THE ROLE OF WILDLIFE IN THE CONTROL OF DOMESTIC ANIMAL DISEASES

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Summary: *The persistence or spread of transmissible pathogens in wildlife can sometimes complicate disease control in domestic animals quite considerably. There are currently few prevention or control methods available to facilitate the management of wildlife diseases of veterinary importance.*

In this context, a questionnaire was used to assess the current state of knowledge and obtain the views of Member Countries of the OIE Regional Commission for Europe on the role of wildlife in the control of domestic animal diseases. Of the 53 Member Countries of the Commission, 37 submitted their questionnaire returns within the given time limit[2]*.*

An analysis of the responses received shows that, in Europe, nearly two thirds of the countries have a certain degree of epidemiological surveillance for diseases and pathogens in wildlife. Rabies, trichinellosis, infection of wild birds with a highly pathogenic or low pathogenic avian influenza virus, alveolar echinococcosis, bovine tuberculosis, classical swine fever and African swine fever were the diseases considered to be the greatest cause for concern in Europe. Among the exotic diseases, Rift Valley fever and peste des petits ruminants were considered to present a potential risk of introduction into Europe.

The OIE Delegates or Focal Points for Wildlife in the countries that responded are, theoretically at least, aware of most of the sanitary or medical control methods for diseases transmissible from wildlife to domestic animals. The problems with implementing these methods stem from their technological complexity or difficulty in mobilising the necessary human or financial resources. Some methods, such as vector control, contraception or modification of the natural environment, would appear to be out of reach for the time being, either because of their deleterious effect, because they have not yet been perfected or because the Veterinary Services are unfamiliar with them.

Most of the countries wished to see the OIE continue its involvement in this field and indicated the need to strengthen research, especially on the epidemiology, surveillance or control of wildlife pathogens.

Keywords: *African swine fever – alveolar echinococcosis – bovine tuberculosis – classical swine fever – disease control – Europe – highly pathogenic avian influenza – low pathogenic avian influenza – rabies – trichinellosis – wildlife – zoonose*

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As Kazakhstan and Norway sent their report after the deadline, their contribution has not been included in this report but has been taken into account in the presentation made during the Conference of the OIE Regional Commission.

1. Introduction

Transmissible diseases of production animals are progressively being controlled by the Veterinary Services of Europe. As progress is achieved it also becomes apparent that some pathogens may persist in the natural environment. Some may therefore re-occur or re-emerge and may cause quite considerable economic losses and negatively impact on international trade in animals and animal products. The persistence of transmissible pathogens in wildlife and the possibility of their subsequent spread to domestic animals are put forward as a potential and sometimes major cause of the resurgence of infectious diseases of production animals.

The control of infectious or parasitic diseases of production animals is therefore highly dependent on the ability to manage the risks associated with contacts with wildlife. The measures applied are based on the fundamental concepts of transmissible animal disease control: circulation of the pathogen must be evidenced and measured through the use of epidemiological investigations or surveillance plans; measures to limit the prevalence or incidence must be applied as appropriate, and will depend on the feasibility of applying these measures to both the wild or domestic source population and the target population. The 'weapons' available to the Veterinary Services consist of sanitary or medical measures, sometimes applied simultaneously.

In this report, we shall examine successively the general risks associated with the persistence or spread of transmissible pathogens in wild animal populations, methods for documenting the presence of hazards, control methods and their effectiveness and, lastly, recommendations on how to achieve better control of these hazards in Europe.

2. General definitions in the *Terrestrial Animal Health Code*

'Feral animal' means an animal of a domesticated species that now lives without direct human supervision or control.

'Wild animal' means an animal that has a phenotype unaffected by human selection and lives independent of direct human supervision or control.

'Captive wild animal' means an animal that has a phenotype not significantly affected by human selection but that is captive or otherwise lives under direct human supervision or control, including zoo animals and pets.

In this report, no reference will be made to captive wild animals. The definition of 'animal' given in the OIE *Terrestrial Animal Health Code* includes only mammals, birds and bees. Vertebrate wildlife species also include amphibians, which are by zoological definition terrestrial and aquatic (amphibian) animals, and the various families of reptiles. Although the health of animal species belonging to these groups is a growing concern for the conservation of endangered species, they play a minor role in the problems presented here.

'Risk' means the likelihood of the occurrence and the likely magnitude of the biological and economic consequences of an adverse event or effect to animal or human health.

'Surveillance' means the systematic ongoing collection, collation and analysis of information related to animal health and the timely dissemination of information to those who need to know so that action can be taken.

3. Nature and evaluation of risks

Infectious or parasitic pathogens may be transmitted naturally between animals by direct or indirect contact or via a vector. It is therefore possible for a pathogen to circulate between domestic and wild animal populations living in sympatry (i.e., a situation in which two related species live in the same geographical area). In this case, either one of the two populations may maintain the pathogen and then transmit it to the other population, which becomes the target or 'victim' [1]. If the pathogen stops spreading in the source population, cases will disappear from the target population. Yet the same result can be achieved, albeit less sustainably, if all epidemiological links between the reservoir and the target can be broken, whether by physical or zootechnical means. The spread of a transmissible pathogen in an animal population can be stopped, either through the elimination of the entire population or by the disappearance of susceptible individuals as a result of naturally acquired immunity (following exposure) or

vaccination. The pathogen may nevertheless persist in the environment if there is a susceptible population, which, though neither a reservoir nor a target, can temporarily maintain the infection or transmit it (i.e. a 'bridge' or liaison species [2, 3]), or if the pathogen can survive or persist in a natural element (water or soil). Lastly, even if the pathogen has disappeared from a given population it may continue to circulate in a neighbouring population and subsequently be reintroduced.

The risk we shall be studying in this report is that of a pathogen that persists in a reservoir population of wild animals being transmitted to production animals [4, 8]. When the disease has been eradicated in the target population or is in the process of being eradicated, the persistence of the pathogen in wild animals and its transmission to domestic animals can have consequences that require the implementation of control measures or preventive measures.

In this context, a survey conducted among Member Countries of the OIE Regional Commission for Europe, and for which 37 countries responded, indicated that the following diseases needed to be considered as a priority in each country on our continent: **rabies**, **trichinellosis**, infection of wild birds with a **low pathogenic avian influenza** virus, **alveolar echinococcosis** and **bovine tuberculosis** (the complete list of diseases that were cited at least once is given in Table 1). In the list of diseases considered to present a risk of emerging in a country of Europe, the main diseases cited were: **highly pathogenic avian influenza**, **classical swine fever** and **African swine fever**, **rabies** and **foot and mouth disease**. Lastly, among the diseases indicated as not present in Europe but presenting a risk of introduction, the most frequently cited were: **Rift Valley fever** (12), **African swine fever** (7), **peste des petits ruminants** (6) and **foot and mouth disease** (4).

However, it should be noted that before disease control can be envisaged, the epidemiological status of a disease of domestic animals and its presence in wildlife must be known in order to assess the risk. This is principally achieved by epidemiological surveillance.

4. Surveillance

Surveillance will normally be implemented to fulfil two objectives: the first is to have a permanent overview of the health status of wildlife (monitoring of prevalence). The second objective relates to epidemiological vigilance, aimed at detecting new health events (detection of incidence) [9, 10].

Traditionally, a distinction used to be drawn between passive and active surveillance, but these terms are not considered appropriate, especially since surveillance is never a passive process.

a) General or scanning surveillance is a form of surveillance of mortality and morbidity and is based on the collection of animal carcases or tissues by various means. All animal species may be included in the system.

b) Targeted surveillance meets certain criteria associated with 'planned surveillance' of the health of domestic species. The aim is usually to target a specific disease and/or specific species; in practice, many wildlife sampling schemes relate to game species monitored during hunting activities.

For the purposes of the survey, carried out among Member Countries of the OIE Regional Commission for Europe, four levels of epidemiological surveillance of wildlife [11, 12] were used: only 1 of the 37 countries indicated that no data were collected or transmitted; 9 countries indicated that they were at level 1; 16 at level 2; and 11 at level 3.

The collection of data to be used for the notification of wildlife diseases was reported to be done by the OIE Focal Point for Wildlife in 26 countries, by an approved laboratory in 26 countries, and by another body or person in 23 countries (many countries therefore used various sources); 34 of the 37 countries indicated that they regularly notify wildlife diseases to the OIE.

Once the epidemiological situation has been ascertained and mapped and the trends have been analysed, control measures can be envisaged.

5. Measures to limit the persistence or spread between wild animals and domestic animals

The most commonly used control methods consist of keeping away, isolating or eliminating categories of animals that act as hosts for infectious or parasitic agents transmissible to domestic animals.

Fences

The creation of barriers by means of fencing is a practical measure [13] to isolate wildlife populations and avoid them coming into contact with domestic herds or flocks, which are thereby protected from attack or the transmission of diseases. Fencing does not afford total protection: infected animals or contaminated products may still manage to get through. Furthermore, fences are expensive to erect and especially to maintain. They can have unintended impact on wildlife populations, leading for example to high mortality when these populations no longer have access to watering points or their regular migration corridors. Lastly, a fence will only be effective if it stops all species that can play an epidemiological role.

Elimination of animals

These methods are based on a simple idea: if the reservoir host disappears, the pathogen disappears with it, and if this ultimate goal cannot be achieved, any reduction in the number of infected animals will help to reduce the scale of the disease. The ethical problems raised by these methods, their lack of selectivity or the danger they represent for the environment may sometimes be considerable and highly influenced by the culture and traditions of the countries where they are applied.

Targeted elimination of sick or infected wildlife

This form of control is only applicable if affected individuals can be distinguished from healthy susceptible individuals: general speaking, diagnostic testing can provide a reliable indication of the status of individual animals. However, even if considerable resources can be mobilised (distribution and surveillance of traps, handling of animals), testing followed by elimination of affected animals is difficult to achieve in the case of free-ranging animal populations.

Elimination of all categories of individuals in an animal population with the aim of reducing the density

The aim here is to reduce both the number of infected individuals and the number of susceptible individuals, thereby reducing the number of possible infective contacts. This approach has been adopted on numerous occasions, very often for lack of any other alternative. Attempts to control rabies in foxes, tuberculosis in badgers and classical swine fever in wild boar tend to show that the regulating effect of eliminating animal hosts is difficult to achieve in rapidly growing wildlife populations covering vast areas.

After the sanitary control methods, we shall now look at methods that have recently been developed or are still at an experimental stage, such as medicinal control or prophylaxis based on the administration of chemical or biological products.

6. Measures to treat or immunise wild animals

Whenever feasible, medical prophylaxis for a disease of wild animals can be a valid alternative to the measures presented above, and can offset their negative effects or enhance their effectiveness. We shall look in turn at the three different approaches: medicinal treatments, vaccination and reduction of fertility.

Medicinal treatments

Therapeutic products have sometimes been used in wild animals, in most cases administered orally, hidden in baits and distributed in the natural environment. Only very exceptionally have they been administered by injection.

Vaccination

As with therapeutic products, vaccines for large-scale use in wild animals are more frequently administered by oral route than parenterally [14]. For oral administration, all vaccines that have proven efficacy in domestic animals can be used in wild animals.

The two best documented examples of oral vaccination to date are rabies vaccination of foxes and classical swine fever vaccination of wild boar. They have both demonstrated the feasibility of proactive vaccination control.

When epizootic diseases affect relatively small populations, a vaccination campaign has a high probability of success. In contrast, no really satisfactory results have yet been achieved in the field when it comes to large-scale vaccination of wild animals against the majority of diseases other than rabies.

It is essential for vaccination strategies to take into account the dynamics of both the infection and the host populations.

Reduction of fertility

The aim here is to gradually, and often sustainably, reduce the productivity of an animal population by administering, using the methods mentioned in the previous paragraph, products that will have the effect of preventing fertilisation or interrupting gestation.

Experimental trials of contraceptive vaccines have already taken place in nearly 15 species of mammals [15], but the progress achieved in this area has not yet produced a solution that is effective, harmless and also applicable in the field.

7. Results of the survey: control methods

Density control or the elimination of apparently healthy wildlife hosts in active outbreaks was viewed negatively by the majority of persons who answered the questionnaire; this method was considered “difficult” by 28/37 countries (76%), as “having only a temporary effect” by 18/37 countries (49%), “expensive” by 17 (46%) countries, and “not well accepted by the public” by 15 countries (40%). In contrast, this method was considered “effective and lasting” by 12/37 countries (32%), “well accepted by the public” by 10 countries (27%), “easy to implement” by 6 countries (16%), and “economic” by 4 countries (11%).

The targeted elimination of sick or infected wildlife hosts was considered a “difficult method to implement” in 28 responses out of 37 (76%), a “method having only a temporary effect” by 13 countries (35%), and an “expensive method” by 12 countries (32%). A majority of countries seemed prepared to consider this method, since in their opinion it would be “well accepted by the public” (19 countries [51%]), compared to a minority of responses that considered the measure would be “not well accepted by the public” (2 countries [5%]). Lastly, several countries saw this as an “effective and lasting method” (10 countries [27%]), “easy to implement” (7 countries [19%]), and “economic” 6 (16%).

Contraception or sterilisation applied to targeted wild animals seems to be poorly applicable: 18 countries (49%) considered that the method “has not yet been perfected”, 16 countries (43%) indicated that they “do not know how to apply this method to wild animals”; however, 15 countries (40%) replied that the method “is only applicable to certain populations of domestic animals living wild or animals that can be easily approached by humans”.

Vector control was considered with caution by the respondents: 27 (73%) indicated that it “should only be applied if strict precautions are taken”, as “vector control can have an impact on bees (21 responses [57%]), “on aquatic animals” or “on birds” (18 responses [49%]) or “on Chiroptera” (15 responses [40%]). In the opinion of 18 respondents, “in practice, this method is only feasible in farms or in urban environments”, whereas only three respondents (8%) considered that “these methods are easily applicable and are harmless”.

Fences in the natural habitat were considered “expensive to install and difficult to maintain” by 33 respondents (89%); 25 respondents (68%) considered that “fencing may prevent natural

movements [...] of wild animals" whereas 21 respondents (57%) considered there are examples of effective use of such fencing.

Confinement of susceptible domestic animals received a higher number of favourable responses: 92% of respondents (34/37) considered the method "effective if biosecurity measures are sustainably respected", but 19 respondents (51%) considered the method "only applicable to rational or industrial farms".

The application of medical prophylaxis to wild animals was seen as an alternative but still experimental method: the majority of respondents indicated that the method "has not yet been perfected" (30 responses, 81%), and in a number of cases it was seen as being "very expensive" (21 responses, 57%).

Vaccination of domestic animals was widely seen as preferable when there are suitable vaccines as it is "easier to apply" (35/37 responses [95%]) but on the one hand "this method can hinder international trade" (28 responses, 76%) and on the other hand it "is expensive and [...] must be subsidised by the state" (18 responses, 49%); lastly, "it will not allow the country to obtain a disease free status" (14 responses, 38%).

Finally, many of the respondents (22 [59%]) were unaware of the possibilities offered by modifying the natural environment to keep wild animals away or channel them. Furthermore, a minority (22%) indicated that animal producers were not willing to modify their practices to avoid transmission of diseases and only 8% (3 countries) indicated that animal producers were willing "to modify land use or agricultural practices" for this purpose.

In practice, few control measures were reported as being implemented in the countries that completed the questionnaire. The main control measures are vaccination of domestic animals, which 28 countries (76%) said is being implemented, and targeted or general elimination of wild animals, each of which is being used in nearly half of the countries (46% and 43%, respectively). Less than a quarter use separation fences or vector control (24% and 22%, respectively). Vaccination of wild animals, chiefly against rabies, is being or has recently been used in 62% of the countries. In addition to vaccination to control classical swine fever in wild boar, which is being used in three countries, two other countries use medication of wild animals, one to control alveolar echinococcosis in foxes and the other to control tuberculosis in badgers.

Lastly, it should be pointed out that the options for controlling infection in wildlife populations are not the only solutions that can be envisaged; it may also be possible to maintain economically viable livestock production in a "contaminated" natural environment. This issue led the OIE to develop new concepts in its *Terrestrial Animal Health Code*. These concepts include **compartmentalisation** (creation of an animal subpopulation in one or more establishments under a common biosecurity management system) and **zoning** (geographical delineation of a part of a territory for animal production purposes), based on the separation of domestic and wild animal populations through the implementation of strict farm biosecurity measures [16].

However, there is a willingness to improve the tools currently available to combat infections in wildlife posing a threat to the health of domestic animals. Indeed, our survey showed that, despite the economic crisis, 92% of the countries consider that "research into the epidemiology, surveillance or control of wildlife pathogens is a priority". Among the various options proposed, "coordination of epidemiological investigations or studies on wildlife pathogens transmissible to production animals in Europe" achieved the highest score, closely followed by "development of more appropriate diagnostic or detection methods for wildlife pathogens"; "development of vaccines or treatments" came quite a long way behind the first two research topics.

8. Conclusion

Infection in wildlife poses very real problems for breeding and rearing livestock but in most cases they are limited in time or space. The source of infection in wildlife is in most cases infection of domestic animals, which have a considerably higher biomass than that of wild animals. Controlling infection in its wildlife reservoir is very complex, involves the use of expensive technologies and requires a large workforce operating in often difficult terrain. Wherever possible, methods that enable production animals to be isolated from infectious wild animals by means of real or virtual barriers are clearly preferable (biosecurity).

Thirty-four of the 37 countries that replied to a question on the subject thought the OIE should continue its involvement in matters relating to wildlife. Among the various aspects proposed, the development of guidelines or standards was by far the leading priority identified by respondents, followed by the production of technical documents and training for Focal Points for Wildlife.

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Table 1.– Diseases of domestic or wild animals ranked by priority according to the number of replies to the questionnaire

Disease (priority 1: 5pts; priority 2: 4pts, etc. the score = total of pts/disease)	Priority/ country		Disease	Estimated risk level of emergence in the country
Rabies	73		Highly pathogenic avian influenza	79
Trichinellosis	60		Classical swine fever	78
Low pathogenic avian influenza	38		African swine fever	75
Alveolar echinococcosis	35		Rabies	58
Bovine tuberculosis	35		Foot and mouth disease	50
Newcastle disease	24		Bluetongue	24
Porcine brucellosis	18		West Nile fever	20
Classical swine fever	17		Crimean Congo haemorrhagic fever	18
Aujeszky's disease	16		Low pathogenic avian influenza	15
Bat rabies	15		Rift Valley fever (RVF)	13
Bovine brucellosis	11		Bovine tuberculosis	11
African swine fever	9		Alveolar echinococcosis	9
Q fever	9		Bat rabies	9
Hydatidosis	9		Porcine brucellosis	9
Johne's disease/ paratuberculosis	9		Bovine brucellosis	7
West Nile fever	7		Newcastle disease	6
Bluetongue	7		Tularemia	5
Tularemia	6		Peste des petits ruminants	5
Highly pathogenic avian influenza	6		Aujeszky's disease	4
Foot and mouth disease	6		Trichinellosis	4
Other Mycobacteria	5		Transmissible spongiform encephalopathies (TSEs), including chronic wasting disease, bovine spongiform encephalopathy and scrapie	4
Bovine viral diarrhoea & Border disease	5		Q fever	3
Leptospirosis	5		Other Mycobacteria	3
Ovine and caprine brucellosis	4		Deer epizootic haemorrhagic disease virus infection	3
Lyme disease	4		Hydatidosis	2
Avian chlamydiosis	4		Tick-borne encephalitis	2
Avian tuberculosis	4		Infection with avian paramyxoviruses	2
Infection with avian paramyxoviruses	3		Maedi visna and CAEV	2
Distomatosis	2		Vesicular stomatitis	2
Infectious keratoconjunctivitis	2		Ovine and caprine brucellosis	2
Toxoplasmosis	2		Ovine epididymitis	2
Bovine genital campylobacteriosis	1		Haemorragic fever with renal syndrome	2
Campylobacter jejuni infection	1		Hantavirosis	1
Tick-borne encephalitis	1		Tulavirus infection	1
Hepatitis E	1		Avian tuberculosis	1
Ophidian paramyxovirus	1			
Distemper	1			
Peste des petits ruminants	1			
Fowl typhoid	1			
Salmonella infection in poultry	1			
Salmonellosis due to S. abortusovis	1			