential to be spread via air-borne as well as faecal-oral routes; and (iii) NDV has been described as "highly contagious" so that transmission from bird to bird is very effective (Section 9.3.3.3).

Conclusion

- At the holding station the probability that a captive bird becomes infected with NDV in the presence of an infected bird could be **high** as a consequence of the contagious nature of this agent and mechanisms by which it is spread.

Probability that a bird is infected at a breeding colony

An important consideration in assessing risks related to breeding colonies is the fact that the country of export of a bird may not necessarily be the country of origin. There is consequently a risk from birds in a third country which has a ND problem being introduced into a breeding colony in a third country which has not reported evidence of NDV.
The problem in breeding stations is that clinical signs of ND are generally rather non-specific and at post-mortem lesions – if any – are in most cases not suggestive of ND.
Managers of breeding colonies may not have or may not seek access to laboratories that are competent to make sophisticated ND virus isolations. Fear exists among these people that the diagnosed ND has detrimental effects on their breeding and trading activities.
Quite a number of countries use live and / or inactivated ND vaccines. Such vaccinated birds (i) can remain healthy, (ii) can still be shedders of NDV, (iii) can not be detected by serology.

Probability that a NDV-infected bird is released undetected from a holding station

The same factors which influence the probability of a NDV-infected bird being retained for export are relevant here. Formal testing for disease is rarely employed, and within wild bird populations reliance upon clinical signs for diagnosis is likely to be misleading as a consequence of the fact that these are frequently not demonstrated.

Conclusion

- The probability that a NDV-infected bird is released undetected from a holding station is **high**.

Probability that a bird becomes infected with NDV during transport from the holding station to the point of export

Again we refer the reader to Section 10.3.1 (AIV) for a discussion of the factors common to both AIV and NDV which are likely to influence the probability that a bird becomes infected with NDV during a transportation stage. Again we must, however, consider the transmissibility (faecal-oral and air-borne) and contagiousness (high) of NDV, which differ from those for AIV.

Conclusion

- As in the transportation between capture and holding station, the probability that a bird becomes infected with NDV may be **high**, again dependent upon transport conditions and duration.

Probability that a new NDV infection is introduced at the point of export

Similar arguments to those presented for AIV in Section 9.3.2.3 regarding the mixing of birds from different third countries apply here.

Conclusion

- Given the host-species diversity and the apparent widespread nature of NDV throughout much of Africa, Asia and Central and South America, the probability that a bird arriving from one of these countries brings an infection to the point of export may be **high**; however, given the fact that an unknown number of birds may already be infected with NDV upon arrival at export the probability of a new infection being introduced at the point of export is **uncertain**.

Summary conclusions on the pre-export chain

The probability that a randomly selected captive bird reaches the point of export infected with NDV is

- **High** in captive birds originating in countries which report numerous and large outbreaks of NDV, particularily in free-running village chickens but not to the same extent in large commercial chicken farms;
- **Low** in captive birds originating from countries which report few small outbreaks of NDV, or do not experience any outbreaks of NDV;
- Uncertain in captive birds originating from third countries for which no documentary evidence of NDV status exists

Probability that a NDV-infected bird is detected at point of export

According to EU directive 92-65, birds must "come from a holding or an area not subject to restrictions under measures to be applied to combat Newcastle disease." Again, certification pre-export in the third country of origin in theory takes place; however we have already noted that NDV carrier status, rather than clinical disease, is common in wild birds and if cerification relies principally on clinical signs, NDV carriers may not be identified at this stage.

Conclusions

- The probability that an infected bird is detected at the point of export is highly variable and dependent on testing capabilities in the third country. The exact nature of

testing in third countries is uncertain, but the probability of detection via this route is likely to be low as a consequence of inherent infrastructures.
- Since vaccination is easier and more rapid to perform and also less costly, countries that have a ND-associated problem prefer vaccination of birds as compared to testing (virus isolation and / or serology) for export.
- Pre-export testing of exported captive birds is not a legal requirement currently (Dimmock report).
- Where testing does not take place, the probability that an infected bird is detected at the point of export is **low**
- If the bird displays clinical signs (unlikely in most captive birds) the probability that an infected bird can be detected at the point of export is **high.**

Probability that an uninfected bird becomes infected with AIV during transport between point of export and Border Inspection Point (BIP)

We refer the reader to Section 8.5. for a discussion of the issues surrounding transport between point of export and BIP, and the resultant conclusions are broadly similar.

Conclusions
- Based upon 2005 data, most transportations from point of export to BIP take place via an air route, and their duration is hence as short as it can be over a given fixed distance.
- Despite this some transportations will have duration of a moderate to high number of hours as a consequence of physical distance between point of export and BIP.
- There may be a relationship between value of bird and probability of infectious disease transmission, but the nature of this is uncertain.
- The probability that a bird becomes infected with NDV during transport from a point of export to a BIP may be **low** for short journeys, though the potential for air-borne spread suggests that this probability may be higher than the equivalent for AIV.
- A pessimistic approach suggests that this same probability could be **high** for longer journeys, but the exact nature of the probability is both **uncertain** and **variable**.
- The applicability of the data upon which these conclusions have been based to a randomly selected year is uncertain.

Probability that an undetected NDV-infected bird introduced into BIP

We refer the reader to section 8.6. for a discussion of BIPs, and draw broadly analogous conclusions to those for AIV regarding the probability that an undetected NDV-infected bird is introduced into a BIP.

Conclusions
- NDV could be present in birds that arrive at a BIP. The potential for sub-clinical carriage in families of birds which might be imported as captive has been demonstrated.
- Absent or incomplete documentation accompanying consignments of birds leads to a greater likelihood of an undetected NDV-infected bird being admitted to the BIP.

Probability that a bird becomes infected with NDV at a BIP

Again we refer the reader to section 8.6. for a discussion of BIPs. We note that the greater contagiousness of NDV by comparison with AIV leads us to a slightly modified conclusion regarding the probability that a captive bird becomes newly infected at a BIP.

Conclusion

- The probability that a captive bird becomes newly infected at a BIP is **low**, but may be higher than the equivalent probability for AIV.

Probability that a NDV-infected bird is released from the BIP to the quarantine

In line with our AIV assessment, given the short timescale spent at a BIP and the predisposition of captive birds to act as carriers for NDV, then if a bird arrives with a NDV infection, it is likely to leave the BIP infected. Formal diagnostic testing at this point is unlikely (Alexander et al., 1977).

Conclusions

- The probability that a NDV infected captive bird is released from the BIP is **high.**

Probability that a captive bird is infected with NDV during transport from BIP to quarantine

We refer the reader to Section 8.7. for a discussion of issues relevant to the transportation of captive birds between BIP and quarantine station, and draw the same conclusions.

Conclusions

- When criteria specified in the health questionnaire which must be presented on arrival at a quarantine are strictly enforced, the probability of infection with NDV during transport from BIP to quarantine should be **low**.
- The rigour with which health certificates are examined at different BIPs is **uncertain** and likely to be **variable**.
- The probability in general of becoming infected during transport from BIP to quarantine is **highly variable** and is **uncertain** as a result of combination of a number of uncertain and variable factors.

Probability that a captive bird during transport between BIP and quarantine infects indigenous EU birds with NDV

The same requirements for the construction of vehicles for transporting birds between BIP and quarantine as described in Section 8.7. apply. We highlight, however, the fact that NDV is highly contagious and can also be transmitted via air-borne routes; these factors may confer a slightly greater risk of transmission of NDV to indigenous captive bird populations than is present for AIV.

Conclusions

- Given the most likely routes of transmission and the opportunity of exposure of EU wild birds via these routes, we conclude that the probability of a captive bird during transport from BIP to quarantine station infects indigenous EU birds with NDV is **low**, but may be marginally higher than the equivalent for AIV as a consequence of the possibility of air-borne transmission.

Probability that an undetected infected bird is introduced into a quarantine station

We refer the reader to Section 8.8 for a discussion of the practices which the quarantine regulations dictate should be implemented during the 30 day quarantine period.

Notable is the fact that birds which are going to develop clinical signs may develop clinical signs within this fixed quarantine period of 21 or 30 days. This does not, however, obviate the possibility of birds which tested negative for NDV between days 7 and 15 (when testing is carried out) but becoming positive between this time and the end of quarantine being released undetected.

This highlights the importance of the point of import as a critical control point… for sampling (cloaca and pharynx for virus isolation and blood for serology) and subsequent testing. Indicate that the same samples can be subjected for isolation / serology for both groups of agents – NDVs and AIVs.

In the case of a third country where disease notifications are rigorously implemented, therefore, this should offer some protection and should result in birds from countries with a documented problem not progressing further.

10.3.4. Risk Assessment Summary Table

Table 10.3. Summary of probabilities and uncertainties for Avian Influenza (AIV), Newcastle Disease (ND) and Avian Clhamidyosis (AChl) for each considered event

Event	Probability		
	AIV	**ND**	**AChl**
Wild bird infected at point of capture	Uncertain For anseriformes high Others lower	High for some species Uncertain for other species	Uncertain
Infected wild bird retained for export	Low (galliformes) High (other birds)	High	High (older birds) Lower (young birds) Low (stressed birds)
Uninfected bird becomes infected during transport from point of capture to holding station	Moderate-High (susceptible birds) Negligible-Low (non-susceptible birds)	High (transport conditions and duration dependant)	Moderate-high
Infected bird introduced into holding station	High	High	High (species and age dependent)
Uninfected bird becomes infected at holding station	Low-Moderate (susceptible birds) Negligible-Low (non-susceptible birds) Uncertain	High	High
Infected bird released for export from holding station	High (sub-clinical shedders)	High	High (sub-clinical carriers) Lower (young birds) Lower (stressed birds)
Uninfected bird becomes infected during transport from holding station to point of export	uncertain Moderate-High (susceptible birds) Negligible-Low (non-susceptible birds)	High (transport conditions and duration dependant)	Uncertain Moderate-high
Infected bird introduced into point of export	Uncertain	High - Uncertain	High (sub-clinical carriers)

			Lower (young birds) Lower (stressed birds)
Infected bird reaches the point of export in third country	Low…. Uncertain….. High…..	Uncertain	
Infected bird is detected at point of export	Uncertain (countries which test) Low (countries which do not test) High (presence of clinical signs)	High (ill birds) Low (for latent infections)	Uncertain (countries which test) High (countries which do not test) Negligible-Low (presence of clinical signs)
Uninfected bird becomes infected during transport between point of export and Border Inspection Point (BIP)	Low (short journeys) High but uncertain (longer journeys)	High but uncertain	Low (short journeys) High but uncertain (longer journeys)
Infected bird introduced into BIP	High (sub-clinical shedders)	High but uncertain	High (sub-clinical shedders)
Uninfected bird becomes infected at BIP	Negligible	Low	Negligible-Low (issues surrounding adequate disinfection)
Undetected infected bird released from BIP	High (sub-clinical shedders) Low (presence of clinical signs)	High	High (sub-clincial infections) Lower (young or stressed birds)
Uninfected bird becomes infected during transport between BIP and quarantine	Low ("ideal" conditions) Uncertain (less than "ideal" conditions)	High	Low (questionnaire criteria satisfied) Uncertain but possibly higher (risk of survival in environment following inadequate disinfection)
Bird being transported between BIP and quarantine infects indigenous EU birds	Negligible	Low	Low
Infected bird introduced into quarantine	High (sub-clinical shedders)	High	High (sub-clinical shedders) Lower (clinical disease)
Uninfected bird becomes infected during quarantine	Low (Uncertain)	High within epidemiological units. Low between units	Negligible-low (clinical signs)
Infected bird released from quarantine	Negligible-Low (clinical signs) Negligible-Low (consignment < 60 birds) Higher [uncertain] (consignment > 60 birds)	High for latently infected birds Low for sick birds.	Higher (sub-clinical carriage)

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13. AHAW Scientific Panel Members

This Scientific Report was peer-reviewed by the Members of the Scientific Panel for Animal Health and Welfare (AHAW) of the European Food Safety Authority. The Scientific Report was used as the basis for a Scientific Opinion adopted on 27 October 2006. The Members of the AHAW Scientific Panel were:

Bo Algers, Harry J. Blokhuis, Donald M. Broom, Patrizia Costa, Mariano Domingo, Mathias Greiner, Daniel Guemene, Jörg Hartung, Trevor Hastings, Per Have, Frank Koenen, Christine Muller-Graf, David B. Morton, Albert Osterhaus, Dirk U. Pfeiffer, Moez Sanaa, Mo Salman, J. Michael Sharp, Philippe Vannier, Martin Wierup, Marion Wooldridge.

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15. ANNEX

15.1. Apppendix Chapter 7

Appendix 7.1: Orders of birds imported to the EU in 2005 by country of origin (CVEDA Quarantine Data)

Continent	Origin	Country	Passeriform	Galliform	Psittaciform	Falconiform	Coraciiform	Strigiform
Africa	BF	Burkina Faso	Yes	Yes	-	-	-	-
Africa	BW	Botswana	Yes	-	-	-	-	-
Africa	CD	Congo, Dro	-	-	Yes	Yes	Yes	Yes
Africa	CG	Congo	Yes	-	Yes	Yes	-	-
Africa	CI	Cote d'Ivoire	Yes	-	Yes	-	-	-
Africa	CM	Cameroon	Yes	-	Yes	Yes	-	-
Africa	EG	Egypt	-	-	Yes	-	-	-
Africa	GA	Gabon	Yes	Yes	-	-	-	-
Africa	GH	Ghana	Yes	Yes	Yes	Yes	Yes	Yes
Africa	GN	Guinea	Yes	Yes	Yes	Yes	-	Yes
Africa	GQ	Eq. Guinea	Yes	Yes	Yes	Yes	-	Yes
Africa	MG	Madagascar	Yes	Yes	Yes	-	-	-
Africa	ML	Mali	Yes	Yes	Yes	-	-	-
Africa	SL	Sierra Leone	-	-	Yes	-	-	-
Africa	SN	Senegal	Yes	Yes	Yes	-	-	-
Africa	TD	Chad	-	-	-	Yes	-	Yes
Africa	TG	Togo	-	-	-	-	-	Yes
Africa	TZ	Tanzania, Uro	Yes	Yes	Yes	Yes	Yes	-
Africa	UG	Uganda	Yes	Yes	Yes	-	-	-
Americas	AR	Argentina	-	-	Yes	-	-	-
Americas	BR	Brazil	-	-	Yes	-	-	-
Americas	CA	Canada	-	-	-	Yes	-	-
Americas	CU	Cuba	-	-	Yes	-	-	-
Americas	GY	Guyana	-	-	Yes	Yes	-	-
Americas	PE	Peru	Yes	-	Yes	Yes	-	Yes
Americas	SR	Suriname	Yes	-	Yes	-	-	-
Americas	US	United States	Yes	-	Yes	Yes	-	-
Americas	UY	Uruguay	-	-	Yes	-	-	-
Asia	AE	U. A. E.	Yes	Yes	Yes	Yes	-	-
Asia	BH	Bahrain	-	-	Yes	Yes	-	-
Asia	JO	Jordan	-	-	Yes	-	-	-
Asia	JP	Japan	-	-	-	-	-	-
Asia	KW	Kuwait	-	-	-	-	-	-
Asia	KZ	Kazakhstan	-	-	-	Yes	-	Yes
Asia	PH	Philippines	-	-	Yes	-	-	-
Asia	RU	Russ. Federation	Yes	-	-	Yes	-	-
Asia	SG	Singapore	-	-	Yes	-	-	-
Asia	TW	Taiwan	Yes	Yes	-	-	-	-
Europe	AD	Andorra	-	-	Yes	-	-	-
Europe	BY	Belarus	-	Yes	-	-	-	-
Oceania	AU	Australia	Yes	-	-	-	-	-
Oceania	NZ	New Zealand	-	-	Yes	-	-	-

Appendix 7.1 (cont)

Continent	Origin	Country	Trogoniform	Ciconiiform	Anseriform	Piciform	Columbiform	Cuculiforme
Africa	BF	Burkina Faso	-	-	-	-	Yes	-
Africa	BW	Botswana	-	-	-	-	-	-
Africa	CD	Congo, Dro	Yes	-	-	-	-	-
Africa	CG	Congo	-	-	-	-	-	-
Africa	CI	Cote d'Ivoire	-	-	-	-	-	-
Africa	CM	Cameroon	-	-	-	-	-	-
Africa	EG	Egypt	-	-	-	-	-	-
Africa	GA	Gabon	-	-	-	-	-	-
Africa	GH	Ghana	-	-	-	-	Yes	-
Africa	GN	Guinea	-	-	-	-	Yes	-
Africa	GQ	Eq. Guinea	-	-	-	-	-	-
Africa	MG	Madagascar	-	-	-	-	-	-
Africa	ML	Mali	-	-	Yes	Yes	-	-
Africa	SL	Sierra Leone	-	-	-	-	-	-
Africa	SN	Senegal	-	-	-	-	-	-
Africa	TD	Chad	-	-	-	-	-	-
Africa	TG	Togo	-	-	-	-	-	-
Africa	TZ	Tanzania, Uro	-	Yes	Yes	-	-	Yes
Africa	UG	Uganda	-	-	-	Yes	-	-
Americas	AR	Argentina	-	-	-	-	-	-
Americas	BR	Brazil	-	-	-	-	-	-
Americas	CA	Canada	-	-	-	-	-	-
Americas	CU	Cuba	-	Yes	-	-	-	-
Americas	GY	Guyana	-	-	-	Yes	-	-
Americas	PE	Peru	-	-	-	-	-	-
Americas	SR	Suriname	-	Yes	-	-	-	-
Americas	US	United States	-	-	-	-	Yes	-
Americas	UY	Uruguay	-	-	-	-	-	-
Asia	AE	U. A. E.	-	-	-	-	Yes	Yes
Asia	BH	Bahrain	-	-	-	-	-	-
Asia	JO	Jordan	-	-	-	-	-	-
Asia	JP	Japan	-	-	-	-	-	-
Asia	KW	Kuwait	-	-	-	-	Yes	-
Asia	KZ	Kazakhstan	-	-	-	-	-	-
Asia	PH	Philippines	-	-	-	-	-	-
Asia	RU	Russ. Federation	-	-	-	-	-	-
Asia	SG	Singapore	-	-	-	-	Yes	-
Asia	TW	Taiwan	-	-	-	-	-	-
Europe	AD	Andorra	-	-	-	-	-	-
Europe	BY	Belarus	-	-	-	-	-	-
Oceania	AU	Australia	-	-	-	-	-	-
Oceania	NZ	New Zealand	-	-	-	-	-	-

Appendix 7.1 (cont)

Continent	Origin	Country	Gruiformes	Coliiformes	Pelecaniformes	Gaviiformes	Apterygiformes	Missing
Africa	BF	Burkina Faso	-	-	-	-	-	-
Africa	BW	Botswana	-	-	-	-	-	Yes
Africa	CD	Congo, Dro	-	-	-	-	-	-
Africa	CG	Congo	-	-	-	-	-	-
Africa	CI	Cote d'Ivoire	-	-	-	-	-	-
Africa	CM	Cameroon	-	-	-	-	-	-
Africa	EG	Egypt	-	-	-	-	-	-
Africa	GA	Gabon	-	-	-	-	-	-
Africa	GH	Ghana	-	-	-	-	Yes	-
Africa	GN	Guinea	-	-	-	-	-	-
Africa	GQ	Eq. Guinea	-	-	-	-	-	-
Africa	MG	Madagascar	-	-	-	-	-	-
Africa	ML	Mali	-	-	-	-	-	Yes
Africa	SL	Sierra Leone	-	-	-	-	-	-
Africa	SN	Senegal	-	-	-	-	-	-
Africa	TD	Chad	-	-	-	-	-	-
Africa	TG	Togo	-	-	-	-	-	-
Africa	TZ	Tanzania, Uro	-	-	Yes	Yes	-	Yes
Africa	UG	Uganda	-	-	-	-	-	-
Americas	AR	Argentina	-	-	-	-	-	-
Americas	BR	Brazil	-	-	-	-	-	-
Americas	CA	Canada	-	-	-	-	-	-
Americas	CU	Cuba	-	-	-	-	-	-
Americas	GY	Guyana	-	-	-	-	-	-
Americas	PE	Peru	-	-	-	-	-	-
Americas	SR	Suriname	-	-	-	-	-	-
Americas	US	United States	Yes	Yes	-	-	-	-
Americas	UY	Uruguay	-	-	-	-	-	-
Asia	AE	U. A. E.	-	-	-	-	-	-
Asia	BH	Bahrain	-	-	-	-	-	-
Asia	JO	Jordan	-	-	-	-	-	-
Asia	JP	Japan	Yes	-	-	-	-	-
Asia	KW	Kuwait	-	-	-	-	-	-
Asia	KZ	Kazakhstan	-	-	-	-	-	-
Asia	PH	Philippines	-	-	-	-	-	-
Asia	RU	Russ. Federation	-	-	-	-	-	-
Asia	SG	Singapore	-	-	-	-	-	-
Asia	TW	Taiwan	-	-	-	-	-	-
Europe	AD	Andorra	-	-	-	-	-	-
Europe	BY	Belarus	-	-	-	-	-	-
Oceania	AU	Australia	-	-	Yes	-	-	-
Oceania	NZ	New Zealand	-	-	-	-	-	-

Appendix 7.2: Orders of birds imported to the EU in 2005 by country of destination (CVEDA Quarantine Data)

Country	Country code	Passerif	Galliform	Psittacif	Falconif	Coraciif	Strigif	Trogonifs
Austria	AT	Yes	-	-	Yes	-	-	-
Belgium	BE	Yes	Yes	Yes	-	Yes	-	-
Cyprus	CY	Yes	-	Yes	-	-	-	-
Czech Republic	CZ	Yes	Yes	Yes	Yes	-	Yes	-
Germany	DE	Yes	Yes	Yes	-	Yes	Yes	-
Denmark	DK	Yes	Yes	Yes	-	-	-	-
spain	ES	Yes	Yes	Yes	Yes	-	Yes	-
France	FR	Yes	Yes	Yes	-	-	-	-
UK	GB	Yes	Yes	Yes	Yes	-	Yes	-
Greece	GR	Yes	Yes	Yes	-	-	-	-
Hungary	HU	Yes	-	Yes	-	-	-	-
Italy	IT	Yes	-	Yes	Yes	-	-	-
Malta	MT	Yes	-	-	-	-	-	-
Netherlands	NL	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Poland	PL	-	Yes	Yes	-	-	-	-
Portugal	PT	Yes	Yes	Yes	Yes	-	Yes	-
Sweden	SE	-	-	Yes	-	-	-	-

Appendix 7.2 (cont)

Country	Country code	Ciconiif	Anserif	Piciform	Columbif	Cuculif	Gruiform	Coliiform
Austria	AT	-	-	Yes	-	-	-	-
Belgium	BE	-	-	Yes	Yes	-	Yes	-
Cyprus	CY	-	-	-	-	-	-	-
Czech Republic	CZ	Yes	-	Yes	-	-	Yes	-
Germany	DE	-	-	-	-	-	-	-
Denmark	DK	-	-	-	Yes	-	-	-
spain	ES	-	-	-	-	-	-	-
France	FR	-	-	-	-	-	-	-
UK	GB	Yes	-	-	Yes	Yes	-	Yes
Greece	GR	-	-	-	-	-	-	-
Hungary	HU	-	-	-	-	-	-	-
Italy	IT	-	-	-	Yes	-	-	-
Malta	MT	-	-	-	-	-	-	-
Netherlands	NL	Yes	Yes	-	-	Yes	-	-
Poland	PL	-	-	-	-	-	-	-
Portugal	PT	-	-	-	Yes	-	-	-
Sweden	SE	-	-	-	-	-	-	-

Appendix 7.2 (cont)

Country	Country code	Pelecaniformes	Gaviiformes	Apterygiformes	Missing
Austria	AT	-	-	-	-
Belgium	BE	Yes	-	-	-
Cyprus	CY	-	-	-	-
Czech Republic	CZ	-	-	Yes	-
Germany	DE	Yes	Yes	-	-
Denmark	DK	-	-	-	-
spain	ES	-	-	-	-
France	FR	-	-	-	-
UK	GB	-	-	-	-
Greece	GR	-	-	-	-
Hungary	HU	-	-	-	-
Italy	IT	-	-	-	-
Malta	MT	-	-	-	-
Netherlands	NL	-	-	-	Yes
Poland	PL	-	-	-	-
Portugal	PT	-	-	-	-
Sweden	SE	-	-	-	-

Appendix 7.3 Descriptive information about requirements for different orders for succesfull breeding in captivity.

Falconiformes

While some years ago falconry and hawking were exclusive hobbies for a limited number of people, today falcon and hawk breeding has become rather popular. To our knowledge there are several thousand owners of birds of prey in the EU at present.
Contrary to what was observed some years ago, when falconers and falcon breeders were actually the same people, nowadays, although a few people breed and use falcons some people are fanciers with this hobby, some are people who fly the birds for whatever reason (i.e. hunting, show, pest control in airports and farms, etc.), and there are people who breed and sell birds of prey.

The breeding of birds of prey necessitates a deep knowledge of their biology (Heidenreich, 1997). Generally speaking the limiting factor in most European Countries is space: large aviaries are needed to host the birds; Furthermore even larger aviaries are needed for young birds to exercise and open fields must be available in the vicinities for training the birds. The majority of breeders are focused on the most commercial raptor species, such as the peregrine falcon (*Falco peregrinus*), the saker falcon (*F. cherrug*), the gyrfalcon (*F. rusticolus*), the barbary falcon (*F. pelegrinoides*), and the Harris hawk (*Parabuteo unicinctus*). Besides these more common birds, there are people who breed very large birds, like eagles or rather small raptors, like the Eurasian and the American kestrel (*F. tinnunculus* and *F. sparverius*).

Some birds of prey will breed when kept in a single aviary but "difficult" species, like the goshawk (*Accipiter gentilis*), may need separate (or separable), aviaries for the male and female. (Heidenreich, 1997). In most cases the breeding aviary will not be accessible to people in the sense that birds will not be able to see people from inside. This can be achieved by several methods, ranging form hidden eye-holes to one-way windows (Fox, 1995).

Another issue concerning the welfare of the birds is the hygiene of the food and the aviaries. Birds of prey are carnivorous and their food is extremely perishable, after it has been defrosted (Fox, 1995). It is important to remember that in most European Countries, there are official suppliers of frozen animals (day-old chicks, quails, mice, rats, etc.) who guarantee the quality of the provided food (expert data).

Finally, and this is particularly true in the case of hybrid falcons, survival of chicks is greater if there is a dedicated nursery to incubate and hatch the eggs and hand-rear the chicks, composed of at least two rooms: one for incubation and hatching and one for rearing. Incubation and hatching can also be separated. Strict hygiene measures in these rooms and regular veterinary control also improve survival (Fox, 1995).

Strigiformes

Compared with falcons and hawks, breeding nocturnal birds of prey is a hobby for a very limited number of people. In some cases, falcon fanciers like owls, as well, but there are also people who breed or keep only *Strigiformes*.
The facilities used for breeding owls do not differ much from the ones used for diurnal raptors, but *Strigiformes* rarely need to be isolated from human sight as falcons do. This is probably due to the fact that most of their activity is at nighttime, when humans are not around very much. Nevertheless owls are shy creatures and privacy, and minimising stress factors improve welfare.

The most commonly kept owls are often the easiest to breed, like the eagle owl (*Bubo bubo*), and the snowy owl [*Bubo* (*Nyctea*) *scandiacus*], but even the most difficult species can be seen in some collections.

Strigiformes and *Falconiformes* share hygiene problems (see previous section).

Psittaciformes

Parrots are one of the bird groups most widely and enthusiastically bred. There are roughly 350 species of *Psittaciformes* ranging from the very small lorikeets and hanging parrots, to the huge hyacinth macaw, and fanciers of one group may not know breeders of other *taxa*.

Parrots are kept in cages or aviaries of different size. This depends on the species and the purpose for which the birds are kept (Abramson et al., 1995; Johnson and Clubb, 1992). For example budgerigars can be easily bred in a home environment, while macaws need long flying aviaries, and cockatoos are known to develop aggressive behaviours when kept in cages that are too small and with little social stimulation. Further, the design of the aviary depends on the geographic location and the species. e.g. keas (*Nestor notabilis*) are known to thrive in the cold climate, even in presence of snow, while birds of the same size, like the palm cockatoo (*Probosciger aterrimus*), are known to have problems when the temperature drops below 10 °C (+/- 50 °F). So that the latter species needs a winter quarter, connected to the outside aviary, while the kea can be hosted in a large light cage or aviary all year round.

This explains why the assessment of good or bad conditions in which a given parrot species is kept is a matter of knowledge of the birds (Silva, 1991)

There are sources of information for the minimum requirements for breeding some selected species (Abramson et al., 1995. Low R, 1986; Schubot et al., 1992). The minimum

requirements for space allowances do not necessarily provide for all of the needs of the birds and hence may not result in good welfare as there have not been scientifically studied.

Nests are also a key point in psittacine aviculture: an aviary with a wrong nest will be not successful. Basically nests for psittacines are wooden boxes of the appropriate size, but their shape and location is extremely important, too. Some nest-boxes are designed to inhibit or limit aggressions.

Furthermore, nutrition of the different species may vary significantly. Besides specific needs of some families, like the lories (*Loridae*), even parrot species that are similar in size (i.e. amazons and cockatoos), should be fed differently (Klasing, 1998). On the other hand, some nutritionists believe that, at least the most common species, may receive the same formulated food that can eventually be improved with selected and organic seeds, grains, fruit and vegetables.

Also in the case of breeding psittacine birds, a nursery has to be organised. This includes a room for egg incubation, a room for hatching (or at least special incubators for hatching), and one to three rooms for hand rearing the chicks.

Phoenicopteriformes

Several species of flamingos are commonly kept in captivity and until recently, many wild caught lesser flamingos (*P. minor*) were regularly imported form Africa.

Being easily caught and readily available on the market, flamingos have been kept in colonies in several different settings, both private and open to public. They are amongst the most popular park birds.

Flamingos have a very specialised feeding method, as they basically filter the micro-fauna they eat, from the water. Although there are several specialized companies that produce food for flamingos, in most collections they are fed a soft, watery blend of different ingredients, such as meat, cereals, trout pellets, shrimps and canthaxantin or astaxantin.

For the welfare of the flamingos in captivity to be good, it is necessary to understand their biology. The minimum requirements are (Crosta et al., 2006):

- The presence of water (pool, lake, pond). There are no data concerning the minimum water surface per bird. One of the key factors is also a smooth access and exit from the water pool, in order to avoid leg traumas.
- The number of birds high enough to make a real flock (at least 10 – 15 birds). Flamingos like to live in a flock and feel protected by the group.
- An even sex ratio. Some flamingo species are more easily bred than others, but in order to breed, they must be in the right sex proportion. Flamingos are easily sexed, either by morphometry, or by endoscopy and the cock and hen number must be similar.
- The correct food. As seen before, flamingos have a specialised bill, and eat special food in a special way. Thus, if one wants to breed flamingos, it is necessary to provide them with the most appropriate diet.
- The right nests. Flamingos will nest readily, provided that:
    - there are good invitational nests, made of mud or concrete.
    - there is mud enough to complete the invitational nests.
    - there is a good nesting area, with a certain amount of privacy.

Passeriformes

Considering that more that the 50% of the living bird species belong to the order Passeriformes, it is not surprising that passerines are among the most popular cage and aviary birds.

There is large internal traffic in passerine birds among European Countries, and a huge number of fanciers (e. g. the Italian Bird Breeders Federation "FOI", has more than 30.000 members. Many passerine birds have been investigated to attempt captive breeding but the majority of the passerine birds bred in captivity belong to a few families:

- *Fringillidae*. Finches.
- *Estrildidae*. Waxbills, grassfinches and mannikins.
- *Turdidae*. Thrushes.
- *Sturnidae*. Starlings and Mynah birds.
- *Ploceidae*. Sparrows.

These birds are generally small sized and most of them are mainly seed eaters. Thrushes and starlings are mostly insect and fruit eaters.

Even if some birds are kept on exhibit in large, mixed species aviaries, many passerines can be kept and bred in relatively small cages or aviaries, ranging in size from the small cages for canaries, to longer aviaries for some of the shyest starlings. For this reason, one of the problems is the very poor hygiene conditions in which those animals can be kept. The small size of the cages allows a large number of birds to be kept in the same room, but with increasingly poor ventilation and hygiene.

In fact, while nutrition and general management of passerines is a well established procedure, because of the low value of single birds, owners seldom use a veterinary service, unless the problem becomes very difficult.

15.2. Appendix Chapter 8

Table A8.1: Single stranded DNA viruses.

Virus group	Family and genus of virus	Predominant avian hosts	Name of the disease	Virus reported in EU	Zoonotic potential	Disease Risk for poultry	References
ssDNA	Circoviridae						
	Circovirus	Psittaciformes	Psittacine beak & feather disease	Yes	No	None	Todd, 2000
		Columbiformes	Circovirus infection in pigeons and doves	Yes	No	Pigeons	
				Yes	No	No	
		Passeriformes	Circovirus infection in canaries and finches	Yes	No	No	
				Yes	No	No	
		Struthioniformes	Circovirus infection in ostriches	Yes	No	No	
		Anatiformes	Circovirus infection in geese	No	No	Unknown	
		Charadriiformes	Circovirus infection in gulls	Yes	No	Unknown	
	Gyrovirus	Chickens	Infectious anaemia of chickens	Yes	No	Yes	
	Parvoviridae						
	Parvovirus	Goose	Derzsy Disease	Yes	No	Geese	Schettler, 1971;
		Muskovy duck	Type 2 of Derzsy Disease	Yes	No	Muskovy	Limn et al., 1996;
	Dependovirus	Pheasant	Pheasant parvovirus infection	Yes	No	chicken	Gelmetti et al., 96;
		Chicken	Adeno-associated virus infection				Goodwin et al., 89
	Microviridae						
	Chlamydiamicrovirus	Many av. spec.	Chlamydia phage 1 infection	Yes	No	None (?)	Fane, 2005
	Polyomaviridae						Bernier, 1981;
	Polyomavirus	Psittaciformes	Budgerigar fledgling disease	Yes	No	None	Enders, 1997;
		Passeriformes	Polyomavirus seed cracker, finch	No	Unknown	Unknown	Johne 1999;
		Falconiformes	Polyomavirus of falcons	Yes	Yes	Unknown	Laferty, 1999;
		Phasianiformes	Polyomavirus of chickens	Yes	Yes	Yes	Guerin 2000
	Papillomaviridae						
	Etapapillomavirus	Passeriformes	Papilloma of green finches	Yes	No	None	Ritchie, 1995
	Thetapapillomavirus	Psittaciformes	African Grey Parrot papillomatosis	Yes	No	None	

Table A8.2: Double stranded DNA containing viruses.

Virus group	Family and genus of virus	Predominant avian hosts	Name of disease	Virus reported in EU	Zoonotic potential	Disease Risk for poultry	References
dsDNA	Poxviridae						
	Avipoxvirus	Psittaciformes	Psittacine pox	Yes	No	None	Bolte et al., 2002
		Columbiformes	Pigeon pox	Yes	No	Pigeons	
		Phasianiformes	Pox of chicken, quail, turkey	Yes	No	Chickens	
		Passeriformes	Kikuth disease, canary pox, starling, other finches	Yes	No	None	
	Herpesviridae						
	Subfamily α-herpesvir.						Witter & Schat,
	Mardiviris	Phasianiformes	Marek's disease	Yes	No	Yes	2003; Guy &
	Iltovirus	Phasianiformes	Infectious laryngotracheitis	Yes	No	Yes	Bagust, 2003;
	Unassigned viruses in the family Herpes-viridae	Many others	Duck virus enteritis (duck plague)	Yes	No	Ducks	Sandhu & Shaw-ky, 2003; Toma-szevski et al., 2003;Vinde-vogel & Ducha-tel, 2003; Kaleta, 1998
			Pacheco's Parrot disease of the sero- / genotypes 1-5	Yes	No	None	
				Yes	No	None	
			Smadel's disease of pigeons	Yes	No	Pigeons	
			Infections of owls, falcons, toucan, storks, cormorant, quail, penguin, canary, weaver finches	Yes	No	No	
				Yes	No	No	
				Most of them	No	No	
	Adenoviridae						
	Aviadenovirus	Phasianiformes	Adenovirus infection serotypes 1-12	Yes	No	Chicken	McFerran & Adair, 2003
		Anatiformes	Egg drop syndrome, EDS 76	Yes	No	Chicken	
		Anatiformes	Goose adenoviruses infection	Yes	No	Goose	
		Phasianiformes	Haemorrhagic enteritis of turkey	Yes	No	Turkey	
		Phasianiformes	Marble spleen disease of pheasants	Yes	No	Pheasants	
		Columbiformes	Adenovirus inf.of pigeons and doves	Yes	No	Pigeons	

Table A8.3: The negative stranded ssRNA viruses.

Virus group	Order, family, subfamily and genus of virus	Predominant avian hosts	Name of disease	Virus reported in EU	Zoonotic potential	Disease Risk for poultry	References
ssRNA	MONONEGAVIRALES Paramyxoviridae Subfam. Paramyxovirinae						Alexander, 2003
	Rubulavirus	Many orders	Newcastle disease	Yes	Minor	Yes	
			Paramyxovirus types 2 to 9	Yes	No	Yes	
	Subfam. Pneumovirinae						
	Metapneumovirus	Phasianiformes	Rhinotracheitis of turkey & chicken	Yes	No	Yes	
	Orthomyxoviridae						
	Influenzavirus A	Many orders	Avian influenza (fowl plague), highly pathogenic avian influenza of HA-subtypes H5 and H7	No	No*	Yes	Swayne & Halvorson, 2003; Kaleta et al., 2005
			Low pathogenic avian influenza of all 16 HA subtypes	Yes	No	Yes	
	Bunyaviridae						Haenni et al., 2005
	Hantavirus	Exotic birds	Rift Valley fever virus	No	Yes	Yes	
	Phlebovirus		Hantaan virus infection	No	Yes	Yes	

Table A8.4: The dsRNA viruses.

Virus group	Family and genus of virus	Predominant avian hosts	Name of disease	Virus reported in EU	Zoonotic potential	Disease Risk for poultry	References
dsRNA	Reoviridae						
	Rotavirus	Phasianiformes	Rotavirus inf. chicken, turkey	Yes	No	Yes	Rosenberger et al., 1998
	Reovirus	Phasianiformes Anatiformes Falconiformes Psittaciformes and many others	No name	Yes	Yes	yes	
	Birnaviridae						
	Avibirnavirus	Phasianiformes	Infectious bursal disease in chickens (Gumboro disease) caused by type 1 and turkey infectious bursal disease virus caused by type 2	Yes Yes	No No	Yes No	Luckert & Saif, 2003

Table A8. 5: The positive stranded ssRNA viruses and the DNA and RNA reverse transcribing viruses.

Virus group	Order, family and genus of virus	Predominant avian hosts	Name of disease	Virus reported in EU	Zoonotic potential	Disease Risk for poultry	References
ssRNA	Picornavirudae						
	Enterovirus	Phasianiformes	Encephalomyelitis chicken, turkey	Yes	No	No	Calnek, 2003;
	Aphthovirus	Phasianiformes	FMD in chicken	No	No	No	Kaleta, 2002
	Caliciviridae	Phasianiformes	Hepatitis in turkey	No	No	Yes	Ritchie, 1995
		Anatiformes	Hepatitis in ducklings	Yes	No	Yes	
	Astroviridae						
	Turkey astrovirus	Phasianiformes	Enteritis in turkey	No	No	turkey	Reynolds &
		Anatiformes	Hepatitis in Pekin duckling	Yes	No	ducklings	Saif, 2003
	NIDOVIRALES						
	Coronaviridae						
	Coronavirus	Phasianiformes	Infectious bronchitis chicken	Yes	No	Yes	Cavanagh &
		Columbiformes	Pigeon coronavirus infection	Yes	No	Yes	Naqi, 2003
		Psittaciformes	Amazone coronavirus infection	Yes	Unknown	Unknown	Gough, 2006
	Flaviviridae						Westaway et
	Flavivirus	Passeriformes	St. Louis Enceph., **WEE, EEE, VEE**	No	Yes	Yes	al., 1985;
		Several orders	West Nile viruses	Yes	Yes	geese	Wünschmann et al., 2005;
		Phasianiformes	Turkey meningoencephalitis	No	No	Yes	Marr & Calisher, 2003
	Togaviridae						
	Alphavirus (Sindbis v.)	Many	No specific name (encephalitis signs)	No	Yes	Yes	Robinson,
	Rubivirus	Columbiformes	Rubella virus infection in pigeons	Yes	Yes	No	2005

TableA8.6: The DNA and RNA reverse transcribing viruses.

Virus group	Family and genus of virus	Predominant avian hosts	Name of disease	Presence of the viruses in EU (25)	Zoonotic potential	Risk for poultry	References
	Hepadnaviridae Avihepadnavirus	Anatiformes and others	Duck hepatitis B virus (DHBV) inf. DHBV in goose heron stork others	Yes Yes	No No	Yes Yes	Sprengel et al., 1988; Pult et al., 2001; Mason et al., 2005
	Retroviridae Subfam. Orthoretrovirinae Alpharetrovirus	Phasianiformes	Avian leukosis, subgroups A to J Oncogenic, replication competent virus: Rous sarcoma virus Replication defective virus / disease: - Avian sarcoma Mill Hill 2 - Avian myeloblastosis virus - Avian myelocytomatosis virus - Avian sarcoma virus CT10 virus - Fujinami sarcoma virus - Avian UR2 sarcoma virus - Y73 sarcoma virus	Yes	No	Yes	Linial et al., 2005
	Gammaretrovirus	Phasianiformes Anatiformes	Reticuloendotheliosis virus group: - Chick syncytium virus - Reticuloendotheliosis virus - Trager duck spleen necrosis virus	Yes	No	Yes	

Table A8.7: Number of publications of HA x NA combinations in **all orders** of birds.

NA subtype	HA subtype																Number of HA x NA combinations
	H1	**H2**	**H3**	**H4**	**H5**	**H6**	**H7**	**H8**	**H9**	**H10**	**H11**	**H12**	**H13**	**H14**	**H15**	**H16**	
N1	27	7	9	9	35	15	11	-	2	2	4	2	3	-	6	-	13
N2	15	9	37	23	39	44	12	-	8	4	10	-	1	-	-	-	11
N3	15	17	11	6	10	11	27	-	1	2	6	-	3	-	-	1	12
N4	10	3	4	3	1	15	7	12	1	9	2	2	1	-	-	-	13
N5	5	1	2	3	-	15	2	-	1	3	-	10	-	2	-	-	10
N6	2	3	23	64	-	10	3	-	2	2	12	-	15	2	-	-	11
N7	-	1	1	1	-	-	19	-	1	21	1	-	1	-	-	-	8
N8	6	1	69	23	3	18	6	-	2	8	3	1	2	-	1	-	13
N9	4	4	20	7	4	4	3	-	1	2	19	-	1	-	1	-	12
Total	64	46	176	139	92	132	90	12	19	53	57	15	27	4	8	1	103

Table A8.8: Detection of AIV and estimated size of total populations of species. A total of 147 species are known within the order Anseriformes, suborder Anseres (Carboneras, 1992). This table contains 35 species that were found to contain at least one AIV- positive species.

Subfamily **Genus** **Species**	**Number of AIV citations**	**Natural habitat of species**	**Estimated size of total population (in millions)**
Anserinae			
Cygnus olor – Mute Swan	2	Western Europe	0.50
C. columbianus –	14	Tundra, north America & Eurasia	0.17
Anser anser – Graugans	2	North & central Europe, Asia	0.30
A. caerulescens – Schneegans	1	North America	1.40
A. indicus – Streifengans	1	Central Asia, India	0.02
A. anser domesticus – Hausgans	20	-	unknown
Branta canadensis – Kanadagans	6	North America, western Europe	3.00
Cairina moschata – Moschusente	1	Central, northern South America	0.01
C. moschata domesticus – Flugente	2	-	unknown

Anatinae			
Anas platyrhynchos – Stockente	167	N. America, Eurasia, not Tundra	27.00
A. p. domesticus – Hausente	33	-	unknown
A. discors – Blauflügelente	66	North & central America	5.00
A. acuta – Spießente	29	Like Anas platyrhynchos	12.00
A. strepera – Schnatterente	27	C. America, Eurasia not Tundra	1.50
A. p. fulvigula – Reiherente	26	Eurasia	0.05
A. crecca – Krickente	27	Like Anas platyrhynchos	7.00
A. c. carolinensis – Am. Krickente	20	Like Anas platyrynchos	0.15
A. falcata – Sichelente	16	Eastern Asia	0.09
A. poecilorhyncha – Fleckschnabelente	11	South Asia	0.13
A. penelope – Pfeifente	11	North Eurasia	1.30
A. americana – Amerik. Pfeifente	7	North America	6.50
A. superciliosa – Augenbrauenente	4	Australia	1.50
A. gibberifrons – Weißkehlente	3	Australia	0.07
A. formosa – Gluckente	2	East Asia	0.01
A. rubipes – Dunkelente	1	Western & north America	1.30
A. clypeata – Löffelente	1	Like Anas platyrhynchos	3.30
Aythya fuligula – Reiherente	3	Eurasia	1.30
Ay. valisineria – Valisineriaente	1	Northern America	0.50
Ay. americana – Rotkopfente	1	Northern America	0.60
Clangula hyemalis – Eisente	1	Arctic Eurasia	10.00
Melanitta fusca – Samtente	1	Like Anas platyrhynchos	1.00
Aix sponsa – Brautente	1	South to northern America	1.30
Aix galericulata – Mandarinente	1	China	0.01
Bucephala albeola – Büffelkopfente	1	North America	0.75
Oxyura jamaicensis – Schwarzkopfruderente	1	North & South America	0.60
Not identified anatiforme birds	139		

Table A8.9: Total number of cited neuraminidase (NA) subtypes in major orders of birds.

Order -formes	**NA subtypes**										**Total**	**%**
	N1	**N2**	**N3**	**N4**	**N5**	**N6**	**N7**	**N8**	**N9**	**?**		
Anati-	78	139	88	60	36	101	31	99	47	39	718	66.5
Phasiani-	18	36	5	4	0	3	11	7	3	41	128	11.8
Charadrii-	13	11	13	11	8	21	7	12	11	10	117	10.8
Passeri-	8	2	0	0	0	18	1	12	0	2	43	4.0
Columbi-	10	4	1	0	0	1	0	0	1	3	20	1.9
Psittaci-	1	0	0	0	0	8	1	9	0	0	19	1.8
Other orders	12	7	2	1	0	2	0	3	0	8	35	3.2
Total	140	199	109	76	44	154	51	142	62	103	1080	
% of 1080	13.0	18.4	10.1	7.0	4.1	14.3	4.7	13.2	5.7	9.5		100.00
Rank	4	1	5	6	9	2	8	3	7	/	/	

Table A8.10: Frequencies of citations of haemagglutinin (HA) subtypes in major orders of birds.

Order -formes	HA subtypes																Total	%
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
Anati-	67	37	122	131	56	112	49	10	14	40	52	12	5	4	1	0	712	65.9
Phasiani-	11	1	9	9	21	22	26	1	4	9	2	12	1	0	0	0	128	11.9
Charadrii-	6	7	10	5	16	9	11	1	9	8	9	4	20	0	7	1	123	11.4
Passeri-	0	0	15	10	6	0	4	0	0	2	5	0	1	0	0	0	43	4.0
Columbi-	5	0	4	0	7	0	1	0	2	1	0	0	0	0	0	0	20	1.9
Psittaci-	0	0	9	8	0	0	2	0	0	0	0	0	0	0	0	0	19	1.8
Other	1	1	4	1	15	2	5	0	1	4	1	0	0	0	0	0	35	3.2
Total	90	46	173	164	121	145	98	12	26	64	69	28	27	4	2	1	1080	
% of 1080	8.3	4.3	16.0	15.2	11.2	13.4	9.1	1.1	2.4	5.9	6.4	2.6	2.5	0.4	0.7	0.1		100.0
Rank	6	9	1	2	4	3	5	13	12	8	7	10	11	15	14	16		

Table A8.11: Distribution of AIV positive genera and species over families and subfamilies within the order **Anatiformes**.

Order **Family** **Subfamily**	**Number of Genera**	**Number of Species within those Genera**	**Total number of AIV positive**		**% AIV positive species in each subfamily**
			Genera	**Species**	
Anseriformes					
Anseranatidae (w/o subfam.)	1	1	0	0	0
Anatidae					
Dendrocygninae	2	9	0	0	0
Stigtonettinae	1	1	0	0	0
Anserinae	11	23	5	5	21.7
Cereopsinae	1	1	0	0	0
Tadorninae	8	15	0	0	0
Plectropterinae	1	1	0	0	0
Anatinae	47	80	15	26	3
Unidentified Anatidae					
Total per order **Anseriformes**	72	131	20	31	23.7

Table A8.12: Distribution of AIV positive genera and species over families and subfamilies within the order **Phasianiformes**.

Order **Family** **Subfamily**	**Number of Genera**	**Number of Species within those Genera**	**Total number of AIV positive**		**% AIV positive species in each subfamily**
			Genera	**Species**	
Phasianiformes					
Megapodidae	7	12	0	0	0
Phasianidae					
Numidinae (dom. Guinea fowl)	4	6	1	1	16.6
Pavoninae	2	3	0	0	0
Meleagridinae (dom. Turkeys)	1	2	1	1	50.0
Argusianinae	3	8	0	0	0
Phasianinae (kept in captivity)	7	21	2	2	9.5
Lophophorinae	1	3	0	0	0
Pucrasiinae	1	1	0	0	0
Ithagininae	1	1	1	1	100.0
Gallinae (dom. chickens)	1	4	1	1	25.0
Tragopaninae	1	5	0	0	0
Galloperdicinae	1	3	0	0	0
Ptilopachinae	1	1	0	0	0
Perdicinae (kept in captivity)	24	97	3	3	3.1
Odontophorinae	8	27	0	0	0
Tetraoninae	8	16	0	0	0
Cracidae (w/o subfam.)	9	35	1	1	2.9

Table A8.13: Distribution of AIV positive genera and species over families and subfamilies within the order **Larinae**.

Order **Family** **Subfamily**	**Number of Genera**	**Number of Species within those Genera**	**Total number of AIV positive**		**% AIV positive species in each subfamily**
			Genera	**Species**	
Lariformes					
Chionidae					
(w/o subfam.)	1	2	0	0	0
Stercorariidae					
(w/o subfam.)	1	4	0	0	0
Laridae					
(w/o subfam.)	11	42	3	7	16,7
Sternidae					
Rhynchopinae	1	3	0	0	0
Sterninae	9	37	2	3	8,1
Anoinae	3	5	1	1	20,0
Total per order Larinae	26	93	6	11	11,8

TableA8.14: Distribution of AIV positive genera and species over families within the order **Charadriiformes**. Taxonomy by Clements (2000).

Order **Family**	**Number of Genera**	**Number of Species within those Genera**	**Total number of AIV positive**		**% AIV positive species in each subfamily**
			Genera	**Species**	
Charadriiformes					
Jacanidae – Jacanas	6	8	0	0	0
Rostratulidae – Painted snipe	1	2	0	0	0
Dromadidae – Crap plover	1	1	0	0	0
Haematopodidae – Oystercatchers	1	11	0	0	0
Ibidorhynchidae – Ibisbill	1	1	0	0	0
Recurvirostridae – Avocats & Stilts	3	10	0	0	0
Burhinidae – Thick-knees	1	9	0	0	0
Glareonidae – Pratincole	5	17	0	0	0
Charadriidae – Plovers & Lapwings	10	66	0	0	0
Pluvianellidae – Magellanic Plover	1	1	0	0	0
Scolopacidae – Sandpipers & others	22	87	3	10	11.5
Pedionomidae – Plains-wanderer	1	1	0	0	0
Thinocoridae – Seedsnipes	3	4	0	0	0
Chionidae – Sheatbills	1	2	0	0	0
Stercoraridae – Skuas & Jaegers	2	7	0	0	0
Laridae – Gulls	6	51	1	24	47.1
Sternidae – Terns	7	44	2	4	9.1
Rynchopidae – Skimmers	1	3	0	0	0
Alcidae – Aukes, Murres, Puffins	9	23	1	3	13.0
Total	82	348	7	41	11.8

Table A.8.15 Collection of Bacteria that have been reported in avian species

Bacteria[1]		Avian host	Name of disease	**Bacteria reported in EU**	Zoonotic potential	Disease Risk for poultry	Recent references[4]
Spirochaetes	***Treponema,***	Anseriformes	Spirochaetosis	Yes	No	?	Swayne et al, 1995
	Borrelia[3] spp	Passeriformes Columbiformes	Lyme Disease Borreliosis	Yes	Yes	N /Y	Fabbi et al, 1995; Reed et al, 2003; Marie-Angele et al, 2006
Gram-negative "Proteobacteria"							
Alpha division (obligate/facultative intracellular parasites)	*Rickettsia, Rochalimea, Ehrlichia, Brucella*]	Not in birds					
Beta division	Bordetella avium	Anseriformes Poultry Passeriformes Psittaciformes	Bordetellosis	Yes	No	Yes	Hinz et al., 1979; Hinz and Glünder,1985; Raffel et al, 2002
Gamma division (Enterobacteriacea) (free-living Gramnegative aerobic rods)	***Escherichia coli*** (APEC – ExPEC)	All orders	Colibacillosis e.g. E. coli O2, O78	Yes	Y/N	Y/N	McPeake, et al, 2005; Ron, 2006
	Salmonella spp many (> 2463) sero- and phage-types	All orders	Salmonellosis	Yes	Y/N	Y/N	Brenner et al, 2000; Millan et al, 2004

	Klebsiella *and other Enterobacteriaceae*	All orders		Yes	Y/N	Y/N	
	Yersinia pseudotuberculosis	Passeriformes	Pseudotuberculosis	Yes	No	No	Poorly documented

	Vibrio spp	Waterfowl	Vibriosis	Yes	Yes	No	Hinz et al, 1999: Miyasaka et al, 2005
	Francisella tularensis	Raptors	Tularaemia	Yes	Yes	No	Morner and Mattsson, 1983; 1988
	Avibacterium spp (***Haemophilus,*** *Pasteurella)*	Poultry	Infectious coryza	Yes	No	Yes	Grebe and Hinz, 1975; Backall et al 2005;
	Pasteurella multocida	Waterfowl poultry	Avian cholera	Yes	No	Yes	Pederson et al 2003; Kumar et al 2004; Kardos and Kiss, 2005; Samual et al, 2005
	Pseudomonas spp, Aeromonas spp	Many orders		Yes	Y/N	No	
	Riemerella anatipestifer	Anserifiormes	Septicaemia	Yes	No	Yes	Segers et al, 1993; Pathanasophon et al, 2002

Gram-negative pleomorphic rods rRNA superfamily V G+C content 37 - 39	***Ornithobacterium rhinotracheale***	Poultry Many bird species	Respiratory disease	Yes	No	Y/N	Empel and Hafez, 1999
(obligate/facultative	***Coxiella burnetti***	Columbiformes	Q fever	Yes	Yes	No	To et al, 1998; Stein and

intracellular parasites)		Passeriformes Anseriformes					Raoults 1999
Epsilon division (curved Gram-negative rods)	***Campylobacter jejuni, C. lari, C. laridis, C. coli***	Many birds Passeriformes Poultry	Avian vibrionic hepatitis	Yes	Y/N	Y/N	Stephens et al, 1998; Tresierra-Ayala and Bendayan, 1998; Chuma et al, 2000
	Helicobacter sp.	Charadriiformes	Gastritis	Yes	Y/N	Y/N	Oxley and McKay, 2005

(obligate intracellular parasites)	***Chlamydophila psittaci***	Psittaciformes Columbiformes Passeriformes Anseriformes	Psittacosis Ornithosis Chlamydiosis	Yes	Y/N	Y/N	Gerlach, 1994b; Olsen et al, 1998; Gautsch et al, 2000; Anderson, 2005
Gram-positive bacteria with DNA of low G+C Content	***Listeria spp.***	Columbiformes Passeriformes Charadriiformes	Listeriosis	Yes	Y/N	No	Quessy and Messier, 1992; Weber et al, 1995; Yoshida et al, 2000;
	Staphylococcus sp, Streptococcus sp,	All birds	Bumble-foot endocarditis	Yes	Y/N	Y/N	
		Passeriformes Columbiformes Falconiformes (Psittaciformes)	Conjunctivitis Upper respiratory tract disease	Yes	No	Y/N	Bozeman et al, 1884; Nagatomo et al, 1997; Lierz et al, 2000; Farmer et al, 2005

	Clostridium perfringens	Passeriformes Psittaciformes Anseriformes Galliformes	Necrotic enteritis, quail disease	Yes	No	Y/N	Gadzinski and Julian, 1992; Asaoka et al, 2004; Murphy et al, 2005; Pisarro et al, 2005; Wilson et al., 2005
Gram-positive bacteria with DNA of high G+C content	***Corynebacterium spp.***	(Psittaciformes) Falconiformes		Yes	Y/N	No	Bangert et al, 1988; Fernandez-Garayzabal et al, 2003
	Actinomyces pyogenes		Arthritis	Yes	No	Yes	Brinton et al, 1993;
	Nocardia nova	Gruiformes	Granulomatous pneumonia	Yes	No	No	Bacciarini et al, 1999
	***Mycobacterium* spp**	Many birds species	Non-tuberculous mycobacteriosis	Yes	Y/N	Y/N	Bercovier and Vincent, 2001; Tell et al, 2001; Katoch, 2004

1. Major groups of pathogenic bacteria, as defined by RNA-based taxonomy in the current edition of *Bergey's Manual of Systematic Bacteriology. 2005 volume.*
2. Most bacteria species consist of many different serotypes and/or phagetypes and "exotic" serotypes may be introduced or unknown to be present in the EU (25).
3. Especially *Borrelia burgdorferi*, a tick-born disease.
4. References are at randomly selected for documentation and illustration but are by no mean exhaustive.

Y/N zoonosis or risk for poultry very dependent on serotype (serovar) or phage-type involved. The majority of strain has no "zoonotic" potential.

15.3. Fungal diseases

Fungal infections are both reported in bird and man like *Aspergillus* sp., *Candida albicans*, *Cryptococcus neoformans*, *Histoplasma capsulatum,* and *Trichophyton* sp (Table 15.3) . In most cases there will be no direct relation between fungal problems in birds and man (Dorrestein and Hage, 1999).
Cryptococcus neoformans and *Histoplasma capsulatum* are similar in many ways. They have been reported related to disease in birds (Bauck, 1994). *C. neoformans* is isolated frequently from the droppings of pigeons, starlings or other avian species. *Histoplasma* spp. grows readily in soil and appear as a white-to-brown molt. This organism has been associated with or found in the feces of chickens, blackbirds, pigeons and gulls. This fungus could potentially proliferate in enclosed aviaries with dirt floors and transport cages. Cryptococcosis and histoplasmosis are potentially serious diseases and may occur when humans inhale dust from the dried droppings of pigeons, starlings or other avian species (Kumlin, et al., 1998).

Table 15.3 Fungal diseases

Name of fungus	**Predominant avian host**	**Name of the disease**	**Present in EU**	**Zoonotic potential**	**Risk for poultry**	**References**
Cutaneous inf						
Candida sp	All species	Candidiasis	Yes	No ?	No	Hubalek, 2004; Lehmann, 1985
Malassezia	All species (?)	Different dermal diseases	Yes	No ?	No	Batra, et al, 2005; Grunder, et al, 2005
Dermatophytes (Trichophyton sp; Microsporium sp., etc)	All species	Ringworm, dermatomysosis	Yes	Yes	No	Grunder, et al, 2005; Efuntoye & Fashanu, 2002
Systemic inf.						
Cryptococcus spp.	Faeces of pigeons, chickens and many other birds	Cryptococcosis	Yes	Yes ?	No	Blaske-Helmessen, 2000; Kohno, 2003; Malik et al, 2003
Blastomyces sp	Faeces of pigeons, chickens and many other birds	Blastomycosis	Yes	No	No	Lehmann, 1985
Histoplasma	Faeces of birds and bats	Histoplasmosis	Yes	No	No	Jimenez, et al, 2002
Coccidioides immitis		Coccidiomycosis	?	No	No	Lehmann, 1985; Gildardo, et al, 2006
Opportunistic						
Candida	All species and environment	Candidiasis	Yes	No?	No	Hubalek, 2004; Lehmann, 1985

Aspergillus sp	All species and environment	Aspergillosis	Yes	No	No	Tell, 2005
Mucorales	All species, environmental	Zygomycosis, mucormycosis	Yes	No	No	Throne Steinlage, et al, 2003; Sundarim, et al, 2005

The introduction of fungal diseases through the import of wild birds is of minor importance. Fungal diseases are an indicator of poor environment and management and hence of poor welfare during the process of catching and transporting the birds into the EU.

15.4. Parasitic diseases

15.4.1. Zoonotic Parasites

Captive birds can serve as definitive or intermediate hosts to a wide range of zoonotic parasites and therefore may pose a potential risk for public health. Below the importance of zoonotic parasites of captive birds is described. Parasites are listed according to their taxonomy (Soulsby, 1982).

Table 8.5 Collated list parasites of captive birds with zoonotic relevance

PROTOZOA	**TREMATODES**	**CESTODES**	**NEMATODES**
Giardia spp. *Cryptosporidium* spp. *Toxoplasma gondii* *Sarcocystis* spp. Microsporidia	*Schistosoma* spp. *Gymnophalloides seoi*	*Mesocestoides* spp. *Diphyllobothrium latum* *Spirometra* spp.	*Baylisascaris procyonis* *Trichinella pseudospiralis* *Capillaria philippinensis* *Gnathostoma* spp.

Parasites of captive birds can be classified according to the level of the certainty of their zoonotic potential as shown in Table 8-2.

Table 8.2 Parasites of captive birds classified according to the certainty level

Certainty of Zoonotic Potential	**Parasite**
Definite	*Toxoplasma gondii**
	Schistosoma spp.
	*Mesocestoides spp.**
	*Diphyllobothrium latum**
	*Spirometra spp.**
	*Capillaria philippinensis***
	Mites
	Ticks

	Fleas
Likely	*Giardia* spp.
	Cryptosporidium spp.
	Microsporidia
	Trichinella pseudospiralis
Uncertain	*Sarcocystis spp.**
	Gymnophalloides seoi
	Baylisascaris procyonis
	*Gnathostoma spp.***

* Human infection is linked with custom of eating raw birds
** Human infection is linked with custom of eating raw fish

These parasites pose a risk to those handling birds but the risk can be controlled by normal hygienic procedures (i.e. de-worming)

15.4.2. Protozoa

NOT EXOTIC

15.4.2.1. Giardia spp.

Members of the genus *Giardia* infect a wide range of vertebrates, including mammals, birds, reptiles, and amphibians (Kulda and Nohynkova, 1996; Adam, 2001) causing gastrointestinal disease. Transmission is through the faecal/oral route, either by direct ingestion of faeces or by ingestion of contaminated food or water.
Giardia has a poorly resolved taxonomy (Monis and Thompson, 2003). Currently, there are six recognised species of *Giardia*, but only one, *G. duodenalis*, is known to infect multiple host species (Thompson, 2000) and only a single genotype (genetic group I from Assemblage A) has been unequivocally demonstrated to infect both humans and animals (Monis and Thompson, 2003). *Giardia* spp. typically found in birds, such as *G. ardeae* and *G. psittaci*, do not appear to cross the host class boundary (Erlandsen and all, 1991).
The evidence for giardiasis being a zoonosis is still limited. It is conceivable that the genotype of *G. duodenalis* infecting both humans and animals has the potential for zoonotic transmission, but the zoonotic potential for avian giardiasis is probably low.

15.4.2.2. Cryptosporidium spp.

NOT EXOTIC

Members of the genus *Cryptosporidium* infect a wide range of vertebrates, including mammals, birds, reptiles, amphibians, and fish causing gastrointestinal disease (O'Donoghue, 1995). Cryptosporidiosis is normally self-limiting in immuno-competent humans, but because there is no known effective drug treatment it is of major concern in immuno-compromised patients. Coupled with the resistance of *Cryptosporidium* oocysts to standard methods (e.g. chlorination) used for the disinfection of water, *Cryptosporidium* is regarded as an important public health threat. Transmission is through the faecal/oral route, either by direct ingestion of faeces or by ingestion of contaminated food or water (Monis and Thompson, 2003).
The taxonomy of *Cryptosporidium* is incomplete and has been based on oocyst morphology, presumed host specificity and cross-transmission studies (O'Donoghue, 1995). Based on morphological criteria and host specificity 10 species have been recognised of which *C. bailey* in poultry, *C. meleagridis* in turkeys and humans, and *C. galli* in finches and chicken (Fayer et al., 2000).

Cryptosporidium meleagridis is the only known species of *Cryptosporidium* that infects both avian and mammalian species (Akiyoshi et al., 2003) but the significance of the zoonotic species of *Cryptosporidium* in human cryptosporidiosis is not yet clear (Gatei et al., 2002). However, *C. meleagridis* from a human patient with diarrhoea was experimentally propagated in chickens, mice, piglets, and calves (Akiyoshi et al., 2003) and *C. meleagridis* has been recognised in immunocompetent humans (McLauchlin et al., 2000; Pedraza-Diaz et al., 2001). It is conceivable that *C. meleagridis* infecting both avian and mammalian species has the potential for zoonotic transmission.

15.4.2.3. Toxoplasma gondii

NOT EXOTIC

Toxoplasma gondii is a coccidian parasite with domestic and wild felids as the definitive hosts and domestic and wild mammals (including man and felids) and birds as the intermediate hosts (Tenter and Johnson, 1997). Transmission of *T. gondii* can take place between the intermediate hosts without involvement of the definitive host and between the definitive hosts without involvement of the intermediate host. Transmission takes place through the faecal/oral route by ingestion of oocysts shed in faeces of infected cats or ingestion of bradyzoites (cysts) in tissues of infected animals.
A wide range of tropical and temperate wild mammals and birds has been found to harbour *T. gondii* (Tenter et al., 2000). *Toxoplasma gondii* infections are subclinical in many wild avian species but toxoplasmosis can be clinically severe in pigeons and canaries (Dubey, 2002).
Toxoplasmosis is one of the most common parasitic zoonoses worldwide and therefore toxoplasmosis of captive birds is of epidemiological importance to humans. Humans can get toxoplasmosis directly from infected captive birds if they consume them undercooked or raw.

15.4.2.4. Sarcocystis spp.

GMD Opposums (Delphinium sp.) are final hosts.

Species of the genus *Sarcocystis* are coccidian intracellular parasites with an indirect life cycle. The asexual stages of *Sarcocystis* develop as intramuscular cysts in the intermediate hosts (herbivores or omnivores), which become infected after ingestion of oocysts from the faeces of definitive hosts (carnivores or omnivores). The sexual stages of *Sarcocystis* develop in the intestine of the definitive hosts, which become infected by preying on the meat of intermediate hosts (Frey, 2004). Most *Sarcocystis* species infect specific hosts or closely related host species. Infections with *Sarcocystis* in waterfowl are frequently encountered in puddle ducks and occasionally in diving ducks, mergansers, sea ducks, geese and swans (Ballweber, 2004).
Humans acquire intestinal sarcocystosis by eating raw or undercooked meat from intermediate hosts. Several domesticated and wild animals, including birds, harbour sarcocysts infective for unknown definitive hosts and are potential sources of human intestinal sarcocystosis (Frey, 2004). Therefore, the zoonotic potential of birds for this parasite is not known.

15.4.2.5. Microsporidia

NOT EXOTIC

The microsporidia are a diverse group of single-celled, obligate intracellular protozoa sharing a unique organelle, the polar filament, and parasitizing a wide variety of invertebrate and vertebrate animals, including insects, fish, birds, and mammals (Canning, 1986). The

microsporidia are considered protozoal organisms, but there is some genetic and molecular evidence suggesting a closer phylogenetic relationship to fungi (Keeling and McFadden, 1998). The microsporidia *Encephalitozoon cuniculi*, E. *hellem*, *E. intestinalis*, and *Enterocytozoon bieneusi* have been identified as opportunistic pathogens of immunocompromised humans, mainly immunoincompetent children and AIDS patients (Wasson and Peper, 2000).
There are a number of reports of spontaneous microsporidial infection in psittacines, including lovebirds (*Agapornis* spp.) (Kemp and Kluge, 1975; Norton and Prior, 1994), budgerigars (*Melopsittacus undulatus*) (Black et al., 1997), and eclectus parrots (*Eclectus roratus*) (Pulparampil et al., 1998).
The zoonotic potential of microsporidia is under discussion but concern has been raised after the recent detection and genotyping of human-associated microsporidia in pigeons from urban parks in Spain concluding that there is no barrier to microsporidia transmission between park pigeons and humans (Haro et al., 2005).

15.4.3. Trematodes

15.4.3.1. Schistosoma spp.

Schistosome parasites, frequently of the genus *Trichobilharzia,* conventionally parasitise ducks, but they can also invade mammals as nonspecific hosts, resulting in cercarial dermatitis (or swimmer's itch) (Horák et al., 2002). Cercarial dermatitis is a severe inflammatory reaction characterized by an early type I hypersensitivity reaction and a late phase of cutaneous inflammation reaction caused by penetration of the skin by schistosome parasites (Kourilová et al., 2004). The disease develops after repeated contact with infectious cercariae and is of increasing importance in human populations throughout large parts of Europe and America (Horák et al., 2002; Kolárová et al., 1999; de Gentile et al., 1996). Human contamination can occur during swimming in fresh water infested with cercariae and notably ducks (Bouree and Caumes, 2004).
Penetration of vertebrate skin by cercariae is a key point in the parasite life cycle. In the avian host, the parasite may continue to migrate to other tissues, but the precise route is not fully understood. *Trichobilharzia regenti* migrates via peripheral nerves to the CNS, and causes serious neuromotor disorders (Horák et al., 1999; Hrádková et al., 2002). In ducks, it ultimately matures in the nasal tissues (Hrádková et al., 2002). *Trichobilharzia szidati* (Syn *T. ocellata*) (Haas and Pietsch, 1991) probably enters lymphatic or venous vessels in the skin and continues via the lungs and systemic circulation to the hepatic-portal system as the final location (Horák et al., 2002; Haas and Pietsch, 1991; Horák and Kolárová, 2000).
Trichobilharzia regenti and *T. szidati* can infect mammalian hosts via a percutaneous route, but neither matures successfully. However, some larvae can reach the lungs (*T. szidati*) (Horák and Kolárová, 2000) or the spinal cord and brain (*T. regenti*), where they cause pulmonary and neuromotor disorders, respectively (Horák et al., 1999; Kolárová et al., 2001). The fate of nonmaturing larvae in mammals is not fully known, although it is suggested that most of them die in the skin (Horák and Kolárová, 2001).
Bird schistosomes spreading via bird vectors throughout Europe (de Gentile et al., 1996) and U.S.A. (Neal, 2004) are considered an emerging zoonosis.

15.4.3.2. Gymnophalloides seoi

Not endemic in the Netherlands

Gymnophalloides seoi is an intestinal fluke of humans and it is transmitted from oysters to humans, and the oysters are commonly eaten raw (Chai et al., 2003). Wading birds, including

plovers, were found to be highly susceptible to experimental infection with this trematode (Ryang et al., 2001). The zoonotic potential of birds for this parasite is not known.

15.4.4. Cestodes

All present in EU.

15.4.4.1. Mesocestoides spp.

The life cycle of *Mesocestoides* species is not completely known. Carnivores (including dogs), birds and humans serve as definitive hosts. Free-living mites serve as first intermediate hosts and amphibians, reptiles, birds, and mammals can serve as second intermediate hosts. *Mesocestoides* spp. have been recorded in the common starling (*Sturnus vulgaris*) (Literak et al., 2004), the falconiform species (*Buteo buteo)* (Sanmartin et al., 2004), and the red-legged partridge (*Alectoris rufa*) (Millan et al., 2003). *Mesocestoides* species (*M. variabilis* and *M. lineatus*) have been recognized as occasional human parasites worldwide. The infection is always linked with the accidental and/or deliberate ingestion of raw viscera or blood of second intermediate hosts containing the infective metacestode stage (tetrathyridium) (Fuentes et al., 2003). Captive birds may pose a zoonotic risk if consumed raw by humans (Eom et al., 1992).

15.4.4.2. Diphyllobothrium latum

Diphyllobothrium latum is a parasitic worm of man and other ichtyophagous mammals. Infection is caused by the ingestion of mostly raw freshwater fish containing plerocercoid larvae (Dupouy-Camet and Peduzzi, 2004). Human infections of *D. dendriticum* appear to be primarily associated with salmonids and coregonid fishes and fish eating birds (Dick et al., 2001). Captive ichtyophagus birds may pose a zoonotic risk if consumed raw by humans.

15.4.4.3. Spirometra spp.

There are several species of *Spirometra* whose second larval stage (plerocercoid or sparganum) is the cause of sparganosis (or larval diphyllobothriasis) in humans. The definitive hosts are mainly domestic and wild canids and felids. The first intermediate host is a copepod, which ingests coracidia (free, ciliated embryos) that develop from *Spirometra* eggs when they reach the water with the faeces of dogs or cats (definitive hosts). The second intermediate hosts include amphibians, reptiles, birds, small mammals (rodents and insectivores), man, nonhuman primates, and swine and harbour the plerocercoid larva when they become infected after ingestion of an infected copepod. Sparganosis in humans can be ocular, subcutaneous, central nervous system, auricular, pulmonary, intraosseous and intraperitoneal (Wiwanitkit, 2005). Humans can acquire infection by sparganum or plerocercoid larva of the tapeworm from drinking water containing infected copepods and by ingesting infected snakes, birds, or other mammals (Tung et al., 2005). Captive birds may pose a zoonotic risk for this parasite if consumed raw by humans.

15.4.5. Nematodes

15.4.5.1. Baylisascaris procyonis

NON EXOTIC

Baylisascaris procyonis is a roundworm of raccoons (Procyon lotor) first described in Europe (Stefanski and Zarnowski, 1951) that is a cause of visceral (VLM), ocular, and neural (NLM) larva migrans in birds and mammals, including man. Humans, birds and animals become infected by accidentally ingesting infective B. procyonis eggs from raccoon latrines or articles contaminated with their feces (Gavin et al, 2005). As with other ascarids, eggs are excreted in faeces and must develop externally, typically in soil, to become infectious. When raccoons

ingest infective eggs, larvae will hatch, enter the wall of the small intestine, and subsequently develop to adult worms in the small bowel. However, ingestion of eggs by other host animals results in extra intestinal migration of larvae (Hamann et al., 1989). Raccoons may also become infected when they eat larvae that have become encapsulated in the tissues of rodents and other animals (Kazakos and Boyce, 1989). Some times, partial or complete development of Baylisascaris adults can take place in animals other than raccoons but it is unknown how often this happens in nature and how these animals became infected (whether by ingestion of infective eggs or larvae in other intermediate hosts) (Greve and O'Brien, 1989).
A wide range of species of wild birds has been found to be susceptible to larva migrans caused by B. procyonis. A study of the prevalence of larva migrans in free-ranging wildlife in California found that 87 birds of 18 species had NLM or VLM or both (Evans, 2002). It is conceivable that imported captive birds infected with B. procyonis may become pray to raccoons and other animals and transmit the disease to local animal fauna. In fact B. procyonis was recently introduced in the raccoon population in the metropolitan Atlanta area, Georgia, USA, even though the infection had been absent from this region of the southeastern United States. No explanation of why this would be happening at this time is obvious but geographic movement of other infectious diseases has been linked to legal or illegal movement of natural host animals for a variety of purposes (Eberhard et al., 2003).

15.4.5.2. Trichinella pseudospiralis

NON EXOTIC

Trichinella pseudospiralis belongs to the non-encapsulated species of the genus *Trichinella* that shows a wider host spectrum than other *Trichinella* species, which includes mammals and birds, because it can complete its life cycle at host body temperatures ranging from 37 to 42 °C (Pozio et al., 2004). Infection with *T. pseudospiralis* is acquired by ingestion of raw meat from infected animals. Experimental infections have shown that *T. pseudospiralis* is infective to various birds (e.g., hens, ducks, magpies, pigeons, crows, sparrows, starlings, partridges, owls, kites and herons) (Bessonov et al., 1976). In addition, natural infection of birds (crows, *Corvus frugilegus*) with *T. pseudospiralis* has been described (Shaikenov, 1980) and nematode larvae similar to that of the genus *Trichinella*, have been detected in 13 different bird species in nature (Pozio et al., 1992, Lindsay et al., 1995 and Pozio et al., 1999), even though *T. pseudospiralis* has been identified at the species level in only seven of them (Pozio, 2005).
The role of birds in the epidemiology of this parasite in comparison to that of mammals is still unknown but human outbreaks of infection with *T. pseudospiralis* have been reported in Russia (Britov, 1997), France (Ranque et al., 2000), Thailand and New Zealand (Takahashi et al., 2000).

15.4.5.3. Capillaria philippinensis

EXOTIC, but not relevant as no direct transmission from birds to humans

Capillaria philippinensis is the cause of intestinal capillariasis in humans in Philippines, Thailand, Japan, Iran, Egypt, and Taiwan, but most infections occur in the Philippines and Thailand. Chronic infections lead to malabsorption, protein and electrolyte loss, and death. The life cycle involves freshwater fish as intermediate hosts and fish-eating birds as definitive hosts. Humans acquire the infection by eating small freshwater fish raw. *Capillaria philippinensis* is considered a zoonotic disease of migratory fish-eating birds. The eggs are disseminated along the flyways of migratory fish-eating birds and infect the fish, and when humans eat the fish raw, they get infected (Cross, 1992).

15.4.5.4. Gnathostoma spp.

EXOTIC, but not relevant as no direct transmission from birds to humans

Gnathostoma larvae are the cause of cutaneous larva migrans in humans (Camacho et al., 1998) who have a custom of eating of raw fish dishes (Camacho et al., 2003). Gnathostomiasis, as the disease is called, is an emerging zoonosis in Mexico and for most endemic zones, the source of human infection has not been established (Leon-Regagnon et al., 2005). Field surveys and experimental infections show that some species of fishes, amphibians and mammals can act as the second intermediate hosts and that some species of reptiles, birds and mammals can act as a paratenic hosts (Ando et al., 1992). Scanning electron micrographs of *Gnathostoma* larvae of human and ichthyophagous birds showed that they were morphologically indistinguishable from *G. spinigerum* (Camacho et al., 1998).

15.4.6. Arthropods

ALL PRESENT IN EU

15.4.6.1. Mites

Birds are hosts to a large mite fauna of medical and veterinary importance. In a study of migratory quail and starling in Egypt 44 species of mites were recovered belonging to 30 families of three suborders (Mesostigmata, Trombidiformes and Sarcoptidiformes) (Mazyad et al., 1999). Bird mites *Dermanyssus gallinae* have been reported to bite humans resulting in urticarial and itchy papulovesicular skin eruptions (Prins et al., 1996) and bird mites *Ornythonyssus bacoti* have been reported to attack human beings indoors (Bogdanova, 2005). In addition, mites of wild birds (*Ornithonyssus sylviarum* and *Dermanyssus gallinae*) can serve as possible vectors of West Nile virus (Mumcuoglu et al., 2005).

15.4.6.2. Ticks

Ticks of birds may attack and feed on humans and serve as possible vectors of diseases. Specifically, soft ticks (*Argas arboreus*) collected directly from wild birds and their nests in Israel were tested positive for the presence of West Nile virus (Mumcuoglu et al., 2005). Also, seabirds have been implicated in a global transmission cycle by demonstrating the presence of Lyme disease *Borrelia* spirochetes in *Ixodes uriae* ticks from several seabird colonies in both the Southern and Northern Hemispheres (Olsen et al., 1995). Finally, ticks (Family: Ixodidae) may transmit to humans babesiosis which is a hemoparasitic disease caused by protozoa of the genus *Babesia* which have occasionally been described from birds (Melendez, 2000).

15.4.6.3. Fleas

Birds are hosts to fleas that may invade and feed on humans. Feral pigeons (*Columba livia*) fleas (*Ceratophyllus columbae*) have been reported to attack humans during the night resulting in allergic urticarial reaction and severe psychological distress with phobic reactions and insomnia (Haag-Wackernagel and Spiewak, 2004). In addition, fleas (*Monopsyllus sciurorum sciurorum*) of the European fat dormouse (*Glis glis*) have been found to carry *Rickettsia typhi* but the potential occurrence of human infections is not known (Trilar et al., 1994).