SCIENTIFIC OPINION

Scientific Opinion on African Swine Fever[1]

EFSA Panel on Animal Health and Welfare (AHAW)[2, 3]

European Food Safety Authority (EFSA), Parma, Italy

ABSTRACT

The risk that African Swine Fever virus (ASFV) remains endemic in the Trans Caucasian Countries (TCC) and the Russian Federation (RF) is moderate, while the risk of its spread in these regions is high. The resulting risk of introduction from these regions into the EU is moderate most likely through food waste. The risk of ASFV remaining endemic in wild boar and the consequent introduction into the EU was considered low in the TCC and moderate in the RF, mainly due to the higher population density in the RF and the connected wild boar populations to the EU from the RF. Within the EU, mainly domestic pigs in the free range (FR) and the limited biosecurity sector (LB) are likely to be exposed to ASFV via swill feeding, with low risk. Once infected, the risk of spread from the LB and FR sectors prior detection is high, mainly due to movement of pigs, people and vehicles and moderate from the High Biosecurity (HB) sector. The risk of endemicity in domestic pigs is considered negligible in HB and low in LB since the implementation of control measures are effective. The risk of endemicity in the FR sector is moderate due to wild boar contact, non-compliance with animal movement ban and difficult access to all individual pigs. The risk of ASFV becoming endemic in the wild boar population in the EU is moderate, in particular in areas with connected wild boar populations. Because of their long life, ticks of the *O. erraticus* complex can be important in maintaining local foci of ASFV, where pigs are kept under traditional systems. Ticks do not, play an active role in the geographical spread of the virus. Wild boar have never been found infested because they do not rest inside burrows potentially infested by ticks..

KEY WORDS: African Swine Fever, Risk Assessment, Caucasus, Russian Federation, European Union, wild boar, *Ornithodoros*

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2 Panel members : Philippe Vannier (Chair), Joerg Hartung (Vice-Chair), James Michael Sharp (Vice-Chair), Anette Bøtner, Donald Maurice Broom, Marcus G. Doherr, Mariano Domingo, Linda Keeling, Frank Koenen, Simon More, David Morton, Pascal Oltenacu, Albert Osterhaus, Fulvio Salati, Mo Salman, Moez Sanaa, Jan Arend Stegeman, Endre Szücs, Hans-Hermann Thulke, Anthony John Francis Webster, Martin Wierup . Correspondence: ahaw@efsa.europa.eu

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SUMMARY

Following a request from The European Commission, the Panel on Animal Health and Welfare was asked to deliver a scientific opinion on African Swine Fever and to assess:

- the significance of the occurrence and risk of endemicity of ASF in the countries neighbouring the EU
- the possibility of ASF becoming endemic in domestic pigs and to maintaining itself in a wild boar population in the EU, keeping in mind the differences in virulence of ASF virus strains, in particular the virus strains which are now endemic in the Caucasus region;
- the role played by vectors in the spread and the maintenance of ASF and provide geographical information and maps of Member States displaying the geographical distribution of *Ornithodoros erraticus* as well as other potential invertebrate hosts.

Methodology:

Due to limited data available, a systematic qualitative risk assessment framework based on the World Organization for Animal Health (OIE) guidelines was developed to address the identified risk questions to satisfy the above mandate. The model considered factors affecting spread of the disease and assessed the impact of preventive and control measures. Opinions from the working group members were used to outline the various pathways of the disease occurrence and/or its spread and to assess the likelihood of events occurring. This information was collectively used to obtain overall risk estimates. From the start, exchange of knowledge between the ASFRISK experts (Community's research project: KBBE- 2007-1-3-05, Grant Agreement nº 211691) and the Working Groups existed.

Background information:

The ASFV circulating in the Trans Caucasian Countries (TCC) and the Russian Federation (RF) is a highly virulent virus that has maintained its virulence since the first outbreak in Georgia in 2007. The potential evolution of this virus, however, should be considered since previous experience in other regions, with other strains, indicated a decrease of virulence after a certain period with the potential for certain percentages of swine to develop a chronic form of disease and to become carriers.

Table 1: Risk estimates for TOR 1 and 2

Risk question	Region/ sector	Risk estimate	Main rational
RP1: Risk of ASF remaining endemic in domestic pigs in the Caucasus	TCC	Moderate	Insufficient outbreak response
	RF	Moderate	Insufficient outbreak response
RP1: Risk of ASF spreading to unaffected area	TCC	High	Non-compliance with control measures
	RF	High	Non-compliance with control measures
RP1: Risk of ASF being released into the EU (domestic pigs)	TCC	Moderate	Illegal movement of swill and food waste
	RF	Moderate	Illegal movement of swill and food waste
RP2: Risk of ASF remaining endemic in wild boar in the Caucasus	TCC	Low	Low population density
	RF	Moderate	Connected wild boar populations
RP2: Risk of ASF release into the EU (wild boar)	TCC	Low	No connected wild boar populations
	RF	Moderate	Connected wild boar populations
RP3: Exposure of EU domestic pigs following illegal introduction of ASFV with swill	EU-HB,	Negligible	Swill feed ban
	EU-LB,	Low	Non-compliance with swill feed ban
	EU-FR	Low	Non-compliance with swill feed ban
RP4: Risk of ASF becoming endemic in domestic pigs in the EU	EU-HB	Negligible	Uncertainty in estimates
	EU-LB	Low	Uncertainty in estimates
	EU-FR	Moderate	Difficulty in implementation of control measures
RP5: Risk of ASF becoming endemic in wild boar in the EU	EU	Moderate	High population density/connected populations in certain areas

TCC: Trans Caucasus Countries, RF: Russian Federation, EU-HB: high biosecurity sector in the EU, EU-HL: limited biosecurity sector in the EU, EU-FR: free range sector in the EU

The little information available from the eastern neighbouring countries of the EU and the Caucasus shows generally a very low density of wild boar, usually less than one head per km^2. However, high densities do occur in some areas of the TCC and RF. In the EU the wild boar population also varies in density but is generally increasing. Although movement of wild boar is limited, spread of viral diseases is quite common if the wild boar populations are connected through the continuity of the habitat.

According to the EU legislation, all trade and import to the EU of live pigs and products of pig origin from the TCC and the RF is banned. Illegal imports of live pigs and products of pig origin, however, are impossible to quantify due to lack of data. Waste food from international means of transport is not always treated according to the EU legislation. The volume of live pigs and pork traded among the MS is substantial and varies by year and region/country. There is also a considerable movement of people (and with them potentially infected pork products) between the eastern neighbouring countries of the EU and the EU MS that is difficult to control.

Risk Assessment:

The risk of maintenance and spread of ASFV in the TCC and the RF is moderate, while the risk of its spread in these regions is high and the resulting likelihood of introduction into the EU is moderate. Recently more cases have been reported in the RF. Factors affecting the risk of spread were similar in both areas; however differences were identified in the outbreak response due to more accurate case confirmation and implementation of rapid actions in the RF. Preventive long term responses are insufficient in both TCC and the RF.

Overall, the risk of ASFV remaining endemic in wild boar was considered low in TCC and moderate in RF mainly due to the higher host population densities in the RF. Given the proximity to some EU MS of some currently affected areas in RF, the possibility of the disease spreading into neighbouring countries through connected wild boar populations and there is currently a moderate risk that wild boar could release the disease from RF into the EU.

Within the EU, domestic pigs in the free range (FR) and limited biosecurity (LB) sectors are likely to be exposed to ASFV via swill feeding, with an estimated low risk, whereas in the High Biosecurity sector (HB) the risk of exposure following illegal importation of swill feed is considered negligible due to compliance with the swill feed ban and the risk for spill-over to the HB sector before detection was considered low. Once HB, LB or FR sectors are infected, the likelihood of spread prior detection from these sectors is moderate, high and high respectively, mainly due to movement of pigs, people and vehicles. Considering that the LB sector is the most predominant in some EU countries, the high risk of spread before detection in this sector will have considerable consequences for certain infected MS.

The risk of endemicity in domestic pigs is considered negligible in HB and low in LB. In the HB and LB sectors the implementation of control measures is effective, however, there is a higher uncertainty in the likelihood estimate to eradicate ASFV in the LB sector, leading to the low likelihood of endemicity (compared to negligible in the HB). Failures in record keeping and non-compliance with animal movement bans are considered the main threats. The risk of endemicity in the FR sector is moderate due to wild boar contact, non-compliance with animal movement bans and lack of access to all pigs. The risk of ASFV becoming endemic in the wild boar population in the EU is moderate. This is mainly due to spread in areas with high population density. Disease control in wildlife is difficult in general.

Role of ticks:
Of all the invertebrates tested up to the present, only soft ticks of the genus *Ornithodoros* have been demonstrated to be ASFV competent vector either naturally or experimentally. *Ornithodoros* ticks feed mainly on animal species living in burrows, such as rodents and reptiles. Pigs are mostly

accidental hosts, which can transmit the virus. The epidemiological role played by ticks may become important where pigs are managed under traditional systems, including old shelters/sties with crevices, where *O. erraticus* are difficult to eradicate.

The *O. erraticus* complex may be important in maintaining the local foci of ASFV due to their long life (up to 15 years), survival for many years between feeds and persistence of infection for up to 5 years. This type of maintenance of the virus may lead to endemicity in a region. These ticks, however, do not play an active role in the geographical spread of the virus because they stay on their hosts for a relatively short period of time.

Wild boar have never been found infested with this type of ticks because, unlike warthogs, they do not rest in protected burrows, which may be inhabited by ticks.

Data on associated factors with the distribution of soft ticks are limited and therefore their potential distribution is difficult to predict.

Recommendations:

- An integrated strategy involving TCC, the RF and the EU would facilitate the trans-boundary control of ASF, including an information exchange platform. This would be strengthened by identifying gaps in knowledge and needs.
- Develop a specific ASF eradication strategy for backyard holdings in TCC, RF and EU.
- Promote knowledge and implementation of biosecurity principles , including mechanisms to reduce or prevent contact between domestic pigs and wild boar in TCC, the RF and the EU.
- Based on the risk assessment, the reduction of the risk for ASFV endemicity in TCC and RF and spread to other regions could be achieved by support to enhance early warning and preparedness and rapid and long term control responses.
- Awareness of both pig farmers and veterinarians of the risk of ASF especially in limited and free-range production sectors should be increased. Inform farmers about the potential origin of infected products.
- Passive surveillance of domestic pigs and wild boar requires strengthening in all MS.
- Active surveillance of wild boar (e.g. routine testing of hunting bag) especially in countries within ecological corridors should be implemented.
- Systematic differential diagnosis for CSF and ASF is required.
- Enhance enforcement of the EU legislation on destruction and disposal of waste food from international means of transport, e.g. by increasing the awareness of the official veterinarians at the MS Border Inspection Posts.
- Further studies are required to improve the predictive value of models for tick distribution.
- Determine the potential carrier status of animals infected with ASFV currently circulating in the TCC and the RF because they could play a potential role in the development of endemicity.

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BACKGROUND AS PROVIDED BY THE EUROPEAN COMMISSION

African swine fever (ASF) is caused by a DNA virus, *Asfivirus*, the sole member of the *Asfaviridae* family. It is a highly contagious virus infection of domestic pigs, with the potential for very serious and rapid spread, irrespective of national borders. Apart from direct contacts between infected and uninfected animals, it is also transmitted through the ingestion of contaminated feed and by certain soft tick species (*Ornithodoros* species). Although different virus serotypes cannot be identified, ASF virus strains differ in virulence, leading to acute, sub-acute and chronic forms of disease. European wild boar are equally susceptible to ASF, which makes the control the infection very difficult if it becomes endemic in these populations. ASF has serious socio-economic impact on people's livelihoods, on trade of animals and animal products, and on protein-food security in countries were many pigs are kept for self consumption.

The potential distribution of the infection is transcontinental and wherever swine are raised, ASF may emerge to a serious animal health problem. Therefore most countries free of the infection take strict measures to prevent entry. The disease is endemic in domestic and wild porcine species in most of sub-Saharan Africa and in the EU in Sardinia. Where the infection occurs in a territory, pig production is sustainable only by adoption of high biosecurity levels by strict separation of non-infected herds from suspect herds or from infected wild boar populations.

In areas where competent vectors of the *Ornithodoros* tick genus exist, transmission via these vectors can be important for virus persistence over long periods. Maintenance of ASF virus in domestic pigs or wild boar in the absence of *Ornithodoros* ticks is probably dependant on the existence of large, contiguous populations of pigs whose high reproductive rate or regular introduction of pigs (piglets) from free areas ensures constant availability of naïve pigs for infection and further spread on the virus.

Outbreaks of ASF were first reported in 2007-2008 in the Caucasus region (Georgia, Armenia, Azerbaijan, Russia) and are likely to spread initially to Eastern Europe or Member States. The actual epidemiological situation in the Caucasus region is obscure. Although there are no recent official reports of new cases, there is still evidence that the disease is spreading throughout the region. From the information available it can be assumed that the infection has became endemic and poses a permanent threat to the neighbouring regions including the Member States in Eastern Europe.

The measures to control ASF are laid down in Community Legislation (Council Directive 2002/60/EC)[4] and Commission decision 2003/422/EC)[5]. No vaccines or drugs are available to prevent or treat ASF infection. All control and eradication measures applicable are based on classical disease control methods, including intensive surveillance, epidemiological investigation, tracing and stamping out of infected herds, designation of protection and surveillance zones. These measures are combined with a ban of swill feeding, strict quarantine and biosecurity measures and animal movement control Prevention in free countries is reinforced through strengthened import controls and especially by proper disposal of waste food from aircraft/ships coming from infected countries.

Concerning the epidemiology of ASF, important gaps of information remain about the real role of wild boar and soft ticks (*Ornithodoros* spp.) in the maintenance of ASF virus, and of their role in the possible transmission to domestic pigs. In the Iberian Peninsula the soft tick species *Ornithodoros*

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[4] Council Directive 2002/60/EC of 27 June 2002 laying down specific provisions for the control of African swine fever and amending Directive 92/119/EEC as regards Teschen disease and African swine fever (Text with EEA relevance), *OJ L 192, 20.7.2002, p. 27–46*

[5] Commission Decision of 26 May 2003 approving an African swine fever diagnostic manual (Text with EEA relevance) (notified under document number C(2003) 1696), *OJ L 143, 11.6.2003.*

erraticus was implicated as a vector of ASF virus for domestic pigs. However, less is known about the distribution of this vector in other Member States and other potential invertebrate hosts in Europe. It remains to be established if wild boar could have a reservoir role or are only infected in areas where there are ongoing outbreaks in domestic pigs, and if there are other biological vectors involved in which case it could be necessary to investigate their vectorial capacity or biting habits.

The presence of ASF in EU neighbouring countries represents a challenge for animal health risk managers. It is therefore necessary to determine the extent of the problem in order to better manage the risk. In addition, risk managers have to manage areas of uncertainty, such as the role played by the vectors and of the risk of the disease becoming endemic in the EU vicinity.

In order to support the Commission and the Member Sates in improving the control and eradication measures as regards ASF in wild boar and domestic pigs, scientific evidence from EFSA would be required in this area.

TERMS OF REFERENCE AS PROVIDED BY THE EUROPEAN COMMISSION

In view of the above, and in accordance with Article 29 of Regulation (EC) No 178/2002[6], the Commission asks EFSA for a scientific opinion on:

- the significance of the occurrence and risk of endemicity of ASF in the countries neighbouring the EU;
- the possibility of ASF to become endemic in domestic pigs and to maintain itself in a wild boar population in the EU, keeping in mind the differences in virulence of ASF virus strains, in particular the virus strains which are now endemic in the Caucasus region;
- the role played by vectors in the spread and the maintenance of ASF and provide geographical information and maps of Member States displaying the geographical distribution of *Ornithodoros erraticus* as well as of other potential invertebrate hosts.

BACKGROUND INFORMATION FOR RISK ASSESSMENT

1. Introduction

African swine fever (ASF) is a viral swine disease caused by an icosahedral complex DNA virus that affects only porcine species of all breeds and ages. The disease was described for the first time in Kenya by Montgomery in 1921 when the virus spread from infected warthogs (*Phacochoerus aethiopicus*) to domestic pigs (*Sus scrofa*) causing a disease with a 100% case-fatality rate. The disease is currently present in Africa, mainly in many countries located south of the Sahara, in most of which the disease is endemic. In Europe, ASF is still endemic in Sardinia. More recently in 2007, ASF virus (ASFV) spread to the Trans Caucasus Countries (TCC) and the Russian Federation (RF).

Pigs are the only domestic animal species which are infected naturally by ASFV. Wild boar have also been identified as susceptible to ASFV infection with clinical signs and case-fatality rates similar to those observed in domestic pigs in Spain and Portugal, in Sardinia (Italy) and, experimentally, in feral

[6] Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety. *OJ L 31, 1.2.2002, p. 1–24.*

pigs in Florida (McVicar *et al* 1981; Sanchez-Vizcaino 2006). Wild boar and feral pigs can transmit the infection directly to domestic swine as well as among them. In Africa, it has been observed that ASFV induces an unapparent infection in three species of wild pigs, warthogs, bush pigs and red river hog, while the role played by the Giant Forest Hog has not yet been clarified (Jori *et al*, 2009).

Some species of soft ticks have proved to be ASFV reservoirs and vectors, such as *Ornithodoros moubata* and *O. porcinus* in Africa and *O. erraticus* in the Iberian Peninsula (Spain and Portugal). In *O. moubata*, transovarial and transtadial ASFV transmission has been described; in *O. erraticus* only transtadial transmission has been demonstrated. Other soft tick species widely distributed in North and South America have been identified as harbouring and transmitting ASFV, and a new species of soft tick, *Ornithodoros savignyi*, present in Africa, can transmit ASFV to domestic pigs experimentally.

ASF virus is spread among domestic pigs via the oral-nasal route. However, it has also been demonstrated that the virus can be infectious by a number of other routes, including tick bites, and experimental inoculation via cutaneous scarification, and by the intramuscular, intravenous, subcutaneous and intra-peritoneal routes. Primary infection usually commences in the monocytes and macrophages of tonsils and mandibular lymph nodes. From there, it spreads through the draining lymph nodes and blood to the target organs (lymph nodes, bone marrow, spleen, lung, liver and kidney) which are the principal sites of secondary replication.

The clinical signs of ASF can resemble a variety of other swine haemorrhagic diseases and can easily be confused with hog cholera (classical swine fever) and erysipelas. Laboratory tests are necessary to confirm diagnosis. On the other hand, ASF can present different clinical signs, mostly depending on the virulence of the virus, infectious dose and mode of infection, with a range of clinical forms varying from acute to subclinical and chronic.

ASFV is maintained in Africa by a cycle of infection between wild pigs/*suidae* and soft ticks. In some of these wild pigs/*suidae*, ASFV infection is characterised by low levels of virus in the tissues and low or undetectable levels of viraemia, but this is sufficient to infect ticks and for tick transmission to domestic pigs. This disease cycle makes it very difficult to eradicate ASF in Africa. In Sardinia, where ASF is still present, wild boar are as susceptible as domestic pigs. No ticks from the *O. erraticus* complex have been found.

Experience of past outbreaks outside Africa has shown that the introduction of ASFV into a non-infected pig population in free regions is most often related to the entry through international ports or airports of garbage containing uncooked pork which is used for pig feeding. Once ASFV is established in domestic swine, infected animals are the most important source of virus dissemination for susceptible pigs. In Europe, ASFV was introduced for the first time in 1957 in Portugal, through waste from international flights. Although this first outbreak was rapidly eradicated, in 1960 the virus entered again in Lisbon (Portugal) and spread through the rest of Portugal and Spain, where ASFV remained endemic until 1995. During this period, some other outbreaks occurred in other European countries, affecting Andorra (1975), Belgium (1985), France (1964, 1967 and 1974), Malta (1978), The Netherlands (1986) and Italy (1967, 1969 and 1993), including Sardinia island, where ASF has remained endemic since 1978. All these virus introductions were also related with swill feeding.

At present, no treatment or effective vaccine against ASFV is available. Since 1963, when the first live-attenuated vaccine was used in Portugal, many efforts have been made in this area with unsatisfactory results. Since no vaccine for ASFV is yet available, the control of this disease in free areas depends on preventing the introduction of the virus. Epidemiological studies have shown that the most frequent source of ASFV contamination was garbage from international airports or ports. Therefore all waste food from planes and ships should be incinerated (Sánchez-Vizcaíno, 2006).

In Europe, several epidemiological paths are known to be able to maintain the virus in domestic pig populations and this complicates the control of the disease. The main routes of transmission are: swill, domestic pig and wild boar interactions, and pig-tick interactions.

2. Characteristics of ASFV strain currently circulating in the Trans Caucasus Countries and the Russian Federation

A detailed description of the genome, the virus structure, the different strains and the genetic typing, as well as the virulence and the stability of the ASFV circulating in Africa can be found in the Scientific Report submitted to EFSA by a consortium in accordance with Art. 36 Regulation No 178/2002 (EC, 2002)[7]: http://www.efsa.europa.eu/en/scdocs/doc/5e,0.pdf.

2.1. Genetic characteristics

Partial sequencing of several genes (including B646L, CP204L, E183L, B602L) from the Georgian isolate obtained in June 2007, showed that this isolate was closely related to isolates belonging to genotype II (Rowlands *et al*, 2008). Genotype II has been identified in Mozambique, Zambia and in Madagascar, the latter following the introduction of ASFV in 1998. Subsequent to the outbreak in Georgia, the ASFV isolate introduced to Mauritius in 2007 was also identified as belonging to genotype II (Lubisi *et al*, 2009). To date, with the small amount of sequence information available from partial sequencing of the B646L gene, no differences have been identified between isolates from Georgia and Russia (Kolbasov, pers. communication). The complete genome sequence of the isolate first introduced to Georgia has been determined (Chapman *et al*., 2008). This shows that the genome is about 189 kbp long and encodes 188 open reading frames. These genes include members of multigene families 360 and 530 which are virulence markers. The Georgia isolate causes haemadsorbtion of red blood cells around infected cells. As expected, the EP402R gene, which encodes the CD2v protein required for this process, is intact. Based on previous experience from Spain and Portugal, less virulent isolates with a reduced virulence emerged once ASFV circulates in domestic pigs. The presence of sero-positive pigs is suggestive of the presence of less virulent strains since infection with highly virulent isolates usually results in death before an antibody response is generated. Unless there is a substantial decrease in mortality rate, it is unlikely that less virulent isolates would be detected by experimental infections of small groups of pigs. Screening for the presence of genes, such as members of MGF360 and 530, which are implicated in virulence and replication in ticks, could help to identify virus variants that may occur over time and which are predicted to be of reduced virulence.

2.1.1. Virulence of different ASFV strains

Experience in other regions, with other ASFV strains, and experimental infections have shown that ASFV isolates can vary considerably in their virulence. In pigs infected with highly virulent and moderately virulent ASFV isolates, onset of viraemia is observed from 3 days post-infection and reaches very high levels. Virulent isolates cause mortality approaching 100% in pigs of all age classes, usually between 5 to 12 days post-infection. Thus, death often occurs before an effective antibody response develops. A proportion of pigs infected with moderately virulent isolates recover from infection and in experimental infections it was shown that virus can persist in the recovered pigs for periods of up to 6 months (Wilkinson and Wardley 1981, Wilkinson 1984; Arias and Sanchez-Vizcaíno, 2002a). In pigs infected with low virulence isolates, only sporadic low viraemia is observed although moderate levels of virus replication can be detected in lymphoid tissues. Most pigs infected with these low-virulence isolates show no disease signs but some pigs develop a chronic form of disease (Leitao *et al*., 2001; Boinas *et al*., 2004; Sanchez-Vizcaíno 2006; Scientific Report submitted

[7] Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002

to EFSA by a consortium in accordance with Art. 36 Regulation No 178/2002[8] (EC, 2002): http://www.efsa.europa.eu/en/scdocs/doc/5e,0.pdf.

Low-virulence isolates have been reported from the Iberian Peninsula. Pigs which recover from infection are usually protected against challenge with closely related virus isolates (Sanchez-Vizcaino 2006).

2.1.2. Field observation with Caucasus ASFV strain

The initial outbreaks of ASFV in domestic pigs in the TCC and RF have been reported to cause acute disease with high mortality in pigs, typical of highly virulent ASFV isolates including other isolates from Genotype II. Subsequent reports have also mainly reported high fatality in pigs which are infected. It is difficult to estimate from these reports the percentage of pigs that may recover since stamping out is usually applied. It was observed that although virulence of the virus was high, healthy animals occurred in herds of infected animals (D. Kolbasov, personal observations). However, post-mortem examinations are often not performed to detect signs of diseases.

2.1.3. Experimental infection with the Caucasus ASFV strain

Preliminary experiments carried out at Friedrich-Loeffler-Institute (FLI) using the Armenian (Caucasian) ASFV isolate have shown that infected pigs develop acute signs of ASF, typical of highly virulent isolates. So far, only limited numbers of domestic weaned or young fattening pigs were inoculated. Following intramuscular inoculation, all animals developed fever between two to four days post-infection and died after a short, acute illness. During the course of infection, most animals developed hyperacute signs with maximum body temperatures of more than 41.5°C. In general, clinical signs were rather nonspecific including severe depression, anorexia, diarrhoea, and slight conjunctivitis. Some animals living beyond the first few days following infection showed severe circulatory problems including cyanosis, dizziness (staggering, tumbling), and seizure-like behaviour after agitation. Case fatality was 100%. During post-mortem examinations, enlarged and bloody gastro-hepatic lymph nodes were commonly found.

Similar signs were observed during experiments carried out at the Russian National Institute of Veterinary Virology and Microbiology in Pokrov, where piglets were inoculated intramuscularly with ASFV isolates obtained either from domestic pigs from Abkhazia or wild boar from Chechnya (Kolbasov, pers. communication). Preliminary results from a small animal trial with intranasally infected wild boar suggest that wild boar show a clinical course similar to domestic pigs (Kolbasov, pers. communication).

2.2. Stability of the virus

ASF virus is very resistant to inactivation in environmental conditions. For example, contaminated pig pens in the tropics were shown to remain infectious to domestic pigs for three, but not five days (Montgomery, 1921). The virus can be isolated from sera or blood kept at room temperature for 18 months.

ASF virus is inactivated by heat treatment at 60°C for 30 min and by many solvents that disrupt lipid bilayers and by commercial disinfectants (1% formaldehyde in 6 days, 2% NaOH in 1 day). Paraphenylphenolic disinfectants are very effective. ASFV can survive over long periods (months or years) when frozen or stored at 4°C (Dixon *et al*., 2005). Infectivity is stable over a wide pH range. Some infectious virus may survive treatment at pH4 or pH13.

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[8] Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002

In meat products, ASFV may persist for several weeks or months in frozen or uncooked meat (Wilkinson, 1989). In products prepared by curing, such as Parma ham, viral infectivity was not demonstrated in ham 300 days after processing and curing (Farez and Morrley, 1997). The virus survived for 140 days in Iberian and Serrano hams and for 112 days in loin. However, in these curing processes, virus inactivation occurs before the products are released for marketing (see table 2). No infectious ASFV has been found in cooked or canned hams when processed at 70°C.

See also chapter 2.4 of the Scientific Report submitted to EFSA by a consortium in accordance with Art. 36 Regulation of EC 178/2002 (EC, 2002)[9] for a detailed description of the virus resistance and persistence:
http://www.efsa.europa.eu/cs/BlobServer/DocumentSet/CFP_AHAW_2007_02_ASF,0.pdf?ssbinary=true

Table 2: Survival of ASFV in meat and meat products (Adkin *et al.* 2004)

Product	Virus survival time (days)
De-boned meat	105
Meat bone-in	105
Ground meat	105
Salted de-boned meat	182
Salted meat bone-in	182
Cooked de-boned meat*	0
Cooked meat bone-in*	0
Canned meat	0
Dried de-boned meat	300
Dried meat bone-in	300
Smoked de-boned meat	30
Frozen meat	1000
Dried fat	300
Offal	105
Skin/fat	300

*Cooked meat at least 70ºC for 30 minutes

Table 3: Survival of ASFV in Iberian products and Serrano hams

Product	Time of commercial day (days)	ASF survival time (days)	Source
Iberian ham	365-730	140	Mebus *et al*. 1993
Iberian shoulder	240-420	140	Mebus *et al*. 1993
Iberian loin	90-130	112	Mebus *et al*. 1993
Serrano ham	180-365	140	Mebus *et al*. 1993
Parma ham	>365 days	183	McKercher *et al*. 1987

Table 4: Survival of ASFV in different conditions

Conditions	ASFV survival time	Source
Temperature of 50º C	3 hours	USDA, 1997
Temperature of 56º C	70 minutes	Mebus *et al*, 1997
Temperature of 60º C	20 minutes	Mebus *et al*, 1997
pH < 3.9 or pH > 11.5 (serum free media)	minutes	Mebus *et al*, 1997
pH 13.4 in serum free media	21 hours	http://www.oie.int/esp/maladies/fiches/e_A120.htm
pH 13.4 with 25% serum	7 days	http://www.oie.int/esp/maladies/fiches/e_A120.htm
Blood stored at 4 º C	18 months	Technical disease cards of Lowa State University, 2006
Blood on wooden bars	70 days	USDA, 1997
Putrefied blood	15 weeks	USDA, 1997
Faeces held at room temperature	11 days	Technical disease cards of Lowa State University, 2006

[9] Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002

Contaminated pig pens Slurry at 65º C	1 month 1 month	Technical disease cards of Lowa State University, 2006 Turner and Williams, 1997
Product		
Susceptible to ether and chloroform		http://www.oie.int/esp/maladies/fiches/e_A120.htm
Inactivated by 0.8% sodium chloride	30 minutes	http://www.oie.int/esp/maladies/fiches/e_A120.htm
Hypochlorites - 2.3% chlorine	30 minutes	http://www.oie.int/esp/maladies/fiches/e_A120.htm
0.3% formalin	30 minutes	http://www.oie.int/esp/maladies/fiches/e_A120.htm
3 % ortho-phenylphenol	30 minutes	http://www.oie.int/esp/maladies/fiches/e_A120.htm
Iodine compounds		http://www.oie.int/esp/maladies/fiches/e_A120.htm
Slurry addition to concentration of of 1 % NaOH or Ca(OH)2 at 4º C	1 minute	http://www.oie.int/esp/maladies/fiches/e_A120.htm
Slurry addition to concentration of 0,5 % NaOH or Ca(OH)2 at 4º C	30 minutes	Turner and Williams, 1999
Environ (1/E) (o-phenylphenol) 1 %	1 hour	Stone and Hess 1973

Table 5: Disinfectant/chemical selections and procedures -African swine fever and classical swine fever (AUSVET PLAN, 2000)

Item to be disinfected	Disinfectant/chemical/procedure
Live animals	Euthanasia
Carcases	Bury or burn
Animal housing/equipment	Soaps and detergents, oxidising agents and alkalis.
Environs Consider	Insecticides (organophosphates and synthetic pyrethroids) for tick eradication, otherwise N/A
Humans	Soaps and detergents
Electrical equipment	Formaldehyde gas
Water	Drain
–tanks	N/A
–dams (reservoirs)	
Feed	Bury or burn
Effluent, manure	Bury or burn, Acids and Alkalis
Human housing	Soaps, detergents and Oxidising Agents
Machinery	Soaps, detergents and Alkalis.
Vehicles	Soaps, detergents and Alkalis.
Clothing	Soaps, detergents, Oxidising agents and Alkalis.
Aircraft	Soaps, detergents and Virkon.

2.3. Transmissibility including modes of transmission

2.3.1. Direct pig to pig transmission of the Caucasus strain

In animal experiments conducted at FLI with the ASFV isolate from Armenia, direct contact between infectious and susceptible individuals always leads to infection and disease. Thus, this isolate seems to be highly efficient in transmitting the infection by direct contact (Blome, personal communication). In Russia, affected farms comprised diseased and healthy pigs in the same building. The lack of antibodies also suggests that these healthy animals were not infected rather than recovered. Nevertheless, all pigs that were infected died, consistent with a virus of high virulence (Denis Kolbasov, personal communication).

Field experience also showed that in small Caucasian farms, where feed from reliable resources was provided, and direct contact with infectious free ranging pigs was prevented, no additional cases were observed.

2.3.2. Transmission observed in other regions and experimental infections

Different modes of transmission of ASFV are known to occur in scenarios outside Africa. The scenarios can be divided into those that involve ticks and those without a tick contribution. Moreover, the target species and/or husbandry systems add to the scenario and the possible ways of transmission. In past outbreaks in Europe, introduction was often due to infected raw meat or uncooked swill fed to domestic animals. Besides direct contact, indirect contact through people, vehicles, and fomites can play a role in ASFV transmission. These routes of transmission seem only to be efficient when a high virus load is involved as infectious blood is the main matrix by which the virus is indirectly transmitted. In situtations where ASFV infection is only present in a domestic pig population, the most common route is by direct contact between infected and susceptible animals (Sanchez-Vizcaino, 2006). Direct transmission has been shown to occur by several routes including oral, nasal, subcutaneous and ocular routes and to require very small quantities of virus. Experimental transmission by direct contact was also observed from pigs infected with a low-virulence isolate, although in this case transmission was less efficient (42-50%) compared to that observed with high virulence isolates (100%) (Boinas *et al*., 2004). Experiments performed to determine if aerosol transmission could occur over short distances showed infection in 8 out of 10 pigs, exposed for 6 days on a platform 2 to 3 metres above 8 infected pigs, (Wilkinson and Donaldson 1977). However experience from the field shows that aerosol transmission over longer distances does not occur. For example, Montgomery (1921) showed that transmission was prevented when direct contact was prevented by double fencing. This is the current biosecurity practice implemented in some areas in Africa. In the Iberian Peninsula, direct transmission by contact between healthy and sick animals, in the presence of infected blood, has been demonstrated as the most common route of transmission (Sanchez-Vizcaino 2006).

Observations suggest that pigs which recover from disease may remain persistently infected over long periods without signs of disease and thus have the potential to act as virus carriers. For example, following experimental infection with a moderately virulent isolate, transmission by direct contact between infected and uninfected pigs was shown to occur for up to 30 days after infection, or for 56 days in the case of contact with blood products (Wilkinson *et al*., 1989). Experimental infections also showed that virus can be isolated from lymph tissues from pigs up to 6 months after infection (Wilkinson, 1984). In another study, ASFV DNA was detected in peripheral blood mononuclear leukocytes at more than 500 days post-infection by a PCR assay (Carrillo *et al*., 1994). Even if virus shedding may not occur from pigs infected for long periods, virus in tissues may still pose a threat for transmission of ASF if uncooked meat from apparently healthy carrier pigs is fed to uninfected pigs.

Since neutralising antibodies are not effective in eliminating ASFV from infected pigs, virus persists after an antibody response is mounted. The period over which virus persists and the percentage of pigs which become virus carriers is not well defined in field situations. It is presumed this can be at least for the same length of time as that described above for experimental infections. The detection of pigs which have antibodies against ASFV can be used as a first step to identify recovered pigs which potentially may remain as virus carriers. To confirm their carrier status, virus would have to be detected in tissues or blood. In control programmes, animals with antibodies against ASFV are generally slaughtered since they are considered potentially to be virus carriers. In West and Central Africa as well as the Iberian Peninsula and Sardinia, a percentage of pigs are sero-positive to ASFV. In some regions, this percentage was shown to increase over time after the initial introduction of the virus. The serological detection, and the subsequent slaughter of potential carrier animals, was an important aspect in the successful eradication of ASF in Spain (Arias and Sanchez Vizcaino, 2002a). ASFV carrier pigs usually present low levels of virus in tissues and viraemia during long periods of time. In these animals, virus levels are sufficient for transmission to domestic pigs through a biological vector, but usually not by direct contact between animals (Sánchez-Vizcaíno, 2006). An increasing percentage of pigs with antibodies against ASFV could be attributed to a decrease in virulence of the virus as it circulates in the pig population and/or to the change to an endemic disease pattern. This is expected to occur as the pig population changes from being completely naïve to infection through to a population exposed and increasingly immune. It is important to note that although the ASFV isolate currently circulating in the Caucasus is highly virulent and it is reported that most infected pigs die over time, it is possible that isolates of reduced virulence may emerge and that the change to an endemic disease pattern may also result in an increase in the numbers of apparently healthy carrier pigs.

In conclusion, the presence of immune but still infected animals is of paramount importance in the management of the infection. The presence of these animals should be quantified and they should be considered as fully infected individuals since they can assume the role of silent epidemiological reservoir of the virus. A distinct scenario arises with pigs that could be in contact with infected wild boar. This scenario is found in Sardinia and is also probably true for most of the TCC. The main types of pig farms at risk through this scenario are free-ranging pigs or pigs in limited biosecurity farms. Direct contact between domestic pigs and wild boar is facilitated by the use of communal lands and free-roaming (ranging) of animals. The ways of transmission between domestic and wild pigs are likely to be through ingestion of infected carcasses or by direct contact. Transmission of ASFV to the European wild boar by ticks is highly unlikely as wild boar do not live in burrows. So far, contact between soft ticks (*Ornithodoros erraticus*) and wild boar has never been demonstrated (Louza *et al*. 1989; Laddomada *et al*. 1994). The role played in the long distance spread by synantropic or sympatric species, and opportunistic scavengers or predators, is still unclear. The presence of virus has never been investigated in these species.

In Iberia, tick associated transmission was linked with the distribution pattern of ticks and the fact that the *Ornithodoros* ticks are usually found hidden in cracks and crevices of traditional old buildings. As a result, only animals that were sheltered in such buildings were at risk from this mode of transmission (Boinas, 1994).

3. Occurrence of ASF in the TCC and RF

Georgia first reported ASF to the OIE on 5 June 2007, however mass mortality of pigs was reported at least 2 months before this (OIE, 2007; Empress 2009). The virus was likely introduced into Georgia by ship waste disposed around the port of Poti and subsequently entered the pig population through pigs feeding from this waste. The disease then quickly spread through the whole country.

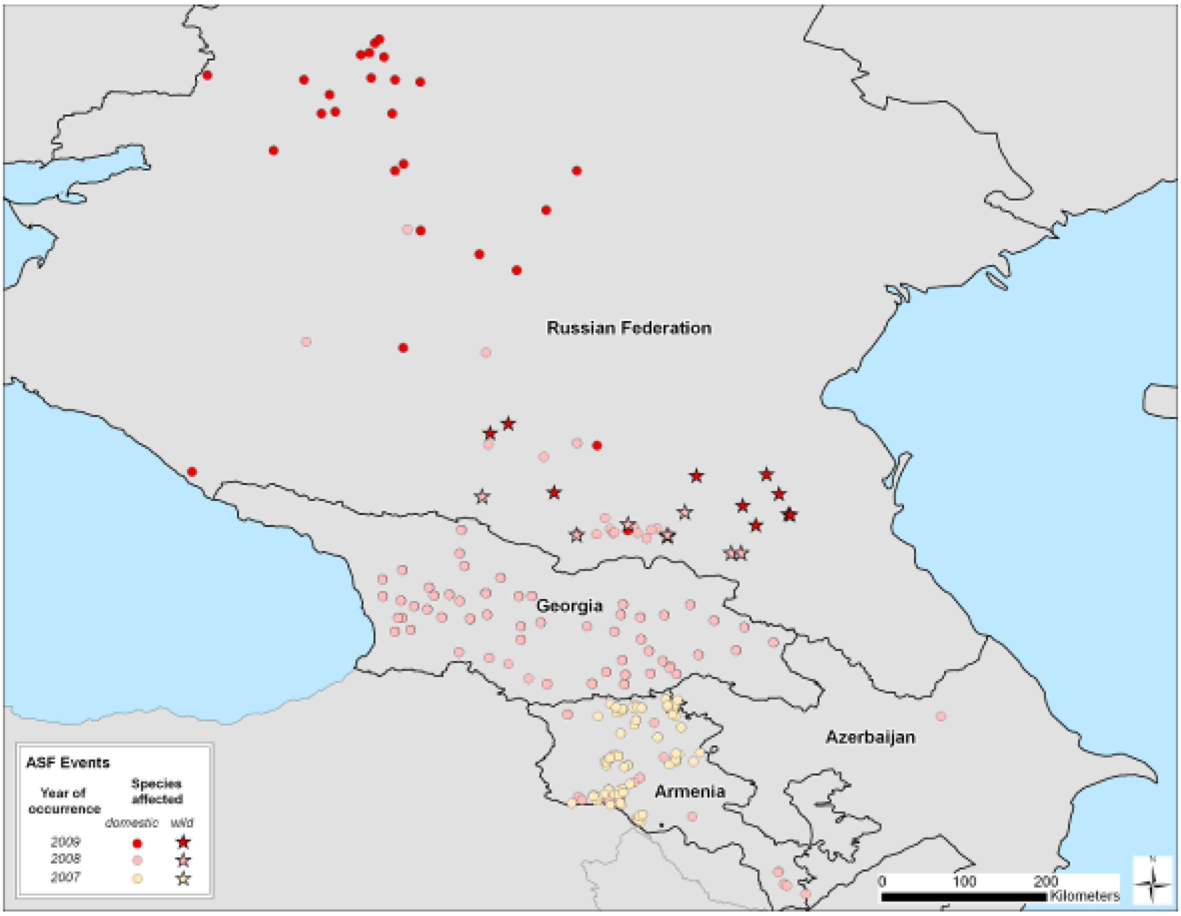
ASF had never previously been officially reported in the Caucasus region. The virus was shown to be Genotype II with a close relationship to virus strains from Southeast Africa (Mozambique, Madagascar and Zambia) (Rowlands *et al*., 2008).

In Armenia ASF was first reported on 6 August 2007, near the border with Georgia. Most of the subsequent outbreaks were also reported in the north of the country.

Azerbaijan has a very low density of domestic pigs and pig husbandry is highly clustered in the few Christian communities. The only reported outbreak occurred in January 2008 in Nidzh, a village where about half of the national pig population was kept.

Georgia declared the outbreaks resolved in the final report to OIE in March 2008, Armenia in May 2008 and Azerbaijan in March 2008. In total, 58 outbreaks were reported to the OIE from Georgia, 13 from Armenia and 2 in the same location from Azerbaijan. There were unconfirmed reports from various sources of further outbreaks during 2008 (see Appendix B).

The occurrence and re-occurrence of ASF in the RF in domestic pigs and wild boar suggests that the disease is not under control. A similar situation could occur in the TCC at any time. An area is locally considered free in the RF or the TCC if no clinical signs are observed in pigs. Azerbaijan has a very low density of domestic pigs and pig husbandry is highly clustered spatially. The outbreak in January 2008 occurred in Nidzh, a village where about half of the national pig population was kept. Most outbreaks in the TCC involved domestic pigs. The occasional involvement of wild boar in the spread of ASF in the TCC seems likely; this is also supported by the involvement of wild boar in the secondary spread of the virus from Georgia to Chechnya at the end of 2007. Figure 1 and Figure 2 show all the outbreaks in domestic pigs and wild boar respectively in the TCC and the RF that were reported to the OIE since the first outbreak in Georgia in 2007. A detailed timeline of the outbreaks can be found in Appendix B.



Note: the map does not show the outbreaks in Orenburg and Leningrad Oblasts

Figure 1: Outbreaks of ASF in domestic pigs in the Caucasus and the Russian Federation since 2007 (source: Empres Watch, December 2009)

In the RF, based on laboratory data obtained from the National Research Institute for Veterinary Virology and Microbiology of Russia (NRIVVaMR), 74 ASF outbreaks in domestic pigs (with 3230 cases and approximately 32 thousand destroyed or slaughtered pigs) were reported to OIE for the period 2007 until end of 2009. There have been continuous reports of disease spread up until January 2010, based on reports to the OIE World Organisation for Animal Health Information Database (WAHID) (see appendix A).

Recently confirmed cases in the RF in wild boar in areas where domestic pigs are few or absent have highlighted concerns that wild boar can spread the virus to distant, free areas. The most likely mechanism of this spread is linked to the continuous geographic distribution of wild boar rather than long distance movement of some infectious individuals. Little, however, is known about the epidemiology of ASF in wild boar and of the pathogenicity of the circulating virus strain in wild boar (cfr. chapter 2.1.3).

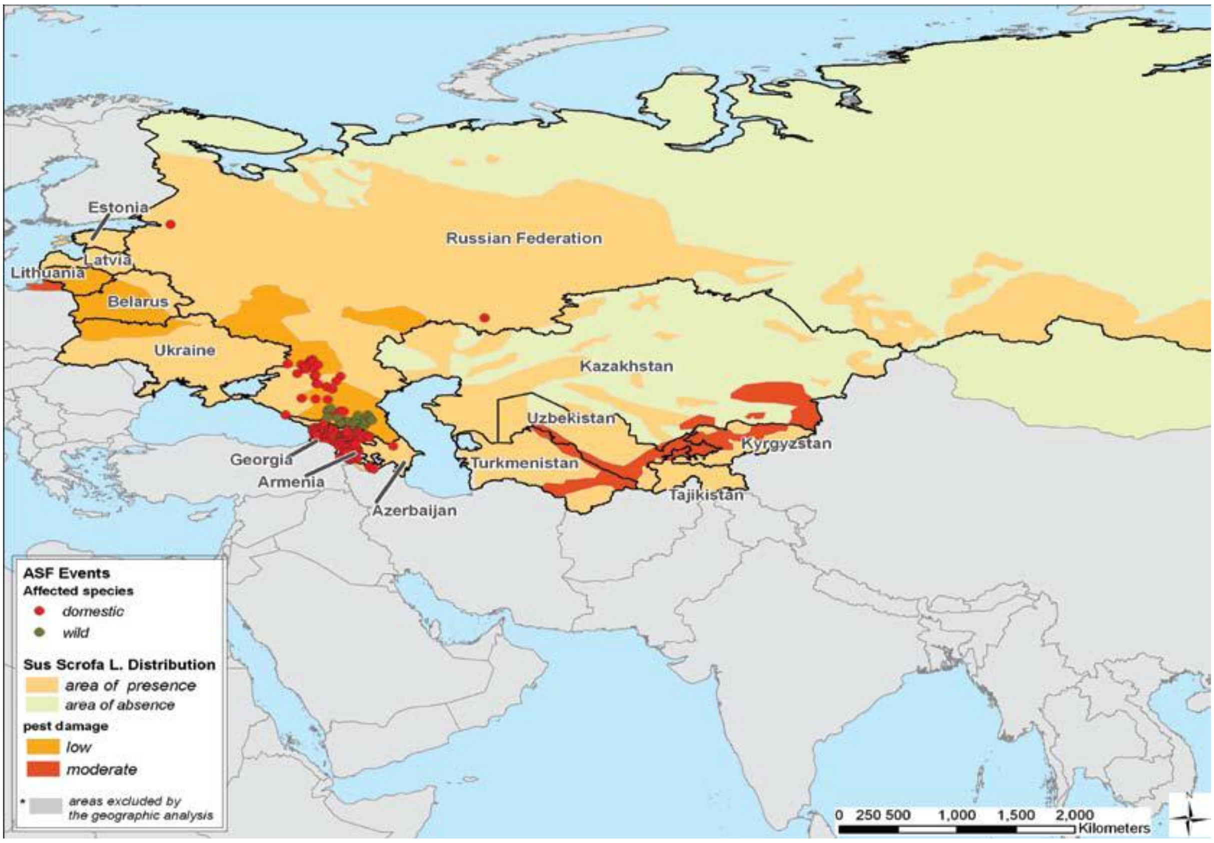


Figure 2: Outbreaks of ASF in domestic pigs and wild boar in the Caucasus and the Russian Federation and *Sus Scrofa* distribution (source: FAO/Empres Watch, December 2009)

Table 6: ASF spread and basic epidemiological data for domestic pigs; Russian Federation, 2007-2009

Republic/ territory/region	**Epidemiological categories (according to the OIE immediate notifications)**					
Number of:	**Outbreaks**	**Susceptible**	**Cases**	**Deaths**	**Destroyed**	**Slaughtered**
Dagestan	1	1	1	1	0	0
Kalmykia	3	5	5	2	2	0
Krasnodar	2	7063	308	247	801	0
Leningrad	1	14	8	7	7	0
North Ossetia	34	22573	2025	2006	10894	9672
Orenburg	1	150	94	94	0	56
Rostov	19	3358	108	89	3272	0
Stavropol	13	8633	681	445	2773	4246
Total:	**74**	**41797**	**3230**	**2891**	**17749**	**13974**

4. Characteristics of the swine populations and husbandry systems in the Trans Caucasus Countries, the Russian Federation and the European Union

4.1. Domestic pigs

4.1.1. Populations

4.1.1.1. Domestic pig populations in the TCC and RF

Domestic pig population sizes of countries in the TCC and RF where ASF was reported are shown in Table 7 and Table 8. Resulting mainly from ASF related mortality and culling, according to official figures of the National Veterinary Service, the pig population has decreased in Georgia by > 423,000 (81%) and in Armenia by > 66,000 (43 %) between 2007 and 2008. In Azerbaijan, the pig population decreased by > 12000 animals (44 %) as a consequence of the ASF outbreak. The population size for each year was the result of a census carried out at the beginning of the year. For the South Federal Region of Russia, population data of wild boar (2008) and domestic pigs (2009) are shown in Table 8.

Table 7: Domestic pig populations (census at the beginning of the year) in the TCC

Region	2006	2007	2008	2009	Source
Georgia	Not available	523830	100600	105000	Nat. VS
Armenia	156000	152791	86710	84801	Nat. VS
Azerbaijan	22936	22932	18676	10299	Nat. VS

Table 8: Populations of domestic pigs and wild boar in South Federal Region of Russian Federation*.

	Domestic pigs (*Sus scrofa*) in 2009			Wild boar in 2008	
Region	Area (thousands km2)	Population (thousands animals)	Density population (animals/$km^{2)}$	Population (thousands animals)	Density population (animals/km^2)
South Federal Region of Russia	585.5	3085.9	5.27	37.6	0.06

Russian National Institute of Veterinary Virology and Microbiology, 2009.

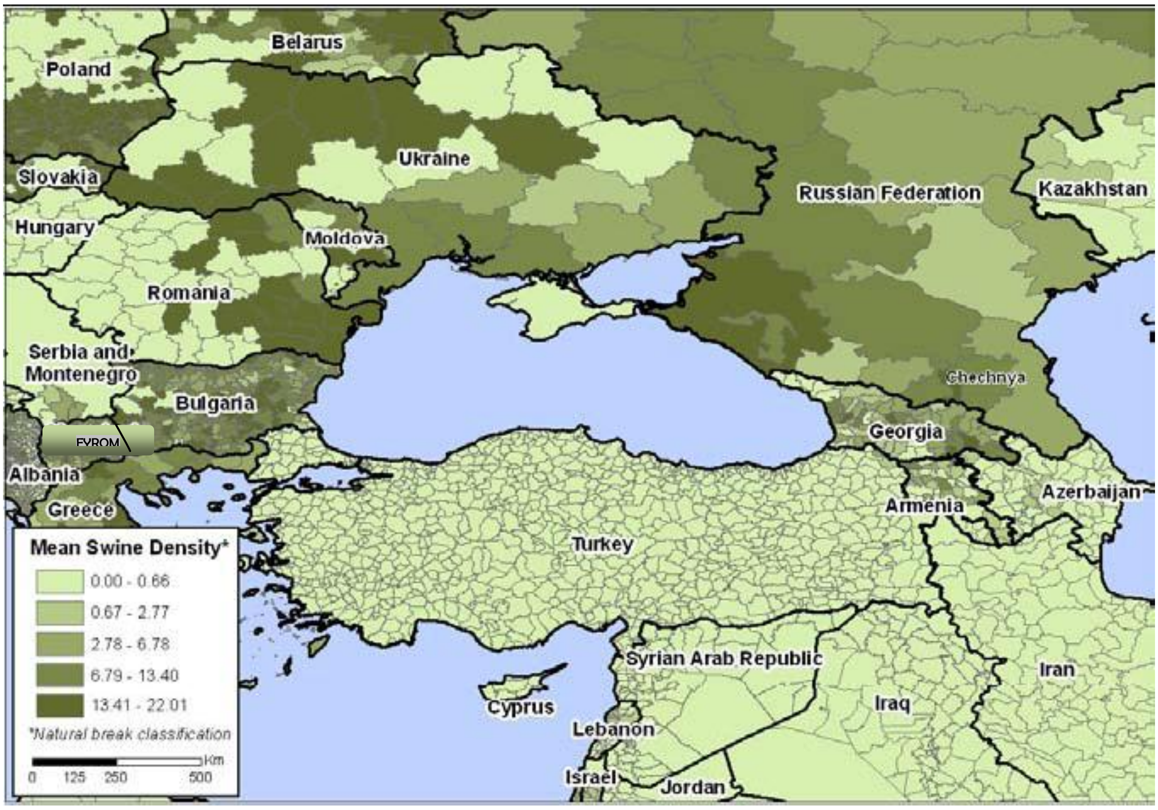


Figure 3: Pig density in Eastern Europe, the Caucasus and the Middle East (Source: FAO GLIPHA - Gridded livestock of the world 2007).

4.1.1.2. Domestic pig populations in the European Union

According to Eurostat (update April 2009) not all 27 Member States have regularly updated the size of their pig population. Therefore, for the purposes of this report we have preferred to consider the data reported in the 2005 Community Summary Report on Zoonoses, Zoonotic Agents, Antimicrobial Resistance and Food-Borne Outbreaks (EFSA, 2006).

The total number of livestock and numbers in the subgroups fattening pigs and breeding animals are summarised in Table 9. The 2005 data refer to 22 MS and two non-MS.

The largest populations were reported in Germany (19.2% of the EU-total) and Spain (17.7% of the reported EU-total), but also Denmark, France, The Netherlands and Poland reported high numbers of pigs (together accounting for 43.1%). Among countries that reported data on the subgroups, the fattening pigs accounted for 34.8-93.9% of the total population and the breeding animals amounted in 1.5-33.8%.

Table 9: Pig populations (livestock numbers), 2005

	Pigs, in total	Fattening pigs	% of total	Breeding animals	% of total
Austria	3,169,541	1,224,053	38.6	-	-
Belgium	5,647,014	4,989,016	88.3	657,998	11.7
Cyprus	859,752	416,563	48.5	13,313	1.5
Czech Republic	2,689,514	935,113	34.8	778,755	29.0
Denmark	14,457,972	-	-	-	-
Estonia	309,714	135,967	43.9	30,879	10.0
Finland	1,401,071	941,406	67.2	459,665	32.8
France	14,761,500	5,780,900	39.2	-	-
Germany	26,989,100	10,894,721	40.1	2,503,600	9.3

Greece	2,017,385	1,894,721	93.9	122,664	6.1
Latvia	307,651	-	-	-	-
Lithuania	1,114,100	-	-	-	-
Luxembourg	90,147	81,824	90.8	8,323	9.2
Malta	66,000	-	-	-	-
The Netherlands	11,311,558	5,504,295	48.7	1,244,272	11.0
Poland	19,970,000	-	-	-	-
Portugal2	2,117,511	-	-	-	-
Slovakia	927,294	-	-	-	-
Slovenia2	607,881	228, 456	37.6	68,566	11.3
Spain1	24,894,956	9,949,697	40.0	2,684,961	10.8
Sweden1	1,818,037	1,094l,537	60.2	195,054	10.7
United Kingdom	4,864,000	-	-	544,000	11.4
EU Total	**140,391,698**	**44,002,248**	**31.3**	**9,322,050**	**6.6**
Norway	802,800	432,500	53.9	61,400	7.6
Switzerland	1,566,298	-	-	-	-

Source: Community Summary Report on Zoonoses, Zoonotic Agents, Antimicrobial Resistance and Food-Borne Outbreaks (EFSA, 2006).
1=2004 data, 2= 2003 data

In Figure 4, the pig population densities in the reporting countries in the EU are shown. The population size of pigs per km2 of arable land was highest in Denmark and The Netherlands followed by Germany, Poland and Slovenia. The lowest densities were reported in Estonia, Greece, Latvia, Lithuania and The United Kingdom.

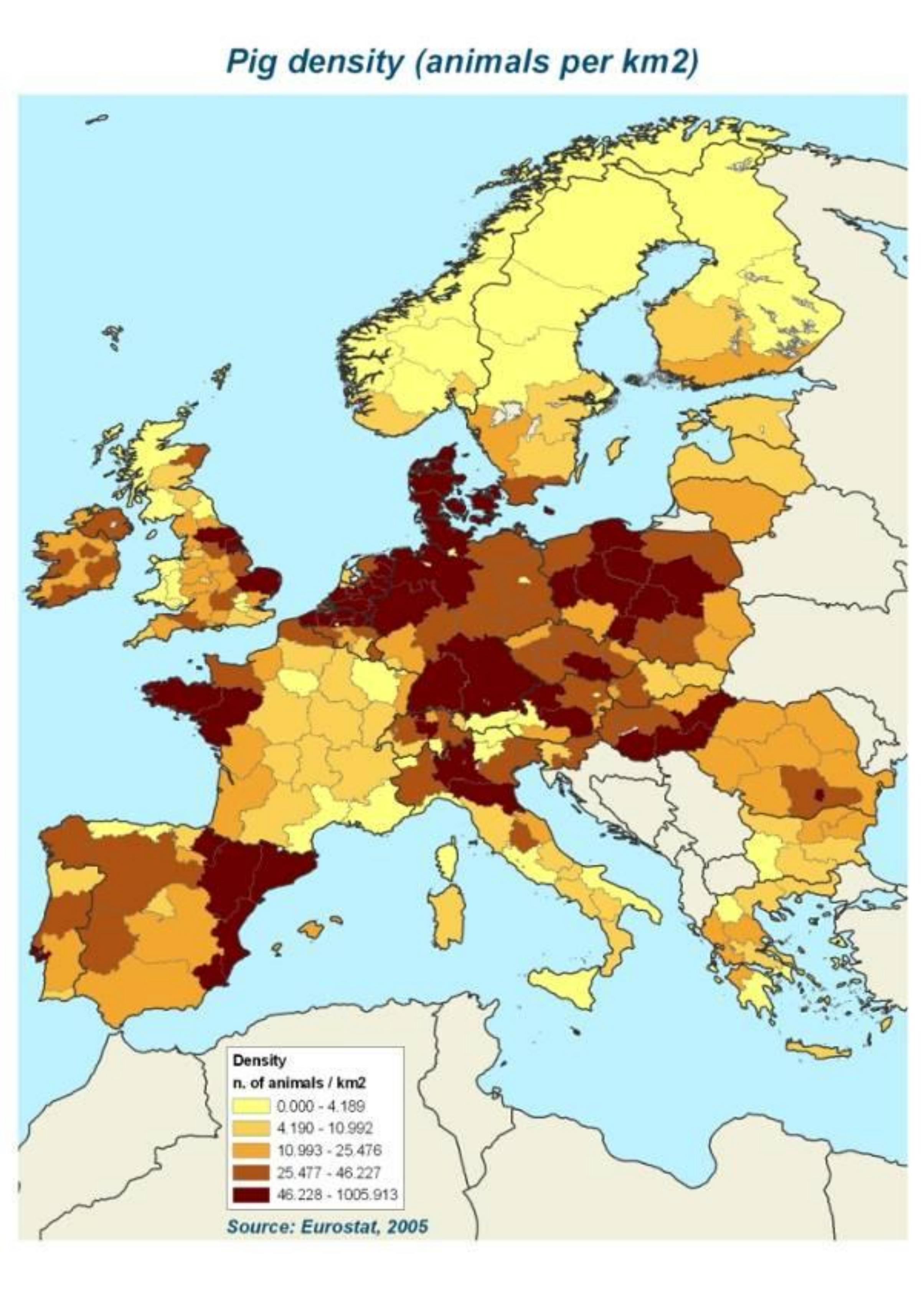


Figure 4: Pig population density in the EU, 2005 (the colour scale indicates the population size per km2 arable land)**.**

The *Eurostat Agriculture Statistics* (Eurostat ISSN 1830-463X: Agricultural statistics 2006-2007) reports the pigs holding structure as *livestock units (LU*), (Table 10), which provides useful information for the present qualitative risk analysis of ASFV introduction in Europe because of its relationship with the husbandry system.

Table 10: Livestock on the farms in the EU-27 in 2005

	Livestock Unit size classes[1]				
	Total	>0-<5	5-<50	50-<100	>=100
Pigs	151988.8	4533.6	17350.7	8915.9	121188.7
Piglets < 20 kg	44675.2	1233.0	5947.4	3249.4	34245.4
Breeding sows	16333.6	530.5	2137.8	1120.8	12544.5
Other pigs	90980.1	2770.1	9265.6	4545.7	74398.7

1 Livestock Unit size classes in 10^3

4.1.2. Husbandry systems and biosecurity

4.1.2.1. Levels of biosecurity

The structure of the swine industry, in which there is a great deal of trade and movement of pigs, requires the implementation of preventive measures to avoid the introduction of diseases to herds and to contain the spread of infections if already present in a herd. In a broad sense, the concept of biosecurity refers to the implementation of such measures. However, this term is most often used vaguely and the impact of such measures is rarely quantified (Casal *et al*, 2007).

Biosecurity measures have been classified into three groups: a) those related to replacement animals; b) those related to husbandry and facilities, and c) those related to the geographical location of the farm (Moore, 1992; Barcelo´ and Marco, 1998; Morillo, 2002).

Generally, for biosecurity measures to be effective, it is necessary to understand how farmers perceive the importance of each measure and what measures the farmers are actually applying. Although there are several technical reports on biosecurity (Moore, 1992; Barcelo´ and Marco, 1998; Morillo, 2002; Pritchard *et al*., 2005), peer-reviewed research papers on the measures present on farms (Pinto and Urcelay, 2003; Boklund *et al*., 2004), or on the impact of such measures on the reduction of the risk of introduction of diseases (Casal *et al*., 2007), is scarce. Some factors associated with non-compliance with these measures are: poor training of farm personnel, lack of communication among the personnel, lack of motivation for following the rules, poor record keeping, and no audit of biosecurity-related activities (Vaillancourt and Carver, 1998). One of the roles of swine veterinarians is to give advice on how to optimise biosecurity on farms.

For this report, the production systems in the EU member states were categorised according to the applied biosecurity measures into high biosecurity, limited biosecurity and free ranging production systems. For the Trans-Caucasus Countries and the Russian Federation, the production system was considered in general to be limited biosecurity and free ranging.

4.1.2.2. High biosecurity

To prevent the introduction of ASFV, the most important biosecurity factors are summarised as follows:

- Presence of physical barriers (fencing-internal and external), bird-proof netting on buildings and facilities for quarantine.

- Minimal and controlled people traffic and access to the farm (restriction of visits and provision of boots and clothes for visitors), fixed labour for fixed sections, equipment not shared by different sections.

- Minimal and controlled animal introduction, including quarantine for newly introduced animals

- Husbandry type: movement records, disease records, disposal of pigs in an incinerator, slurry disposal facilities, feed loaded outside the fencing, waste management put in place, water from safe sources.

- Procedure of washing and disinfection of transport vehicles, main entrance, changing facilities for workers and visitors

- Pest-control programmes.

Production systems that comply with all of the above listed factors are considered as high biosecurity level production systems.

4.1.2.3. Limited biosecurity

Production systems that have poor compliance with one or more of the high biosecurity factors as described above, but do not allow free ranging (e.g. the lack of the control of introduction of animals will limit the biosecurity of the production system). Outdoor production systems and backyard production systems are classified under limited biosecurity production systems if animals are kept within intact fenced areas all the time. Since ASF is not transmitted by aerosol, an intact fence was assumed sufficient to prevent transmission.

4.1.2.4. Free ranging farming systems

In some areas, the traditional pig husbandry system is represented by free ranging herds, which means that pigs are not kept within fenced areas and they do not have daily contact with people. In some cases, the free ranging pigs share the same habitat with wild boar populations (e.g. in Sardinia, the free ranging pig production system is practised in mountainous and hilly areas where pigs are kept on communal land).

4.1.2.5. Husbandry systems in the TCC and RF and potential spread of ASFV between infected farms

Pig keeping is a common practice in rural and suburban areas of the RF and the TCC (FAO 2008, Hurnik, 2007; SDC, 2007, FAO/EMPRES, 2009). It represents an important source of meat and income for the people. Pig production in the TCC is mainly practised in Armenia and Georgia. In Azerbaijan, only a small and localised pig population is kept (Table 7). In Armenia and Georgia, about 80-90 percent of the pigs are kept in backyards, with 1-2 pigs per owner. In Armenia, the average number of pigs is 70 per village.

Backyard pig keeping in the RF and the TCC relies on low inputs and cheap food and is characterized by swill feeding and often free roaming scavenging pigs, a lack of continuous containment and almost no biosecurity. Pigs are often let out during the day and return to their housing at night for feeding. In some areas, pigs are left in the forest from spring until they are collected again at the end of autumn. In other parts, backyard pigs are fully confined in purpose-built housing. Backyard pig breeding is seasonal during spring to autumn. Most pigs are slaughtered at the beginning of winter and during Christmas and New Year. Therefore, at the time of national census the population is at the lowest level. During summer, the population size will be several times more than that in January. Moreover, in the absence of a herd registration or animal identification system, it is likely that the official figures are underestimated. Therefore, the economic importance of pig production is estimated to be greater than official statistics have indicated.(FAO 2008, Hurnik , 2007; SDC, 2007, FAO/EMPRES, 2009).

There are wide regional differences in pig husbandry systems in the RF. In contrast to the TCC, there are large intensive pig farms in RF. Some intensive pig farms with a few hundred pigs under full confinement, mainly for breeding, are also found in Georgia and Armenia with limited biosecurity practiced. Free ranging of pigs is prohibited in the RF and the TCC after the outbreaks; however, it is still practised.

In Georgia and Armenia, backyard pigs are mostly sold at informal livestock markets or through direct contact with potential customers. Pigs are usually slaughtered at home with the complete absence of slaughter plants. In the absence of abattoirs, pigs are often slaughtered without veterinary inspection.

Traffic between infected premises in the TCC and RF with different kinds of vehicles has been reported, including exchange of different vehicles or machines between farms. This traffic is not regulated and does not include requirements for disinfection. Cases of unauthorized and uncontrolled transport of animals and products have been reported in the Russian media (Rosselkhoznadzor, 2009).

The movement of both professional and non-professional people can be a potential means of spread of ASFV, particularly among farms with limited implemented biosecurity measures. The Russian Veterinary service considered that the spread of the disease in Nov to Dec 2009 resulted from the poor awareness and the low level of responsibility of the farmers (linked to the non-compensation policy), as well as the poor performance of the control points on roads in the RF (Rosselkhoznadzor, 2009).

The Russian media reported a potential link to feed exchange between smallholders and occurrence of ASF cases in the Rostov region. The risk that contaminated feed is distributed/ exchanged between small farms and backyards is therefore higher than negligible. The feed produced and delivered directly from the processing plants, however, is not affected here. The Russian Veterinary Service advises the owners of pigs to pay attention when buying feed for the farm. http://www.promedmail.org/pls/otn/f?p=2400:1001:57555::NO::F2400_P1001_BACK_PAGE,F2400_P1001_PUB_MAIL_ID:1095,79613.

4.1.2.6. Husbandry systems in the European Union and potential spread of ASF between farms

There is a broad range of different pig production systems types scattered all over the 27 EU MS, implementing different levels of biosecurity measures, which will have an important effect on the potential spread of ASFV in a region. To structure the qualitative risk assessment more clearly, this report categorises three different levels of biosecurity: high biosecurity (HB), limited biosecurity (LB) and free ranging (FR) farming systems (see chapter 4.1.2.1 for their description).

Although there are strict requirements for transport of pigs between high biosecurity farms for cleaning and disinfection of the lorries, movement of pigs are still considered as an important factor leading to spread even between HB and LB farms before the detection of the outbreaks. Elbers *et al*. (2001) found, in their retrospective analysis of the CSF epidemic in The Netherlands, where 429 herds became infected, that pig movements were most important for disease spread at the first stage of the epidemic.

Besides vehicles for transport of pigs, other lorries visit HB and LB farms every week, presumably at least twice per week. For lorries used to transport pigs to and between LB farms, cleaning is less well controlled, less rigorously implemented and does not include requirements for disinfection. When an outbreak is confirmed, all traffic to and from infected premises will be stopped. The use of contaminated lorries for transport of pigs can also spread diseases such as ASF or CSF over large distances, as shown by the introduction of CSF into the Netherlands in 1997, presumably by an infected transport lorry that had been in contact with infected pigs or pig products in Germany (Stegeman, *el al*., 2000).

Although movement of people occurs among HB farms, biosecurity measures are able to prevent, or at least significantly reduce viral transmission. People visiting this production system are usually required to change their clothes and to wear clothes that remain at the farm and subsequently are washed on the premises. Moreover, footwear and sometimes overalls and even masks are provided for professional visitors. In certain cases, showers are available for visitors at the premises. A case-control study from the outbreaks of CSF in 1997-1998 in The Netherlands, showed that the absence of biosecurity measures (such as wearing coveralls and boots supplied by the farmer) increased the risk of CSF spread (Elbers *et al*., 2001).

In HB production, there is already a high level of biosecurity and the risks created by professional visitors should be low. However, on LB and FR farms, the risks generated by professional visitors may be higher due to possible gaps in general biosecurity and a lack of awareness of information about correct procedures. In practice, on FR farms there is only a low level of contact with professionals such as veterinarians.

Non- professional visitors can be expected to have a lower level of awareness of the importance of biosecurity measures in comparison with health professionals, which may lead to gaps in the system. Furthermore, pest control is rigorously applied on HB farms and pets should not have access to the premises. However, on farms where limited biosecurity systems are practiced, contamination of feed or other materials is possible. On these farms, there is also increased accessibility for pests. By this means, transmission of infection to other farms could occur. Consequently, pets may move freely between such farms. After confirmation of the primary outbreaks, although, pest control should be implemented, movement of pets between farms may have continued.

The likelihood of spill-over of infection from HB farms to premises with uncontrolled free ranging farms or to wild boar is low because the two production systems are not linked. However, spread from farms with limited biosecurity to uncontrolled free ranging farms and vice versa is more likely.

4.2. Wild Boar

Wild boar (*Sus scrofa)* and feral pigs are susceptible to ASFV and show similar clinical signs and mortality to domestic pigs. Evidence of ASFV infection in wild boar was reported from the Iberian Peninsula (Arias & Sanchez-Vizcaino, 2002a; Wilkinson, 1984), Sardinia (Laddomada *et al*., 1994; McVicar *et al*., 1981) and most recently in the TCC and the RF (OIE-WAHID, 2009).

4.2.1. Populations

4.2.1.1. The importance of population size estimation and host geographical distribution knowledge

Any transmissible disease can be maintained in the environment in any susceptible host population when a minimal number of susceptible individuals is available.

As a general process, any new infection introduced in a new environment will easily spread if sufficient hosts of susceptible species are locally available. After its onset, the infection can fade out, become locally endemic or when there is a continuous host geographical distribution, spread to other areas.

The probability that an infection spreads in a population is strictly linked to some epidemiological and host population demographic parameters. Lethality of the infection, efficiency in infection transmission, host population size, extent and duration of the population immunity and host population turn over each play an important role in disease evolution. In particular, they determine whether there is a subsequent fade out of the infection or ongoing endemic evolution. The knowledge of the host geographic distribution, and in particular, the existence of corridors connecting different host meta-populations, is extremely important in understanding the risk that the infection will spread to different areas/countries.

Relevant criteria for the risk that ASF will spread in wild boar populations in areas covered by this report are:

a) Population size estimates in the actual infected areas (TCC and RF);

b) Presence of possible ecological corridors connecting the infected population with free bridge populations closer to the EU (Belarus, Ukraine);

c) Presence of possible ecological corridors connecting the bridge populations of Belarus and Ukraine with those in the EU (Poland, Romania);

d) Population size estimates of the EU wild boar meta-populations that are connected with the bridge populations.

4.2.1.2. Wild boar population density

Generally, the density of any wild boar population is mainly conditioned by the availability of food and safe areas. Usually the best conditions are found in the forests of the temperate areas of Central Europe. Mediterranean or Northern forests have a limited carrying capacity for the species mainly due to the climatic condition and hence the availability of food (EFSA, 2009c). Feeding of wild boar in order to enlarge the hunting bag by hunters in some western European countries can also increase locally the population density and thereby the risk for disease spread and maintenance.

The estimation of the wild boar population size and distriution is relevant to an understanding of the possible role played by the species in the epidemiology of ASF. The estimation of the geographic distribution of the species is a predictor of the possible geographic spread of the virus. The population density, together with high population turn-over, is the main relevant demographic parameters facilitating/promoting the endemic persistence of the virus in the environment.

There are direct and indirect methods for estimation of population density, however each has certain limitations. In general, direct methods are more precise but expensive, time consuming and adopted only for small areas. Indirect methods are mainly based on the use of the hunting bag and can be applied over large territories, but may be highly biased depending on local hunting pressure. Furthermore, the official estimation of the wild boar population density is often inconsistent, underestimating the real number of wild boar when compared with the actual annual hunting data (EFSA, 2009c; Zanardi *et al*., 2003). High densities of wild boar increase direct contacts with other wild boar but reduce long distance dispersals.

Hunting can temporarily increase the home range of wild boar causing disruption of population structures. The indirect transmission through meat, boots, clothes, cars etc. associated with hunting may also lead to distant spread.

4.2.1.3. Wild boar populations in the TCC and RF

Wild boar are present in all the TCC and in the RF. In Georgia, they are found mainly in East Georgia and in the region bordering Turkey. In Both Armenia and Georgia, wild boar are protected species (apart from a small number of private hunting reserves in Georgia) due to its low density and restricted geographic distribution. Illegal hunting is certainly present but not quantified. In the RF, wild boar are hunted frequently as an attempt to decrease population density.

There are limited reliable data on wild boar population densities in the TCC. Some data for the South Russian Federation, Armenia, Ukraine and Belarus are provided in Appendix A. The limited official information available from the TCC and Eastern Europe show a very low density of wild boar, usually less than one head per km^2, however, clustering of wild boar occurs in some areas of the TCC and the RF. In 2008, Belarus and the Ukraine counted respectively, a total of 61940 and 46932 heads of wild boar. The official total number of wild boar in 2007 in Armenia was estimated to be 1080 heads (Appendix A). Despite the low population density, wild boar are widespread and do not have any natural borders for their movement or distributional range restriction (Kurinnov, 2009). It is possible for wild boar to pass through the Caucasus Mountains following natural breaches, such as rivers (Durov, 1987).

It has been demonstrated that critical factors that influence the population density of any wild boar population are the average winter temperature and the length of time during which the average temperature is below zero degrees Celsius. In both Eastern Europe and the TCC, both of these critical parameters are above the minimum threshold (Melis *et al*, 2006) and therefore favour higher densities of wild boar in these regions.

4.2.1.4. Presence of ecological corridors connecting indirectly the TCC and RF wild boar population with the Europe Union ones

The available data clearly indicate the existence of several continuities in wild boar population geographic distribution (Figure 5).

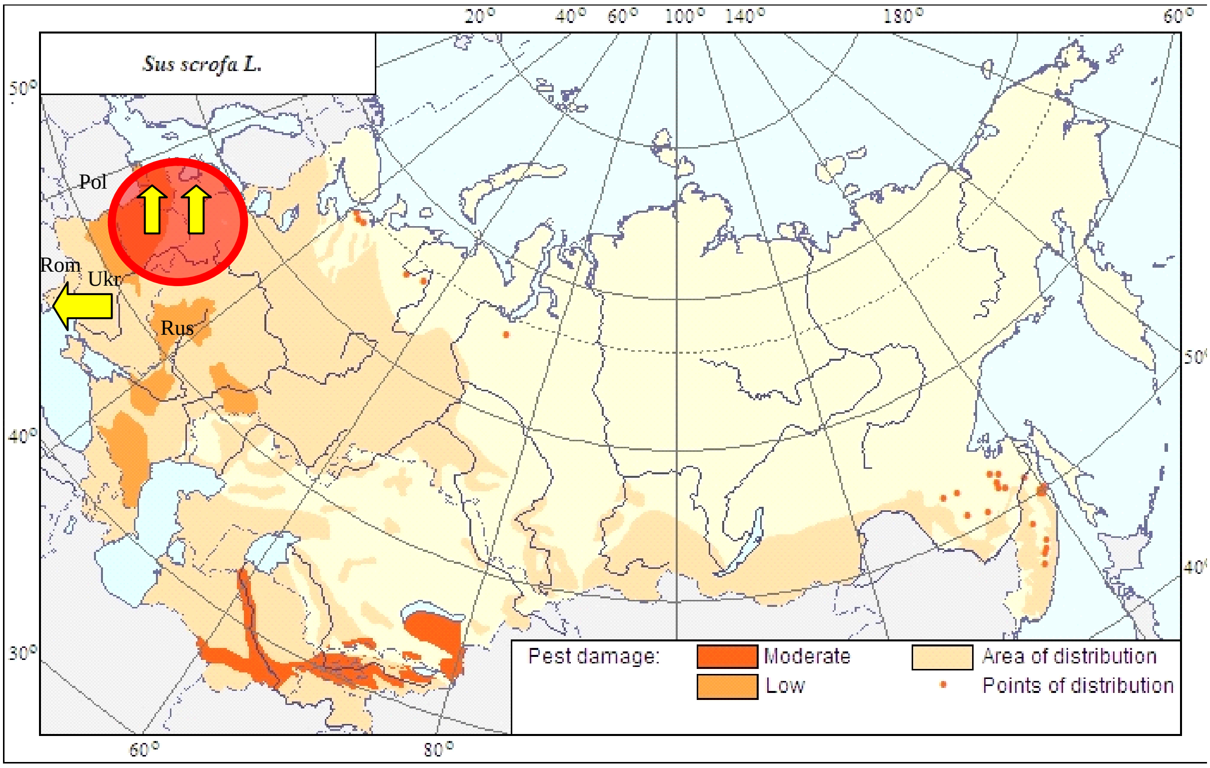


Figure 5: Connected wild boar populations through continuity of habitat wild boar distribution (source: (http://www.agroatlas.ru/content/pests/Sus_scrofa/Sus_scrofa_en.gif)

In particular the wild boar populations of Belarus are well connected with those of Poland and Lithuania, while the Ukrainian wild boar populations are connected with the wild boar populations of Poland and Romania and, to a lesser extent, the Slovak Republic and Hungary.

4.2.1.5. Wild boar populations in the European Union

The population of wild boar (*Sus scrofa)* is widespread in most European continental areas, with the exception of northern parts of Fennoscandia and northern parts of the European part of Russia. The altitudes where they could be found in Europe are from sea level to 2,400 metres, such as in the Pyrenees (EFSA, 2009c; Palomo and Gisbert, 2002). There is a trend of increasing wild boar populations in Europe, caused by changes in the practice of hunting, climate warming and/ or improvement of food supply by agricultural crops. Wild boar density is very high in most parts of Western Europe (EFSA, 2009c).

There is proven presence of wild boar in many European countries: Albania; Austria; Belarus; Belgium; Bosnia and Herzegovina; Bulgaria; Croatia; Czech Republic; Estonia; Finland; France; Germany; Greece; Hungary; Italy; Latvia; Lithuania; Macedonia, the former Yugoslav Republic of; Moldova; Netherlands; Poland; Portugal; Romania; Russian Federation; Serbia and Montenegro; Slovakia; Slovenia; Spain; Switzerland; Turkey; Ukraine and reintroduced in Sweden and United Kingdom (EFSA, 2009c). From the quantitative point of view, the recent history of CSF shows that some European meta-populations are at very high densities and can easily sustain viruses through density dependent processes. The most important of these are in Germany (almost all forested areas), North France and Central Italy.

4.2.2. Ecology

Wild boar are ubiquitous and populate most of the broadleaved forests, especially evergreen oak forests. Wild boar are also found in open habits like steppe, or even in wetlands, reed belts along rivers or mountainous areas (Baubet, 1998; Acevedo *et al*., 2006).

Wild boar show mainly nocturnal behaviour. The peak of births happens mainly in March and April or earlier when important oak mast production occurs (Mauget, 1982; Dardaillon, 1988; ONCFS, 2004; Hohmann, 2005).

Wild boar are a highly social species. Females, piglets and juveniles live together in stable social matriarchal groups (Kaminski *et al*., 2005; Heibeisen, 2007). It is a sedentary species with a short native-dispersal distance (<10km) (ONCFS 2004). The home-range area may however vary according to food availability, landscape structure and hunting practice. In conflict areas, the wild boar home-range may be disturbed.

As a consequence of the social behaviour of the wild boar, direct contact amongst wild boar occurs frequently. Direct contacts are extremely frequent within the family group while they are less frequent between family groups. During the mating season (lasting about 7 months in Europe), contacts are facilitated and male dispersal (not migration) increases. Pendulum movements (consisting of rapid movements of escape from and return to the usual areas) are generally increased during the hunting season.

Wild boar do not migrate, at least according to the classic definition of migration. Some small seasonal movements are registered but always inside the usual individual home range that varies from 20-100 km^2. Infections can spread between larger regions, however, where there is continuity in the geographical distribution of the wild boar, as observed for CSF (EFSA, 2009c). In this respect, the Ukraine (Crimea), Poland and Romania may be at risk due to the continuous distribution and the high density of wild boar. Possible corridors may also exist from the infected Russian areas into Lithuania or Latvia. Where wild boar are absent or natural/artificial barriers prevent direct contact between infected and susceptible populations, infections usually fade out spontaneously (Artois *et al*., 2002); for ASF, this pattern has been observed in Sardinia only (Firinu and Scarano, 1988).

4.2.2.1. Wild boar/domestic pig interface in the TCC and RF

In both Georgia and Armenia, the domestic/wild life interface is quite intense. There are many areas in which a high density of pigs coincides with the presence of wild boar. Moreover, the domestic pig husbandry systems facilitate contact with wild boar. The habitat and distribution area of both domestic pigs and wild boar largely overlap during late summer and early autumn, when wild boar visit inhabited valley floors to eat fruits and walnuts, and may meet free-ranging domestic pigs. In late autumn, this pattern is disrupted due to the deceased population size of the domestic pigs (most slaughtered) and the absence of food. Wild boar remain in the deciduous tree forests (Gerasimov, 2008). Higher risk of contacts between domestic pigs and wild boar may also be observed in some areas such as North Ossetia (Denis Kolbasov, personal communication).

Wild boar carcasses, from animals that died because of ASF, were retrieved in large areas of the Chechen Republic and the Republic of Ingushetia during 2007 to 2008, which suggested that there was an active circulation of ASFV in the local wild boar population even in the absence of a local domestic pig population (both are Muslim Republics). Nowadays, it is clear that the wild boar population of the Caucasus is involved in the epidemiology of the infection; nevertheless the epidemiological role played by the wild species is not yet understood (Beltrán-Alcrudo *et al*. 2009).

4.2.2.2. Wild boar/domestic pig interface in the European Union

Due to the wide geographic distribution of wild boar in Europe, back yard pig populations and, in particular, the free ranging pig populations can be at high risk of direct contact with wild boar. This direct contact is well know for certain areas of Sardinia (Italy), Spain, Portugal and Romania and can be assumed for areas with FR pig husbandry and high wild boar density (EFSA, 2009c). It is worth underlining that at present, there is neither map distribution nor reliable quantitative data on the FR pig sector in the EU and its neighbouring countries.

5. The role of ticks as vectors in the spread and the maintenance of ASF

5.1. Ticks

Ticks are obligate blood-feeding arthropods (class Arachnida). There are two large families of ticks, the Ixodidae (or hard ticks) and Argasidae (or soft ticks). Other than many morphological differences between these two families, hard ticks feed for long time periods (days to weeks) while soft ticks feed only for short time periods (up to 30 minutes). As far as is known, only the soft ticks (family Argasidae) are able to transmit ASFV (Table 11). Among around 190 species currently recognized in the Argasidae, some are responsible for the transmission of ASFV in Africa. All *Ornithodoros* species tested, up to the present, have shown to be competent vectors for ASFV. Some of these belong to the taxonomical group of *Ornithodoros erraticus*, a group of species distributed mainly in the Mediterranean basin and Middle East, including Transcaucasia and parts of Russia (Morel, 1968). Sanchez Botija (1963) demonstrated that *O. erraticus* found in pig sites can be a vector of ASFV in Europe, while Plowright *et al*. (1969a, b) demonstrated that *O. moubata/porcinus* ticks associated with warthogs were also involved in virus transmission in Africa.

5.1.1. Tick detection and identification methods

There is no standardised monitoring system for soft ticks, which has been undertaken by means of different tick collection methods or by detection of antibodies to tick proteins in pigs. The most commonly used tick collection methods are based on manual collection from suitable habitats (Boinas, 1994), by vacuum (Butler *et al*. 1985) or with CO_2 traps (Caiado *et al* 1990, Boinas 1994). Serological approaches depend on detection of antibodies to tick salivary gland extracts (Canals *et al*. 1990). In certain circumstances, observations of subcutaneous haemorrhagic lesions in pigs may be an indicator for the presence of soft ticks (Encinas-Grandes *et al*., 1993).

Generally identification is based on morphological characteristics. Recently, molecular tools (Vial *et al*., 2006) have been used to improve the differentiation between species.

5.1.2. Geographic distribution

In Europe, the Mediterranean Basin, the TCC countries and the RF, the only *Ornithodoros* species that had been reported historically were those belonging to the *O.erraticus* complex (*O. alactagalis, O. asperus, O. normandi, O. pavlovskyi, O. tartakovskyi,O. tholozani, O.erraticus, O.lahorensis and O.sonrai)* (Table 11). This report, therefore, will be restricted to the biological aspects of the complex of species *O. erraticus* regarding its potential for ASFV virus transmission.

Table 11: Reported *Ornithodoros* spp. in Europe, the Mediterranean Basin, the TCC and the RF

Ornithodoros species	Country reported	Reference
O. alactagalis	Armenia, Azerbaijan, Georgia, Iran, Northern Caucasus, Transcaucasia, Turkey	Filippova, 1966; Gugushvili, 1972 and 1973; Ismailova *et al*. 1981; Kadatskaya, and Talybov, 1979; Shustrov, 1956.

O. asperus	Algeria, Italy, Morocco, Portugal, Spain, Tunisia	Filippova, 1966.
O. erraticus	Algeria, Egypt, Italy, Morocco, Portugal, Spain, Tunisia	Baltazard, M. 1937; Baltazard, *et al.* 1950; Blanc and Brunean, 1954; 1956; Boinas *et al.*, 2004; Boinas, 1995; Caminopetros and Triantaphyllopoulos, 1936; Cordero Del Campillo, M. 1974; Davis and H. Hoogstraal 1954; Hoogstraal *et al*. 1954; Khalil *et al.* 1984; Martinez Pereda. and Espinosa 1997; Morel, 1968; Estrada-Peña, 2005; Oleaga-Perez *et al.* 1990; Perez-Sanchez, 1994 ; Shoukry *et al.* 1993.
O. lahorensis	Armenia, FYROM, Kazakhstan, Kosovo, Syria, Turkey	Akopyan, *et al*., 1981; Aydin and Bakirci, 2007; Campana, Y., 1946; Golem, 1951; Gutzevich, 1948; Hoffmann *et al*., 1971; Inci *et al*., 2002; Kalkan, 1982; Kusov, 1962 and 1966; Liebisch, 1975; Milutinovic, *et al*., 1997; Pavlov, 1944; Payzin and Akkay, 1952; Payzin, 1949; Sayin, *et al*., 1997; Sayn, *et al*., 2009
O. pavlovskyi	Kazakhstan, Kirghizia, Tajikistan, Turkmenistan, Uzbekistan	Filippova, 1962.
O. sonrai	Egypt, Morocco, Mauritania	Morel, 1968; Vial, pers. comm. (the presence of *O. sonrai* in Morocco is controversial)
O. tartakovskyi	Daghestan, Iran, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan	Filippova, 1982; Pospelova-Shtrom, 1941; 1949; 1963
O. tholozani	Cyprus, Daghestan, Egypt, Iraq, Iran, Israel, Jordan, Kazakhstan, Kyrgyzstan, Lebanon, Libya, Syria, Turkey, Ukraine, USSR	Assous and Wilamowski, 2009; Avivi, *et al*., 1973; Davis and Hoogstraal, 1956; L'vov *et al.* 1975; Morel, 1968; Pospelova-Shtrom, 1941; 1949.
O. verrucosus	Armenia, Georgia, Russian Federation	Maruashvili, G. M. (1965); Pavlovskii, E. N. (1936); Gugushvili, 1972 and 1973; Shustrov, 1956.

Questionnaires were used for preliminary surveys on the distribution of soft ticks in the field (Boinas 1994). Predictions of vector and vector-borne disease occurrence are based on determining the appropriate combination of habitat conditions for vectors and reservoirs (habitat including climate and other ecological factors), and the susceptible host.

Although previous studies on climate suitability of hard ticks have been presented (i.e. Cumming, 2000), it is difficult to adapt these methodologies to soft ticks. This is due to the peculiar biology and ecology of argasid ticks. To date, efforts to model climate suitability for soft ticks have been restricted to *Otobius megnini* (Estrada-Peña *et al*., submitted). Other studies are in progress to map the distribution and to understand the climate conditions suitable for other species of soft ticks, such as the *O. porcinus/ moubata* group (Vial and Estrada-Peña, pers. communication). The major feature that always discriminates this group of organisms in relation to their environment is the nidicolous life-style (they inhabit the dens or burrows of the host) of soft ticks. These ticks are limited to specific niches and have evolved well-adapted life history traits that ensure their persistence in their microhabitat.

The presence of ticks of the *O. erraticus* group has been reported in the Caucasus; however, knowledge of their distribution and host preferences is limited (Table 11). The ecological niche of these ticks in the region has not been adequately determined.

The *O. erraticus* group is important in maintaining the local foci of ASFV; however, they do not play an active role in the geographic spread of the virus. This is because these ticks feed for short times and drop off the host, commonly at night when animals are resting. Therefore, the chances that these ticks move with an infected host to new premises or territories are minimal or should be considered negligible. Once a focus is established, soft ticks may have a role as local reservoirs of ASFV, as already observed in the Iberian Peninsula where repeated outbreaks occurred in premises infested with ticks (Perez-Sanchez *et al.*, 1994; Arias and Sanchez-Vizcaino, 2002b). The Spanish ASF eradication programme showed that in areas of outdoor pig production, where infected ticks occurred, the time to achieve eradication was significantly longer that in areas without ticks (Arias and Sanchez-Vizcaino, 2002b). To our knowledge, no report is available to indicate the role of local soft tick populations in the Caucasus in regards to ASF.

5.2. Potential vectors of ASFV

5.2.1. Studies on *Ornithodoros* spp. as vectors

5.2.1.1. Field data

O. erraticus and *O. moubata* are accepted as natural reservoirs for ASFV with a well established role in the maintenance of the infection in nature (Plowright, 1970), Replication of ASFV in these tick species has been demonstrated, which allows these ticks to remain infectious for months and up to 5 years (Table 12), posing a threat of transmitting the virus each time they feed on pigs (Plowright, 1970; Boinas, 1994).

The adults and nymphal stages 4 and 5 of *O. erraticus* remain infected for longer than the larvae up to nymph 3 (Basto *et al*., 2006; Boinas, 1994). It was reported that the prevalence of infected *O. erraticus* and the average titres of ASFV per tick decreased over time when pigs were not present (Boinas, 1994). The maintenance of virus infection in the tick can constitute a risk if they are able to feed on pigs for periods of 40 weeks after an ASFV infective meal (Basto, *et al*., 2006). More recently, Vial *et al* (2007) demonstrated ASFV DNA in *O. sonrai* collected from the field in West Africa. *O. sonrai* is a different species that is morphologically undistinguishable from *O. erraticus*. They may copulate with *O. erraticus* but the progeny is not fertile (Estrada-Pena personal communication). Therefore, molecular analyses are required to differentiate them.

Amongst those tick species that were tested, various vectorial competences were observed for different ASF virus isolates, which has been inferred from variations in the titres of virus obtained, clearance rates, and the contradictory reports on the mortality of colonies infected with different ASFV isolates (Boinas,1994; Hess *et al*., 1987, Endris *et al*., 1992, Mellor and Wilkinson, 1985;). However, the vectorial competence of ticks for the ASFV strain circulating in the Caucasus is unknown.

5.2.1.2. Experimental data

Experiments on the transmission by soft ticks of ASFV are limited. Of all tick species tested, experimental evidence shows that, in addition to *O. erraticus* and *O. moubata,* another five *Ornithodoros* species, can be infected (Table 12). Four of them have been reported in North America and the Caribbean Basin: *O. coriaceus, O. turicata, O. parkeri* and *O. puertoricensis* (Hess *et al*., 1987) and one in Africa, *O. savignyi* (Mellor & Wilkinson, 1985). Transstadial transmission of the virus was confirmed in those species after four moults in *O. coriaceus,* and after one moult in *O. savignyi* and *O. parkeri* (Table 12). Transovarial transmission of the virus was demonstrated only for *O. puertoricensis* (Hess *et al*., 1987).

Table 12: Laboratory and field studies on *Ornithodoros* species to determine the vector capacity for ASFV

Species	Region	Max. DPI[1] virus presence	Virus transmission[2]				References
			Trans-Stadial[3]	Trans-ovarial	Sexual	To pigs	
O. coriaceus	North America	502 days	+ (4)	-	ND	+ 502 DPI	Hess et al., 1987; Endris and Hess 1994.
O. turicata	North America	23 days	ND4	ND	ND	+ 23 DPI	
O. puertoricensis	North America	239 days	ND	+	ND	+ 239 DPI	
O. parkeri	North America	70 days	+ (1)	ND	ND	-	
O. savignyi	Africa	106 days	+ (1)	-	ND	+ 106 DPI	Mellor and Wilkinson, 1985
O. moubata	Africa	3 years	+ (5)	+	+	+ 3 years	5
O. erraticus/ marocanus	Europe	5 years	+ (5)	-	+	+ 588 DPI	Hess et al., 1989; Endris and Hess, 1994; Boinas, 1994

1DPI: Days post-infection; 2 only the maximum lengths of time for virus presence and transmission to pigs or horizontal or vertical transmission among tick populations are considered; .3 Numbers of moults; 4ND: no data; 5 (Kleiboeker, et al., 1998; 1999, 2001; Plowright, 1976; Plowright et al., 1970a, 1970b, 1974, 1994; Rennie et al., 2001.)

The experimentally infected species *O. parkeri*, fed on susceptible pigs for 46 and 70 days, did not transmit ASFV, although virus was recovered from ticks in both sets of experiments. In one case, 6 experimentally infected ticks were reported to have an average titre of 10^3 HAD_{50}/tick (Haemadsortion 50% doses) (Hess *et al.*, 1987). The other four species of ticks infected pigs when fed between 23 and up to 502 days post-infection (Table 12). The virus was detected in the haemolymph and the salivary glands of some specimens of a colony of *O. turicata* at 20 days post-infection (DPI) and transmission was achieved when they fed on pigs at 23 DPI (Hess *et al*., 1987). No follow up, however, from this study exists, to indicate the potential transmission of the virus through these species.

It must be stressed that, to our knowledge, the soft tick species present in the TCC and the RF have not been involved in experiments to demonstrate the transmission of ASFV. However, because they all are included in the *O. erraticus* group, their role as potential vectors cannot be ruled out.

5.2.2. Studies with other potential vectors

There have been several studies evaluating other blood-sucking invertebrates as mechanical vectors of ASFV. These included several species of lice, mites, flies and ixodid (hard) ticks. Transmission of ASFV by a mechanical vector was achieved with the pig louse, *Haematopinus suis* (Sanchez Botija & Badiola, 1966). However, several other researchers were unable to demonstrate transmission of ASFV with this louse species (Heuschelle & Coggins, 1965 and Montgomery, 1921). Further, no ASFV was isolated from specimens of two warthog lice species, *Haematopinus phachochoeri* and *Haematomyzus hopkinsky*, that were collected from ASFV infected warthogs (Plowright, 1976; Thomson *et al*., 1985). Another experimentally-proven potential mechanical vector of ASF that transmitted the virus to pigs after 24 hours was the stable fly, *Stomoxys calcitrans*, kept at 25-26 ºC (Mellor *et al*., 1987, Webb, 1990).

The following ixodid ticks have been tested for the transmission of the ASFV to pigs with negative results: *Rhipicephalus* spp. (Sanchez Botija, 1963), *R. simus*, *R. bursa*, *Amblymoma variegatum* (Plowright, 1976), *Hyalomma* spp. (Plowright *et al*., 1994), *A. americanum* and *A. cajennense* (Groocock *et al*., 1980). Although ASFV was detected in these last two tick species for 4-7 days after feeding on viraemic blood, they did not transmit virus to pigs. Adults of a calliphorid fly species, *Auchmeromyia luteola,* collected near infected warthog burrows were tested for ASFV with negative results (Plowright, 1976, Thomson *et al*., 1985). Adults of flea species, as well as the Diptera, *Phlebotomus* spp., biting midges *(Culicoides* spp.) and black flies (*Simulium* spp.) collected from warthog burrows also were not infected with ASFV (Thomson *et al*., 1985)

According to Plowright *et al*. (1994), mosquitoes (*Anopheles* spp.) and unspecified flies (no other information was provided in the original paper) failed to transmit virus by feeding on pigs. The blood sucking Hemiptera kissing bug species, *Triatoma gerstaeckeri,* also failed to transmit the virus, but transstadial passage was demonstrated and ASFV was recovered 41 days later (Hess *et al*., 1987).

5.3. Biology

5.3.1. Biological characteristics of *O. erraticus* relevant for potential vectors of ASFV

Every stage of *O. erraticus* feeds rapidly on the blood of the vertebrate host, less than 30 minutes on average (Fernandez-Garcia, 1970). After engorging, they detach and drop to the ground. They are classified as endophilic and nidicolous (Sonenshine, 1993).

Ticks of this species are harboured inside pig sties in old buildings, where they hide in the cracks, crevices and surfaces that provide sufficient humidity, and are only rarely found in buildings without cracks. Although ticks have been reported in rabbit burrows within less than 300 m of infested loci, this is a rare situation (Oleaga-Perez *et al.*, 1990). The soft ticks cannot move by themselves outside the buildings, although their spread can occur mechanically by the transfer of utensils and soil harbouring the parasites. Ticks could spread ASFV if the ground (soil where they live) or parts of the building (such as bricks from pig sties) were transported to another place. The spread by animals infested with soft ticks is unlikely because the time of feeding is short.

In both Georgia and Armenia, the domestic/wild life interface is quite intense. There are many areas in which a high density of pigs coincides with the presence of wild boar. Moreover, the domestic pig husbandry systems facilitate contact with wild boar. The habitat and distribution area of both domestic pigs and wild boar largely overlap during late summer and early autumn, when wild boar visit the inhabited valley floors to eat fruits and walnuts and may meet free-ranging domestic pigs. In late autumn, this pattern is disrupted due to the deceased population size of the domestic pigs (most slaughtered) and the absence of food. Wild boar remain in the deciduous tree forests (Gerasimov, 2008). Higher risk of contacts between domestic pigs and wild boar may also be observed in some areas such as North Ossetia (Denis Kolbasov, personal communication).

5.3.2. Life cycle

The life cycle of *O. erraticus* includes the stages of eggs, larvae, nymphs (3 to 5 stages) and adults. The larvae and each of the nymphal stage need a blood meal before moulting to the next stage of life cycle. The adults need to have blood meals to reproduce. The females lay about 120 eggs in each oviposition (Encinas-Grandes *et al*., 1993) and up to 6 gonotrophic cycles can occur.

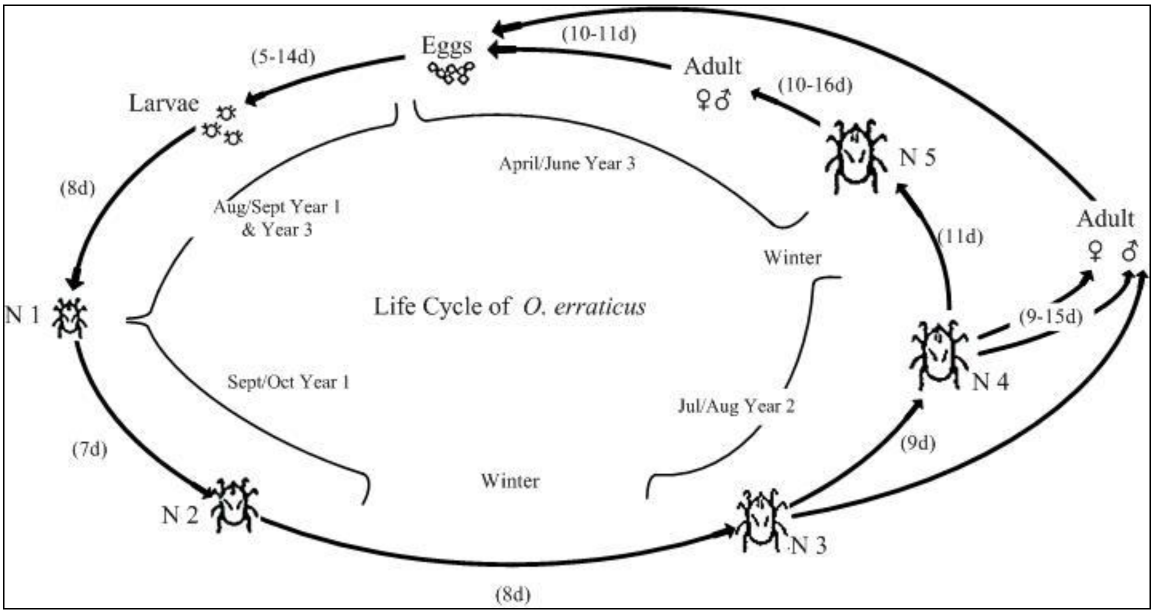


Figure 6: Life cycle of *O. erraticus* in the field (Spain) and in the laboratory (adapted from Boinas, 1994)

Under laboratory conditions, the complete cycle can occur in only 154 days (el-Shoura, 1987). In the field the tick has a seasonal activity associated with temperature and humidity. In the winter, the tick is inactive, and activity only starts when the minimum external temperatures are within the range 10-13^{o}C, so completion of the cycle takes from 2 to 4 years in the Iberian Peninsula (Caiado *et al*., 1990; Encinas-Grandes *et al.*, 1993; Fernandez-Garcia, 1970; Oleaga-Perez *et al.*, 1990).

All the soft ticks (not only the ones involved in ASFV transmission) are able to resist long starvation periods of up to 5 years for large nymphs and adults (Fernandez-Garcia, 1970; Oleaga-Perez *et al.*, 1990, Boinas, 1994) and their life span, if regularly feeding, is up to 15 years (Encinas *et al*., 1999).

5.4. Tick prevention and control

Eradication of *O. erraticus* from the old pig sties is invariably unsuccessful. This is due to the ticks long life and long survival without feeding, the existence of accidental hosts other than pigs and the possibility of penetrating into the cracks and surfaces of the buildings, where they are not accessible to acaricides and to the use of fire torch on the surfaces or ground. These factors have been the major reason to abandon *O. erraticus* infested pig farms after an ASF outbreak; and they have led to avoiding the use of this type of building to shelter pigs in the Iberian peninsula (Boinas, 1994). The use of endoectocides in pigs can reduce the level of infestation in the premises but does not prevent pigs becoming infected with ASFV if bitten by an infective tick.

In practice, pigs should not be housed in infested buildings. When such buildings are located in the area of a pig herd, the premises can be isolated with fences to prevent the access of pigs or even destroyed and then new premises are rebuilt in another location (Arias and Sanchez-Vizcaino, 2002b). No effective vaccine against the ticks exists but there are promising studies on salivary glands extracts and "concealed" gut antigen extracts (Astigarraga *et al*., 1995; 1997, Manzano-Roman *et al*., 2006 and 2007; Oleaga-Perez, 1995).

6. Potential international spread of ASFV through trade of pigs and pig products

6.1. Trade between the eastern neighbouring countries of the European Union

6.1.1. Trade of live swine

Since the ASF outbreaks, all trade of swine and their products between the TCC and the RF has been banned; however, it is difficult for the regional Border Inspection Posts to effectively control movements of animals or animal products. This is also supported by the risk analysis for introduction ASFV in the RF (IAC_public1, 2008) where illegal import was considered as one of the major risk factors for introduction. In Azerbaijan and Georgia, the veterinary border inspection is not under the responsibility of the Ministry of Agriculture (USDA, 2007), which might have an impact on the coordinating efforts towards animal movement controls.

Uncontrolled animal movements and trading within and among countries in the region take place routinely. In Georgia and Armenia, movements of piglets from outbreak regions to unaffected regions were observed (USDA, 2007). Large livestock markets with substantial pig populations are organised and are frequented by international traders.

6.1.2. Trade of pig products

Legal trade of pig products between the TCC and the RF has been forbidden since the introduction of ASF; but uncontrolled trade of pig products is likely to take place due to the limited enforcement of border inspections. The ASF outbreak in Orenburg in the RF was due to movement of pork products from the TCC (OIE, 2008, Kolbasov personal communication). The UN Comtrade database reported export of frozen pork meat from Georgia to Armenia in 2007 and 2008 (see appendix C).

Pig production in the TCC is only sufficient for local consumption. Georgia and Armenia are net importers of pork meat (fresh and frozen) to cover the national consumption. Furthermore, the reduction of pork meat production observed in the area has been followed by increased importation of pork meat. The main countries exporting to Georgia are Brazil (Jan-May 2007: 2162 tons) and the Netherlands (Jan- May 2007: 603 tons). Some pork meat has been imported from China (Jan-May 2007: 130 tons) (Comtrade database, FAO STAT/TradeSTAT). The small price differences of pigs and pork observed in the TCC and RF are not the main drive for trade between these countries (see table 13). However, the experts of the working group reported that when farmers suspect outbreaks on their farmers, they may try to sell their pigs and meat at any price.

Furthermore, close links exist between people of the same ethnic communities in neighbouring countries, which result in frequent movements of people across borders, specifically between Georgia and Armenia. There is also a large Georgian and Armenian work force in the RF who may bring along infected pork meat during their travels.

Table 13: Pig and pork prices in the region (04/2009)

	Price for Pigs/pork in Euro/kg			
	Districts		Capital	
Country	Live pigs	Pork	Live pigs	Pork
Russian Federation	2.3	4.6-5.5	n.a.	4.9-5.5
Georgia	2.3	4.6-5.5	n.a.	4.9-5.5
Armenia	2.2-2.7	4.1-5.4	n.a.	5.2-6.2
Azerbaijan	n.a.	n.a.	n.a.	n.a.

n.a. - not applicable

No legal base to control swill feeding has been established in the TCC and the RF and swill feeding is widely practised. Increased awareness as a result of the last outbreak might have reduced the probability of reintroduction or spread of ASF through this means.

6.2. Trade from the Eastern neighbouring countries to the European Union

According to the EU legislation, Member States shall not authorize the importation of swine or pork meat unless they come from third countries which have been free of ASF for the previous 12 months and a list of countries from where export of swine and pork shall be drawn up by the council (EEC, 1972, 1979)[10]. According to Council Decision 79/542/EEC[11], the TCC, RF, Ukraine, Moldavia or Belarus may not export live animals and meat/meat products into the EU (EEC, 1979).

DG(SANCO)/2007-7617 final report provides an overview of the outcome of 37 missions carried out by the Food and Veterinary Office between 2004 and 2006 in 25 MS to evaluate the import control systems for live animals and products of animal origin and to inspect at Community-approved border inspection posts (BIPs). In most MS, the veterinary checks (documentary, identity and physical) were carried out adequately, although in a few instances in a number of MS, checks were not carried out in the BIP facilities. A number of shortcomings were more prevalent or significant and these include the acceptance of live animals in four MS, even though the region of origin was not indicated in the accompanying documents, and in one case the third country was not authorised to export.

Also, acceptance of consignments without health certificates, wrong health certificates, or incomplete route plans was observed in a few cases http://ec.europa.eu/food/fvo/specialreports/gr_import_controls_en_2007-7617.pdf.

Under the European project entitled "ASFRISK", some preliminary results of the risk assessment of ASFV introduction into the EU by legal movements of live pigs indicated that two EU MS accounted for 72.2% of the global risk of ASFV entrance into the EU. Sensitivity analysis using regression coefficients revealed that model outcomes were particularly sensitive to two input parameters: (1) the probability of selecting an infected pig to be imported into the EU from Belarus (0.49) and the probability of not detecting an infected pig during quarantine (0.36). These preliminary results for the pathway of legal import of pigs will be grouped with the results for the other risk pathways to obtain the total risk of ASFV introduction into EU (Sánchez-Vizcaíno, personal communication).

Illegal imports of swine and products thereof are difficult to quantify due to the lack of reliable data. According to Eurostat data, the RF illegally exported small quantities of live swine, pork meat and offal of swine to the EU in the period 2006 to 2009 (Appendix E). Several outbreaks of ASF were reported in the RF for the period 2007 to 2009. More in detail, Poland imported 248 and 160 live swine (animal units) in 2008 and 2009 from the RF whereas Lithuania imported 135, 544 and 1322 live swine (animal units) in 2 007, 2008 and 2009, respectively, (Eurostat, 2009; Appendix E). Moreover, the EU imported 97,600 kg frozen swine meat from the RF in 2007, 141,200kg in 2008 and 9,057 kg in 2009. Detailed data by member state are given in Appendix E. Table 11 in Annex E shows the EU imports of fresh or chilled or frozen offal of swine. Imports from the RF amounted to 131,100 kg, 167,000 kg and 301,800 kg in 2007, 2008 and 2009, respectively.

The EU also imported small quantities of live swine and offal from Belarus, and frozen meet from Ukraine and offal in that same period (Eurostat, 2009). Also the UN Comtrade database reported export from the Russian Federation to the EU of frozen meat and edible offal in 2007 and 2008 (Appendix C).

[10] Council Directive 72/462/EEC of 12 December 1972 on health and veterinary inspection problems upon importation of bovine animals and swine and fresh meat from third countries. OJ L 302, 31.12.1972, p. 28–54

[11] EEC, 1979. Council Decision 79/542/EEC of 21 December 1976 drawing up a list of third countries from which the Member States authorize imports of bovine animals, swine and fresh meat. OJ L 146, 14.6.1979, p. 15–17.

6.3. Trade between the Member States of the European Union

Network analysis and basic graph theory were applied to trade data of live pig and pig meat (EUROSTAT, 2006, 2007, 2008) by using the *network* package in the R software (http://cran.r-project.org). Graphical representation of live pig and pig meat movements in the EU were produced and the frequency distributions were calculated for the numbers of MS from which each MS imported live pigs and pig products, and of the numbers of MS to which each MS exported.

6.3.1. Trade of live swine

Live pig import is summarized in Table 14. Large numbers of live pigs are traded amongst the MS and there is heterogeneity across MS in the number of commercial partners and in the amount of imported pigs. Pig movements vary by the year, region and country. The maximum number of pig units which were imported by a country in a single year exceeded 9 million for Germany in 2008.

Table 14: Import of live pigs in EU MS, from 2006 to 2008.

Year	2006		2007		2008	
MS	n of partners	total pig units	n of partners	total pig units	n of partners	total pig units
AT	7	761977	10	40186	10	830278
BE	9	825604	11	438245	7	1235489
BG	9	23546	13	104132	9	12935
CY	2	287	3	519	4	312
CZ	7	127010	12	113148	7	266237
DE	17	8529895	17	567418	15	9105451
DK	4	321	10	189845	1	4124
EE	1	20	13	9457	2	32
ES	13	1730237	8	117666	10	935651
FI	0	0	3	32	0	0
FR	7	334316	12	338178	8	260072
GB	1	478457	10	159473	5	438588
GR	10	136559	12	11317	12	51244
HU	12	644610	13	31429	10	290857
IE	1	210	7	31030	2	139
IT	14	684865	13	169497	14	542847
LT	4	40015	17	48264	7	88984
LU	5	75857	5	2287	6	119939
LV	7	64692	12	13591	5	32137
MT	0	0	3	300	0	0
NL	12	938519	11	302047	11	1139760
PL	10	237211	16	48185	14	1040353
PT	7	1064322	6	60291	2	1008491
RO	10	228745	16	219181	13	670356
SE	2	3980	4	4256	1	36
SI	6	19953	6	5445	6	28885
SK	9	337621	9	19933	7	117181

n of partners: numbers of other MS from which live pigs were imported; total pig units: imported pig units (1 pig unit = 100 kg of live weight). Source: EUROSTAT, 2006, 2007, 2008.

Live pig movements (2006-2008) are represented in Appendix D, figures 16, 18, and 20. Certain countries are the main loci in the networks either as importing (Germany, Italy, Spain, among others) or exporting countries (The Netherlands, Denmark), and could theoretically play a main role in the spread of ASFV if it should enter the EU.

The bar graphs Appendix D, figures 17, 19, and 21 represent the frequency distribution of the number of MS from which each country imported live pigs and of the number of MS to which each country exported live pigs (out-degree). Although there is heterogeneity in both directions of movements it is of interest to note that heterogeneity is greatest in the export portion. In fact, there are only a few countries that export live pigs to the major proportions of the other countries. This was most evident in 2007, when The Netherlands exported live pigs to all of the other 26 MS.

6.3.2. Trade of pig products

The weight of pig meat, after combining trade data (EUROSTAT, 2006, 2007, 2008) for fresh and frozen meat, and offal, is even larger than that of live pigs. Moreover, even for meat, certain countries are constantly at the centre of the network (as importing or exporting countries), and certain countries exported pig meat to most of the MS. The maximum amount imported by a country in a single year was slightly above one billion kg for Germany in 2007.

Table 15: Import of pig meat in EU MS, from 2006 to 2008. N of partners: n of other MS from which pig meat was imported.

Year	***2006***		***2007***		***2008***	
MS	**n of partners**	**total 100 kg units**	**n of partners**	**total 100 kg units**	**n of partners**	**Total 100 kg units**
AT	**16**	1202500	16	1349355	17	1498616
BE	**18**	937314	20	964916	18	1085284
BG	**16g**	201865	18	565309	20	766089
CY	**8**	29091	7	20896	9	15234
CZ	**15**	1016695	19	1209628	21	1534678
DE	**18**	9803994	23	10086614	21	9862681
DK	**15**	666952	19	496983	15	630714
EE	**16**	196592	16	163816	16	197723
ES	**14**	898716	17	999018	15	731781
FI	**9**	115882	9	119485	12	120288
FR	**17**	3580429	17	3697053	22	3698374
GB	**16**	4677977	19	4682814	16	3979552
GR	**15**	2104360	15	1838755	17	1852605
HU	**17**	817239	15	661820	21	879494
IE	**11**	402987	10	409800	12	377507
IT	**21**	9177768	19	9491751	19	8480584
LT	**17**	165182	17	210128	17	541023
LU	**8**	62086	8	58344	10	57398
LV	**15**	163622	14	177526	16	269861
MT	**10**	20491	10	21885	8	17530
NL	**18**	2450524	20	2327594	20	2778870
PL	**21**	1705203	22	2468510	23	4463803
PT	**11**	1197273	11	1413948	10	1138911
RO	**16**	1444865	18	2036736	23	2583762

SE	**15**	542559	16	625449	16	710653
SI	**12**	347210	12	341550	12	363601
SK	**13**	443334	11	446169	13	578944

7. Potential incursion of ASFV into the EU through movement of people

7.1. Tourism

7.1.1. Hunting tourists

The Ministry of Agriculture of Russia (Department of Protection and Rational Use of Hunting Resources) authorizes hunting and issues game tickets for Russian and foreign hunters on the territory of the RF. There are established procedure and rules for giving permission for hunting and additional permission for taking trophies abroad have to be requested (Ministry of Agriculture Russia, 1998).

In Georgia, amendments to the law on hunting licenses and permits entered into force from January 1st, 2008, according to which it is no longer mandatory to have a hunting permit. If a person has the right to bear arms, then he will be able to hunt freely; however, wild boar are protected from hunting. The State only determines where, how and when to start hunting. In some regions, the season could last from late August until the 1st of March. There are obligations for foreign hunters. They have to pay a fee to obtain a licence to hunt certain animals. In addition, payment for each hunted animal is required and payment for hiring a local guide, who supervises the hunting and confiscates all prey that were not covered by the licence (http://www.apsny.ge/news/1217008234.php#).

The experts of the working group considered the risk of introduction of ASFV into the EU by hunting wild boar in the TCC and bringing trophies to the EU as negligible. The risk to bring infected hunting trophies from the RF was considered low.

7.2. Waste food from international means of transport

Art. 16 of Directive 97/78/EC[12] foresees the destruction of kitchen waste unloaded from means of transport that operate internationally and point 5.3 of the Annex to Decision 001/812/EC[13] and Regulation (EC) No 1774/2002[14] lay down further provisions regarding the arrangements for the disposal of this waste.

All MS have arrangements in place for the destruction of products intended for consumption by crew and passengers on board means of transport operating internationally and their waste but, in many cases, the record keeping obligations on the operators (specified in Regulation (EC) No 1774/2002) are not being met. Additionally, in a number of MS, the official veterinarians in the BIPs have not demonstrated that they are aware of the arrangements for the disposal of such waste (DG SANCO, 2007).

[12] Council Directive 97/78/EC of 18 December 1997 laying down the principles governing the organisation of veterinary checks on products entering the Community from third countries. OJ L 24, 30.1.1998, p. 9–30.

[13] Commission Decision of 21 November 2001 laying down the requirements for the approval of border inspection posts responsible for veterinary checks on products introduced into the Community from third countries (Text with EEA relevance) (notified under document number C(2001) 3687). OJ L 306, 23.11.2001, p. 28–33

[14] Regulation (EC) No 1774/2002 of the European Parliament and of the Council of 3 October 2002 laying down health rules concerning animal by-products not intended for human consumption. OJ L 273, 10.10.2002, p. 1–95.

7.3. Seasonal workers

The existence of a seasonal workforce is noted throughout the EU, mainly throughout the harvesting and building/construction season. There is no harmonised regulation of seasonal immigration.

There is also increasing pressure from illegal agricultural workers, who mainly come from Eastern neighbouring countries of the EU. They only need to obtain a three-month tourist visa under the pretext of visiting members of their family living abroad for some years, or a training session certificate issued by an existing or fictional school establishments or universities (GEOPA, 2000).

Seasonal workers may bring along infected pork products which could infect swine, especially when they are employed in LB production systems.

7.4. Other

Legal or illegal immigration from Eastern Europe outside the EU into the EU may represent an influx of people that could potentially import infected pork products.

The amount of people migrating to Europe from Eastern neighbouring countries is large; e.g.: during the first and second quartile of 2009, Eurostat reported 8255 Russian and 3590 Georgian asylum seekers in the EU (EUROSTAT, 2008). EUROPOL (2009) also highlights the important role of Eastern Europe outside the EU, not only as a source of illegal immigration but also as a transit region for mixed migration flows. Illegal immigration from, and through, the Western Balkans and the Former Soviet Union is observed in the whole of the EU and not just in those MS situated in Eastern and South Eastern Europe.

8. Outbreak detection and response

8.1. Detection

8.1.1. Preparedness and early warning

According to the standard definitions, preparedness and early warning are two distinct procedures that must be applied at different times and under different risks of virus introduction/release. Preparedness mainly applies in disease free periods, while early warning should be initiated when ASF is detected in any neighbouring or commercial partner countries.

The TCC and the RF

Preparedness should mainly concern the maintenance of a basic level of knowledge in selected personnel; assuring a basic level of diagnostic capability to detect ASFV antibodies and ASFV; continual checking of the infection situation in both neighbouring and commercial partner countries and organising refreshment courses (all components of the Veterinary Services) at least every 5 years. During this period the National Contingency Plans need to be updated. ASF contingency plans, as intended in EU MS, are not available in the TCC; even if some similar documents do exist in Georgia, they are not yet approved by the Government. The Competent Authorities of Armenia, Azerbaijan, and the RF consider equivalent to a Contingency Plan, their “orders” being a list of 15-20 different actions that the Veterinary Services have to apply during ASF outbreaks. In the RF, this ASF Contingency Plan equivalent is called: “Instruction of measures for ASF prevention and Instruction of measures for ASF prevention and eradication” that was approved in 1980 by the Senior Management for Veterinary Affairs of the USSR Ministry of Agriculture. These forms are not in accordance with the present protocols for contingency plans for ASF. Based on past experience and performance, the National Veterinary Service identified some administrative shortcomings in the process of decision-making, and the organisation and appointments of the responsible persons for veterinary services, influencing central and local performances (Rosselkhoznadzor, 2009). However, experience was built up during the past outbreaks and measures were implemented based on the OIE guidelines.

Early warning mainly consists in updating, reminding, and disseminating a suspect case definition to stakeholders; enhancing biosecurity in the populations, compartments and areas at risk; upgrading laboratory capability to diagnosis the virus, establishing contact with the international reference laboratories; alerting field veterinarians (both public and private) and organising of training to sample and correctly deliver samples to laboratories; and making material for field sampling available at the local level.

Since ASFV had never spread to East European and West Asian countries before, the level of preparedness was limited and thus those countries were not really prepared to face the infection. At present and mainly through the advice of international organisations, Belarus and Ukraine are developing specific procedures in the framework of the early warning and detection of ASF. Unfortunately, due to the complete lack of a preparedness phase, the time needed to update and approve any legislation, and some constraints such as the lack of compensation for farmers and the role played by private veterinarians, the compulsory reporting of suspected cases may be prolonged even during an outbreak.

The European Union

Each MS shall draw up a contingency plan specifying the national measures to be implemented in the event of an outbreak of ASF and this plan shall be updated every 5 years and submitted to the Commission for approval (EC, 2002)[15].

8.1.2. Early detection

8.1.2.1. Passive surveillance

The TCC the RF

The diseases that are easily detected by passive surveillance are those that are characterised by obvious clinical signs, high lethality rates and the presence of few or any true carrier animals. ASF in the TCC and the RF clearly belong to this group of diseases which are easily and early detected by passive surveillance. One of the main critical points affecting the efficacy of passive surveillance is the availability of an official suspected case definition, and a follow up procedure aimed to ensure that the case will be properly managed.

At present in both the TCC and the RF, passive surveillance is still the main tool to detect ASF in free areas. In the TCC, an official case definition has been adopted but the weak chain of command and the Veterinary Service situation do not ensure a proper management of the suspected cases. During 2008, only 4 suspected cases were investigated in Georgia and none in Armenia; these numbers are inconsistent with the pig population size and the a priori probability of some animals showing clinical signs matching the case definition for ASF. The low number of suspected cases reported and investigated suggests that the early warning detection system based on passive surveillance in these countries has insufficient performances.

Passive surveillance of wild boar is simply based on the testing of any retrieved dead animal. Discovering the carcasses of wild boar is not an easy task as they are generally eaten by other animals or hidden by high grass during the summer (EFSA, 2009c). The remote areas and the low animal density could be other obstacles for identifying died wild pigs.

[15] Regulation (EC) No 1774/2002 of the European Parliament and of the Council of 3 October 2002

In Georgia and Armenia, it is not compulsory to report the retrieval of dead wild boar to the official authorities while in the RF all wild boar found dead must be sampled and tested for ASF. In the period March 2008 - May 2009, 2450 samples of wild boar in Russia were investigated (Kolbasov and Kurinnov, 2009). Ninety-five positive samples were identified from wild boar in Chechnya (54), North Ossetia (8), Ingushetia (9), Kabardino- Balkarya (4), Stavropol (20) (SCoFCAH, 2009).

The European Union

Passive surveillance plays a pivotal role in detecting the infection in domestic pigs and wild boar. Currently, there is no information available concerning the surveillance activities in the MS for ASF.

8.1.2.2. Reporting by farmers and private veterinarians

The TCC the RF

There are two main limitations to achieving prompt and efficient reporting in the Caucasus.

a) Farmers’ education and awareness are relatively low and most of them do not breed pigs as a primary source of income. Pigs are mainly bred as FR and owners are used to having many losses. In addition, except in Armenia and Azerbaijan until 2008, there is no compensation for pig destruction when the disease is confirmed; consequently, farmers are reluctant to report deaths to the competent authorities and prefer to slaughter and sell the diseased animals.

b) Private veterinarians do not play a substantial role in disease control in rural areas of the TCC and disease control plans and legislation are often poorly enforced because of lack of resources.

These two constrains will certainly impair a reliable disease reporting and control. Also there are not enough abattoirs or slaughter houses with veterinary inspection to monitor signs of ASF infection in pigs.

In some areas of the RF, an increase in the number of wild boar found dead could be detected and reported. For instance, wild boar carcasses were regularly found in large areas of the Chechen Republic and the Republic of Ingushetia in 2007 and 2008, suggesting active virus circulation (Kurinnov *et al.*, 2009).

European Union

In the EU, a highly fatal disease of pigs should be noticed by the farmers, even in farms with FR pigs. Consequently, the veterinarian will probably be contacted quickly if ASFV is introduced in a farm: the higher the mortality, the sooner the veterinarian will be called. In contrast, the probability is high that a veterinarian with no specific skill on ASF or no information about recent increase risk of ASF may not suspect ASF after the first visit. This is because veterinarians and farmers have a low lever of awareness about ASF and CSF in most European countries that have not experienced swine fever for decades (EFSA 2009c). In addition, antibiotics can be prescribed as a first intervention and suspicion of a viral disease only suspected when the treatment has failed. In that case, it may take some weeks before laboratory confirmation is asked for, during which animal movements are maintained and ASFV is spread. This is supported by previous report of EFSA on Classical Swine Fever (EFSA, 2009c).

Generally, wild boar mortality is declared by hunters. However, not all dead wild boar may be reported leaving the opportunity for virus persistence in some areas. The delay between ASF suspicion and confirmation is difficult to estimate. However, in some regions, owing to the fact that CSF is an ongoing problem in wild boar, there is a chance that CSF will be suspected and samples send to the reference laboratory for differential CSF/ASF diagnosis. However, the reports of the annual CSF/ASF CRL meetings showed that systematic differential diagnosis for CSF and ASF is not performed.

8.1.2.3. Handling samples by veterinarians

The TCC the RF

In the TCC, state veterinarians at the central and district levels have received specific training for sampling tissues and blood. Sampling material was provided to both private and governmental veterinarians. Private veterinarians are encouraged to take samples and pass them to the official veterinarians, who are allowed to dispatch them to the lab. International shipment out of the TCC is difficult and time consuming.

Shipment within the RF is not a problem. Hip bones are taken as samples for examination by PCR. These samples are easy to take and to ship, and are not sensitive to degradation (Kolbasov, personal communication). However, international shipment is difficult.

European Union

In the EU, it is considered that veterinarians are skilled and good veterinary services are present in all EU countries. Collection of samples and their shipment to diagnostic laboratories for testing is not considered to present a problem (CISA-INIA, 2009).

8.1.2.4. Differential Diagnosis

Various diseases are to be included in the list of differential diagnosis for ASF in general, such as classical swine fever (CSF) or other viral and bacterial infections that lead to systemic disease with circulatory disorders and /or haemorrhages. Also, poisoning may lead to similar signs.

In field conditions, the ASFV circulating in the Caucasus region caused disease that demonstrated classical signs of ASF. In experimental infections using intramuscular inoculation, the clinical signs observed at the FLI resembled a peracute to acute course of classical swine fever (CSF). Infections with old CSF virus (CSFV) isolates of genotype 1.1 (e.g. CSFV strain Koslov) create the same clinical picture. Therefore, it is not possible to differentiate this clinical presentation of CSF from the ASF signs described above.

The chances of misdiagnosis are very high.

8.1.3. Laboratory confirmation

The TCC the RF

The national laboratories in Georgia and Armenia are not under the NVS but directly under the responsibility of the Ministry of Agriculture. The central veterinary laboratories are well equipped and the staff is trained with the assistance of various international projects. The laboratory staff often lack experience in using new techniques due to the limited amount of samples to be examined, the absence of routine national surveillance programmes and the need of a continuous quality control (USDA, 2007). Diagnostics: reports and data suggest that facilities to confirm cases are adequate; however, these laboratories do not participate to regular inter-laboratory proficiency tests and therefore their performances are uncertain.

In the RF, all examinations for ASF are carried out at one laboratory, the State Research Institution, National Research Institute for Veterinary Virology and Microbiology of Russia (SRI NRIVVaMR). A group of researchers there have been trained in ASF diagnostics and carry out the diagnostic work. SRI NRIVVaMR collaborates with the EU Community Reference Laboratory (CRL) for ASF, Animal

Health Research Centre, Valdeolmos, Spain. Testing for ASFV is done by direct immunofluorescence test (DIF test) and PCR (African Sine Fever in the Russian Federation, Report February, 2009, Kurrinov, Kolbasov *et al*.).

European Union

In 2008-09 all but 3 EU NRLs participated in the inter laboratory comparison test and all participants showed a good performance of the different serologic techniques used. Four of the NRL from EU MS did not perform any virus detection technique (CISA-INIA, 2009).

8.2. Outbreak response

8.2.1. Time before implementation of control measures

The TCC the RF

In the RF, stamping out is very often performed only after a major delay from the beginning of clinical signs (Rosselkhoznadzor, 2009). Furthermore, when the sum for compensation is not estimated properly, some of the owners reject the proposal of stamping out, which causes further delay (http://www.rosbalt.ru/2009/10/20/681977.html). This delay leads to stamping out of a few surviving animals. Also, in Georgia and Armenia, delays in the implementation of control measures were observed during past outbreaks since the NVS in both countries were not experienced in ASF control.

European Union

The Working Group experts concluded that after the confirmation of the outbreak in HB and LB farms, the control measures should be implemented without delay. The people involved in the control of the outbreak are well trained, contingency plans are in place and the legislation is respected. In FR farms a delay may occur, merely due to the difficulties to catch all the animals.

8.2.2. Rapid response

The TCC the RF

The current ASF outbreaks and those in 2000/2001 have demonstrated that the TCC are able to stamp out diseases if the spread is limited to a few single villages. However, contact tracing and response to more widespread and complex disease situations is limited and will probably not be efficiently executed without international assistance.

In Georgia and Armenia, the outcome of a FMD simulation exercise in 2009 highlighted that outbreak investigations are a weak point, due to the lack of epidemiological training and their hierarchical system (FAO/EuFMD, 2009). Despite ample training opportunities and continuous support from international projects for epidemiology staff, applied epidemiology and IT skills are often not used sufficiently in survey planning and management, analysis, and presentation of data

In the TCC and the RF, a special ASF commission is established in case of an outbreak. It will investigate movement of animals, efficacy of quarantine of all agricultural products of the considered zone. These investigations mostly result in the identification of dangerous contacts and help to contain the outbreaks. The weak point is the delay in the confirmation of the outbreaks, during which spread may happen.

The TCC and the RF have electronic disease reporting systems. In Armenia, the National Animal Disease Surveillance System (NADSS, based on TADInfo/FAO) has been used for disease reporting and simple descriptive statistics for many years. In Georgia and Azerbaijan, DTRA has started to implement a laboratory case-based Electronic Integrated Disease Surveillance System (EIDSS).

European Union

The Community legal framework in EU MS on control measures for eradication and monitoring programmes of animal diseases, including ASF, are laid down in the Council Decision 2008/341/EC [16]

In the EU, monitoring and surveillance activities are currently in place only in Sardinia. The Sardinian model of ASF control outside the endemic areas shows that the main risk factors linked to the reintroduction and the spread of ASF in free areas is represented by the movement of animals and/or meat and by illegal pig farming. The experience gained in Sardinia shows that in order to increase the surveillance in a territory, different classical health measures, including control of pig movements, should be implemented. This is particularly true for husbandry systems represented by small pig farms or backyard farming systems. Recording of all herds, animal identification and control of herd book updating is important.

A different picture has to be considered for intensive swine production in industrial countries. The Iberian model for control and eradication of ASF was basically based on the detection of ASFV positive and carrier animals by laboratory diagnosis and the enforcement of strict sanitary measures.

The key actions in successful ASF control in Europe in the past have been summarised as follows: i) upkeep of a network control and diagnosis of the disease by mobile veterinary field teams; ii) serological control of the disease; iii) increased biosecurity level of holding facilities; iv) elimination of all the ASF outbreaks and identification and slaughter of pigs on confirmed farms; v) veterinary control of all swine movements with individual identification of every animal moved for fattening or breeding purpose; vi) tick control; vii) disinfections of premises followed by a rest period; viii) restocking, including sentinel animals; ix) correct and timely compensation for producers (Arias and Sanchez-Vizcaino, 2002b; Costard *et al*, 2009).

The CSF control in EU MS demonstrates that there is a great pool of experience and history of successful control and surveillance measures in Western and Central European MS.

8.2.3. Surveillance

In response to an outbreak, a combination of passive and active surveillance is required in order to maximize the probability to detect new cases within a short time. The geographical extent and the duration of the surveillance in and around the outbreak will depend on both, legislation and the epidemiological situation.

8.2.3.1. Passive surveillance during outbreak management

The TCC the RF

In the infected Caucasian countries (including the RF) passive surveillance is the only practical option to detect cases in the infected or neighbouring areas and in the outbreak follow up activities. Of

[16] 2008/341/EC: Commission Decision of 25 April 2008 laying down Community criteria for national programmes for the eradication, control and monitoring of certain animal diseases and zoonoses (notified under document number C(2008) 1588) (Text with EEA relevance). *OJ L 115, 29.4.2008, p. 44–46*

course, the same limitations highlighted for the use of passive surveillance in the early detection framework are still present in the outbreak response activities.

European Union

Domestic pigs: according to the legislation, passive surveillance needs to be enforced in both protection and surveillance zones. Passive surveillance also plays a pivotal role in detecting the infection in domestic pigs living in wild boar infected zones.

Wild boar: passive surveillance plays a major role in the definition and updating of the infected area.

8.2.3.2. Active surveillance during outbreak management

The TCC the RF

Due to the epidemiological situation and the high lethality that characterises the Caucasian ASFV, the probability is almost zero to detect an infected animal before it shows clinical signs or dies. To statistically balance this low probability, a huge amount of samples would need to be investigated. Unfortunately, the field capacity merged with the cost of reagents and the lack of personnel in the laboratories prevents any real possibility to have any active surveillance in place.

Recently (Autumn 2009), both Georgia and Armenia were equipped with adequate sampling material for active field surveillance. Also, the laboratories of the countries have been refurnished with diagnostic reagents.

In Georgia, to have the veterinary service in the field, a serological survey in domestic pigs has started recently (August 2009) and aimed at checking the presence of antibodies in animal between 4 and 8 months of age. The serological survey in this specific age class should reveal recent undetected/unreported/undiagnosed outbreaks. The serological survey will also allow detection of antibodies against ticks. Unfortunately, weak collaboration between the DTRA laboratories and the Veterinary Service has, until now, prevented the laboratory testing of the already collected samples. In the RF, commercial farms are monitored by the SRI NRIVVaMR (SCoFCAH, 2009). In 2008-09, 15000 samples were collected in infected areas in the context of a monitoring programme. Samples from commercial farms were collected in each region and submitted for PCR testing. Surveillance for sero-positive pigs should give an indication if there are pigs that survived from the infection and on the geographic spread of the virus. In the RF, in infected and neighbouring areas, all hunted wild boar must be sampled and tested. Due to the short incubation time and fast progression of the disease, as well as the high suspected fatality rate, the WG experts found it very unlikely that an infected wild boar could be hunted and detected: thus a low uncertainty was ascribed to this low probability. Sero-positive wild boarhave not been found so far. The WG experts concluded that the detection of increased mortality in wild boar due to ASF should be detected by the surveillance network. However, if the population density is small, the spread of the disease may be limited and consequently the risk for non-detection may be high.

European Union

The Community legal framework on ASF surveillance and control is laid down in Council Directive 2002/60/EC[17] and in the Commission Decision 2003/422/EC[18], where both active and passive

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[17] Council Directive 2002/60/EC of 27 June 2002

[18] Commission Decision of 26 May 2003 approving an African swine fever diagnostic manual

surveillance is considered. The virus is actively searched through the appropriate application of sampling procedures (including clinical examination) in areas where infected holdings are suspected or confirmed. These procedures are applied even if the clinical and epidemiological patterns suggest a very low probability of occurrence of ASF.

Domestic pigs: In the outbreak management, active surveillance is composed of, both, an active search of diseased animals (showing clinical signs) and sampling for laboratory testing. Active sampling is also requested during the stamping out of the index case and whenever the epidemiological evidence suggests it. Active surveillance based on clinical examination (including the measurement of the body temperature in a pre-determined number of individuals) is foreseen for the removal of pigs from non-infected holdings to slaughterhouses in protection zones under exceptional circumstances. Specific clinical examination and sampling for testing are included in the slaughtering procedures.

Active surveillance (both clinical and testing) is foreseen to end the control measures in both protection and surveillance zones.

Wild boar: due to the low probability of directly observing infected wild boar showing clinical signs in the forest areas, active surveillance is mainly undertaken by sampling and testing all (or a fraction of them) of the shot animals in the infected area and those surrounding it, when considered at risk.

RISK ASSESSMENT

9. Introduction

The assessment of ASF related risks for the EU due to currently affected regions in the TCC and The RF had different objectives as outlined by the Terms of Reference (cfr. page 10). Based on this, the WG had to develop a systematic framework that allows the risk managers to better understand the current situation and the factors affecting resulting risks of introduction and establishment of the disease in EU MS.

The World Animal Health Organization (OIE) and Codex have each developed their guidelines on how to carry out risk assessments for risk questions related to import of animals or food safety. Both guidelines request assessments to be based on scientific knowledge and demand transparency throughout the process of the risk assessment.

The OIE framework differentiates between release, exposure and consequence assessment (Murray, 2004). The release assessment addresses the origin or the source of a disease, and the ways it can be introduced into the country or region in question. The exposure assessment considers the risk of exposure of the susceptible animal population in a country/region where the disease was introduced. The consequence assessment focuses on direct and indirect consequences of having the disease in the country/region.

The crucial part of the risk assessment is to develop risk pathways for the release, exposure and consequence assessment. These risk pathways outline crucial steps leading to the considered outcome. This part of the risk assessment process is a system analysis, which allows the risk manager to follow the conclusions of the risk assessors and to identify where the main risks or uncertainties lie (Hatfield and Hipel, 2002).Assessment of the likelihood of occurrence of each step of the pathway improves objectivity of the risk resulting from the entire pathway. It is the responsibility of the experts and subject matter specialists to develop potential risk pathways and to participate in the assessment of the likelihood of events to occur.

In a data scarce environment a qualitative approach for risk assessment has proved useful for many examples of animal health related questions (EFSA 2009 a and b) and provides a useful tool for risk managers to identify ways to mitigate the risk and to communicate their decisions. A qualitative approach is based on subjective risk levels compared to the quantitative approach where probability values are specified between zero and one. Qualitative risk assessments only have a certain number of risk levels and therefore the overall resolution is limited, which may lead to an overestimation of the risk (Cox, 2008). Qualitative risk assessments, however, prevent an overconfident interpretation of outcomes if little or no data are available, but opinions from experts can easily be gathered, and qualitative assessments are easy to understand for users (Gravenor and Kao, 2003; Heim *et al*, 2006).

10. Materials and Methods

10.1. Risk questions

To address the terms of reference, five sets of risk questions were defined. The questions reflect difference in risk for domestic and wild boar:

- Risk Question 1: What is the risk of ASFV remaining endemic in domestic pigs in the Caucasus region and spread to the eastern neighbouring countries of the EU and what is the resulting risk of introduction of ASFV into the EU?
- Risk question 2: What is the risk of ASFV remaining endemic in wild boar in the Caucasus region and spread to the eastern neighbouring countries of the EU and what is the resulting risk of introduction of ASF into the EU?
- Risk question 3: What is the risk of exposure of the susceptible domestic pig population in the EU following illegal import of feed or swill?
- Risk question 4: What is the risk of ASFV becoming endemic in the domestic pig population in the EU if it were introduced?
- Risk question 5: What is the risk of ASFV to become endemic in wild boar in the EU if it were introduced?

10.2. Risk pathways

The five risk pathways developed for the risk questions are part of a general framework of this assessment. Figure 7 represents a generic risk pathway of steps that may lead to the release, exposure and the potential endemicity of ASFV in an area, and the subsequent spread to unaffected areas including EU MS. Basically, risk associated with spread of the infection and impact of risk mitigation measures had to be considered. By “spread”, the pathway comprises what happens if a disease is introduced to a region and how it spreads, detected or undetected, leading to a new exposure. By “actions”, the pathway reflects how surveillance and control measures are expected to impact the spread.

The arrows on the left in Figure 7 indicate which parts of the generic pathway were involved to address the five risk questions.

For risk question 1 and 2 addressing the situation in domestic pigs and wild boar in the TCC and the RF, the risk pathway first assessed the likelihood of disease presence. At the beginning of the risk assessment the first outbreaks were already detected and therefore only the likelihood of ASFV spreading undetected was included. It was then assessed whether the current measures in place (dealing with new cases and preventive measures) are effective to control the disease and to prevent spread into currently unaffected areas, including neighbouring countries.

For risk question 3, which addresses the exposure of domestic pig populations in the EU if ASFV were introduced via swill, the pathway was repeated for the different production sectors HB, LB and FR. The pathway included the steps identifying the likelihood of feeding of swill, survival of ASFV in swill, and the likelihood of infection following ingestion of contaminated swill.

For risk questions 4 and 5, which address ASF spread within the EU after introduction, the first step was to assess the likelihood of (undetected) spread because of delayed detection of disease incursion. The result was combined with the estimate of the non-effectiveness of the rapid response, and then with the likelihood of further spread once the disease has been detected (likelihood of multiple outbreaks). To assess the likelihood that ASF becomes endemic after an introduction of the disease, the latter likelihood of having several outbreaks was combined with the likelihood that ASF becomes endemic due to a failure in containing the outbreaks (non-effective long-term response).

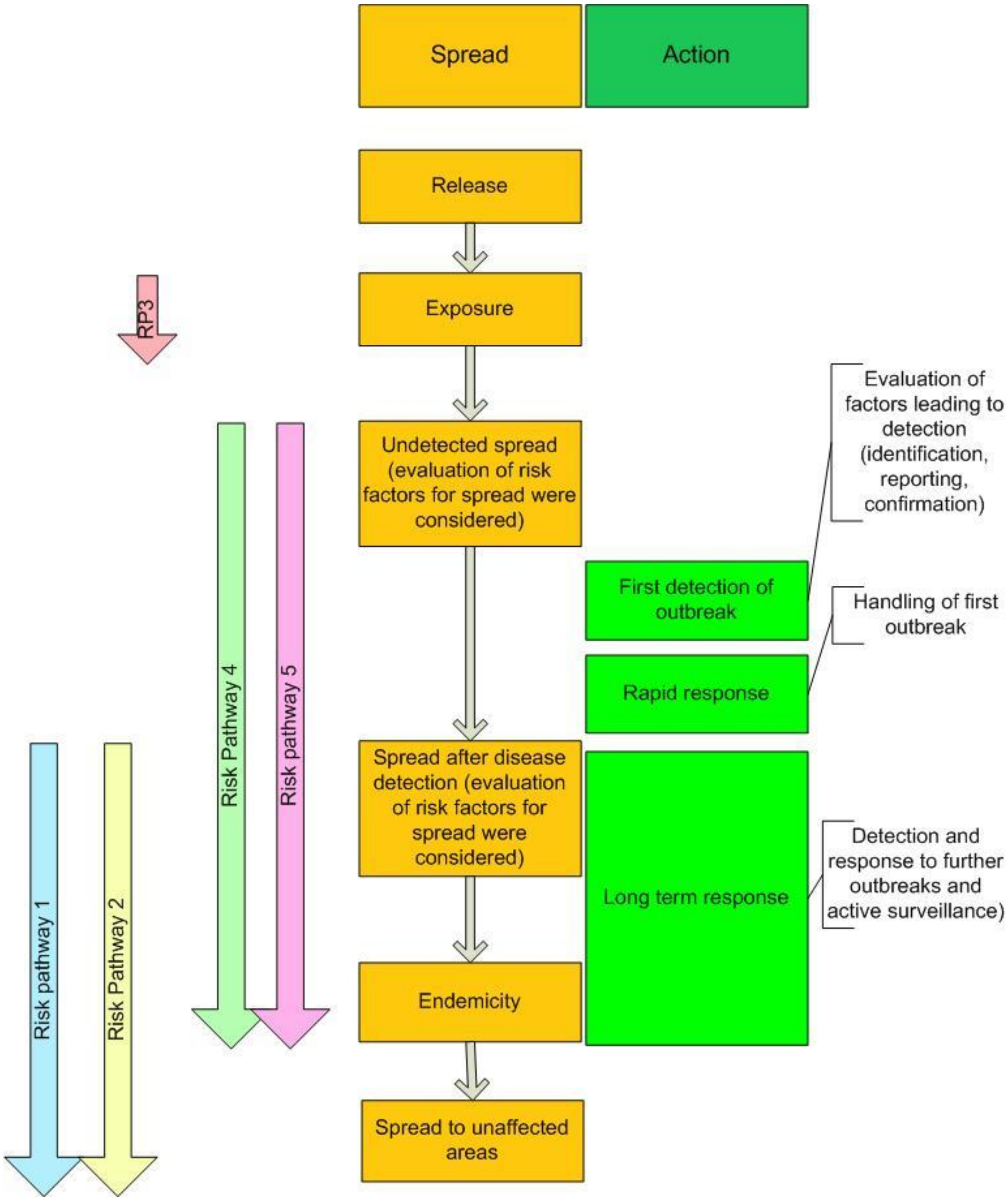


Figure 7: Generic risk pathway for the ASF risk assessment

10.3. Model input parameters

The likelihood of several steps in the generic risk pathway is known to depend on multiple risk factors. The relevant factors were collected in accordance with exiting expert knowledge by engaging the WG members. Whenever spread was addressed in any of the risk pathways, the main known risk factors for ASF spread were included and their role was critically reviewed.

(a) Factors influencing spread of ASF in domestic pig populations:

- Pig movement resulting in direct contact between pigs (intentional through transport or unintentional through free ranging);
- Pork products resulting in indirect contact between pigs (for example, swill feeding);
- Movement of vehicles between farms (for example, transport lorries) resulting in indirect contact;
- Contamination of feed resulting in indirect contact;
- Movement of professional people, such as veterinarians, and associated fomites resulting in indirect contact;
- Movement of non-professional people and associated fomites resulting in indirect contact;
- Spread through pets and pests which act as mechanical vector resulting in indirect contact;
- Contamination of the environment which results in indirect contact;
- Spill-over into ticks which results in direct contact;
- Spill-over into wild boar populations which results in direct or potentially indirect contact.

(b) Factors influencing the spread of ASF in wild boar:

- Ecology determining the behaviour of wild boar which results in direct contact between wild boar groups, including scavenging behaviour;
- Contamination of the environment which results in indirect contact;
- Hunting practice which results in indirect contact between areas;
- Spill-over into ticks which results in direct contact.

(c) Factors influencing ASFV introduction in EU MS through domestic pigs:

- Illegal import of feed and swill (incl. dumping of waste in harbours);
- Migratory workers (associated with pig production, leading to indirect contact);
- Other people (tourists);
- Trade (legal or illegal movement of live animals and animal products);
- Ticks.

(d) Factors influencing ASFV introduction in EU MS through wild boar:

- Ecology (connected wild boar populations leading to direct contact between animals by scavenging);
- Hunting tourism (leading to indirect contact);
- Feed and swill;
- Migratory workers (associated with pig production, leading to indirect contact);

- Other people (leading to indirect contact);
- Ticks.

For the assessment of the effectiveness of measures to mitigate the risk, the following were considered:

- Case identification
- Reporting
- Case confirmation
- Rapid response
- Long term response

Details on all factors are given in Appendix F.

The likelihood of each factor in any model was estimated separately. These estimates were based on available data or derived through elicitation of expert opinion. Experts were asked to give likelihood estimates according to predefined definitions presented in Table 16.

To identify the factors affecting the effectiveness of long term control measures for the different production sectors in the EU and to derive the likelihood estimates, experts were asked to complete a questionnaire and to give their rationale for the estimates, outcomes are presented in Appendix H.

Table 16: Definition of likelihood categories

Risk category	***Interpretation***
Negligible	probability of event sufficiently low to be ignored or event only possible in exceptional circumstances
Low	occurrence of event is a possibility in some cases
Moderate	occurrence of event is a possibility
High	occurrence of event is clearly a possibility

Besides estimating the likelihoods, for each factor the uncertainty of the estimate was given to prevent misinterpretation and overconfidence in the outcomes of the risk assessment and to highlight areas with extremely poor data quality or disagreement between experts. Definitions of these uncertainty categories are presented in Table 17.

Table 17: Definition of uncertainty categories

Uncertainty category	***Interpretation***
Low	Solid and complete data available; strong evidence provided in multiple references; authors report similar conclusions
Medium	Some but no complete data available; evidence provided in small number of references; authors report conclusions that vary from one another
High	Scarce or no data available; evidence is not provided in references but rather in unpublished reports, based on observations, or personal communication; authors report conclusions that vary considerably between them

Tables 34- 40 present the rationale for each estimate and uncertainty assigned, and provide the links to further explanations on the respective topic in the various chapters of the report.

Finally, if more than three factors contributed to the same step in a risk pathway, the factors were ranked according to their importance. The ranking was done independently of the likelihood estimates or the assigned uncertainty. The ranking was performed by expert opinion elicitation collected with questionnaires, details and results of which are presented in Appendix G. Experts for this task were solicited within the WG members.

Example: outcome of factor selection, risk and uncertainty grading, and ranking:

7		6		5		4		3		2		1		Ranking importance	
Pests		Environ -ment		Feed		Vehicles		Profes- sional		People		Pigs		Factor name	
L	L	L	L	L	L	L	H	L	L	L	M	H	L	Risk estimate	Uncertainty grade

10.4. Risk model

The risk model formalises the combination of risk estimates downstream from the steps of the risk pathway (hierarchical model). To construct the general model applied to each risk question, three components must be defined:

- Deriving total likelihood estimates of steps influenced by multiple factors;
- Combining likelihood estimates of dependent steps;
- Combining likelihood estimates of non-dependent steps

10.4.1. Deriving total likelihood estimates of steps influenced by multiple factors

If several factors contributed to the risk estimate of a step, the factor with the worst estimate of the step was used in the downstream calculations. If more than three factors contributed to the estimate of the step, only the three most important factors (rank 1, 2, and 3) were retained. Out of the three, the risk factor with the worst estimate determined the risk estimate of the step and went into the downstream calculations.

Example: of how risk estimates were derived if several factors needed to be considered:

Ten factors contribute to the risk of undetected spread of ASF. To determine the risk estimate of the step, the three risk factors that were ranked as most important by expert opinion elicitation were considered (factor1 = M; factor 2 = H; factor3 =M). Out of the three risk estimates, the worst case (e.g. highest risk of spread) was taken as the risk estimate for that step.

10	9	8	7	6	5	4	3	**2**	**1**
N	L	L	L	M	M	H	**M**	**H**	**M**

H

The likelihood of undetected spread was considered to be high

Similarly, if ten factors are supposed to impact the efficacy of mitigation measures, then the lowest estimate out of the three top ranking factors is taken as the efficiency estimate for the step, representing the worst case. Eventually the efficiency estimate of the step is turned into a risk estimate by restating the estimate as “being NOT efficient”.

10	9	8	7	6	5	4	3	2	1
H	M	M	M	L	L	N	L	N	L

The likelihood of effective mitigation was considered to be Negligible ➔ the risk of worse mitigation then is 1-N = High

A combination matrix uniquely defines the resulting likelihood estimate for any binary combination of input likelihoods (e.g. Table 18 and 19). If a risk pathway consists of steps that are completely dependent on the outcome of the previous step, then the principles of conditional probabilities can be applied. There are animal health related examples where such combination matrices were applied (OIE, 1999) and the respective risk matrices were derived from Beckett (2007).

In a different scenario, where an increase of the overall risk is possible between steps, for example, due to an increased number of infected animals (spread of disease), there is a need to reflect such scenario in the combination matrix used to combine the likelihood estimates of non-dependent steps. An example for such a matrix was presented by Zepeda-Sein (1998).

Combination matrices standardise the evaluation of resulting risk along steps constituting a specific pathway. Hence, they may contribute to the reliability/repeatability of the overall risk estimation.

However, once the rules in the matrix are established, application of this approach to sequentially combine the risks may limit the need to interpret the outcomes Therefore, the specific combination rules implemented in the model by combination matrices (Table 18 and 19), was discussed and agreed by the WG.

10.4.2.1. Combination of likelihood estimates of dependent steps

The first approach considers pairs of steps in the risk pathway that described an exclusive cascade of events (e.g. "presence of disease" followed by "non-efficient response measures" leads into "disease endemicity"). Table 18 provides the matrix applied to combine risk estimates of such cascading, or dependent, steps. With this matrix, increase of risk along a pathway is not possible. To maintain the "High" risk estimate of the first step, the second step estimate must also be "High". All other estimates will decrease the combined risk estimate. The matrix principle transfers the multiplication of conditional probabilities to combinations of qualitative risk levels.

Table 18: Combination Matrix 1, used to evaluate two risk estimates based on the assumption that the second event is conditioned on the first event and/or an increase of risk is not meaningful.

Event 2 **Event 1**	**Negligible**	**Low**	**Moderate**	**High**
Negligible	Negligible	Negligible	Negligible	Negligible
Low	Negligible	Low	Low	Low
Moderate	Low	Low	Moderate	Moderate
High	Low	Moderate	Moderate	High

Matrix 1, based on Beckett (2007), was adapted to four risk categories, and agreed by the working group. Application: if event 1 has an estimate "Low" and event 2 has "Moderate", the combined estimate of the sequence event1 and event 2 will be "Low".

The matrix was also applied to combine steps assessing the efficacy of risk mitigation measures. Usually these measures have to be performed in a logical order (identification, reporting, and confirmation are steps leading to an effective case detection) and respective estimates of the consecutive steps were combined with matrix 1 (Table 18).

Example:

Assume there are three steps representing the effectiveness of confirming a case and every step depends on a previous one (identifying a case, reporting a case, and confirming a case). According to the model, combination matrix 1 is applied stepwise to combine the estimates. In the example shown below, the probability of being effective in confirming a case was "Low".

Step 1: How likely is it to identify a case? M

Step 2: If identified, how likely is it that the case is reported? H

Step 3: If reported, how likely is that the case is confirmed? L

(MxH = M) x L = L

10.4.2.2. Combination of likelihood estimates of non-dependent steps

The second approach considers pairs of steps in the risk pathway that described independent events ("ASF endemic" or "further spread despite mitigation", either leads into "spread into unaffected areas"). Table 19 provides the matrix applied to combine risk estimates of such non-dependent steps. With this matrix an increase of risk along a pathway becomes possible. If the risk estimate of one step is "Low" but the second step is "High" the combined risk will be "Moderate". Hence, the overall risk is assumed to be between "Low" and "High". The matrix principle transfers the average of independent probabilities to combinations of qualitative risk levels.

Table 19: Combination Matrix 2 is used to evaluate two risk estimates that were independent of each other and/or an increase of risk is meaningful.

Event 2 **Event 1**	**Negligible**	**Low**	**Moderate**	**High**
Negligible	Negligible	Low	Low	Moderate
Low	Low	Low	Moderate	Moderate
Moderate	Low	Moderate	Moderate	High
High	Moderate	Moderate	High	High

Matrix 2, was based on Zepeda *et al.*, (1998) and agreed by the working group. Application: if event 1 has estimate "Low" and event 2 has "Moderate", the combined estimate of event 1 or event 2 worsening the situation, will be "Moderate"

Example:

Assume two steps representing the risk of further spread of the disease into unaffected areas (disease endemicity; and continued spread despite measures). The steps independently cause risk for unaffected areas. Therefore, combination matrix 2 has to be applied to combine the estimates. In this example the probability of being effective in confirming a case would be "High".

Step 1: How likely is ASF endemicity? M

Step 2: How likely is further spread despite response measures? H

MxH = H

11. Risk Pathways and risk estimates

In the following paragraph, particular risk pathways will be shown and the results of the risk evaluation model are given in full detail (Figure 8-15). The graphs are structured in a consistent way. To the left of each graph, the input factors that influence the basic steps are listed stepwise horizontally. The factors are ordered by increasing importance, or decreasing rank value from left to right. The three most important factors (lowest rank value) were shaded by more intense colour (see 10.3.). Below each factor, the risk respective efficacy estimate together with an uncertainty grade is given, based on expert elicitation (left pink – risk/efficacy estimate; right blue – uncertainty grade). To the right of each factor set, the respective basic step of the pathway is named and the resulting risk/efficacy estimate (see 10.4.1.) is provided. Steps relating to spread events are shaded in orange and, respectively, in green if the step relates to mitigation action. The estimates of the basic steps are combined using either matrix 1 (Table 18) or matrix 2 (Table 19). The first is indicated by green arrows chaining consecutive steps (see 10.4.2.1.), while the second is indicated by orange arrows, coupling steps that represent independent or equal events (see 10.4.2.2.). All arrows end up in the next step of the risk pathway which is named again, shaded orange or green, and assigned by the explicit combination rule according to matrix 1 or 2, together with the resulting estimate. Any step that has received an efficacy estimate is first converted into the opposite outcome (e.g. “effective response” → “non-effective response”, shown by two adjacent boxes linked with a blue arrow). The respective efficacy estimate is converted into a risk estimate by taking the reminder of 1 (e.g. “Low” → “1 – Low = High”).

11.1. Risk Question 1: What is the risk of ASFV becoming endemic in the domestic pig population in the Caucasus region and eastern neighbouring countries of the EU and what is the resulting risk of introduction of ASFV into the EU?

Given differences in the current situation and preventive and control measures in place, the Caucasus region was divided in the TCC (Georgia/Armenia) and Northern Caucasus (Russian Federation). Figure 8 and 9 show the outline of the resulting risk pathway for risk question 1 for Georgia/Armenia and for the Russian Federation, respectively. For the part of the risk pathway addressing detection and control of ASF, combination matrix 1 was applied. For steps in the pathway addressing spread, combination matrix 2 was used. Table 34 (Appendix F), which summarises the risk estimates and the uncertainty of the estimates, gives a brief rationale for each risk estimate and refers to the respective section in the report where more details on the rationale can be found.

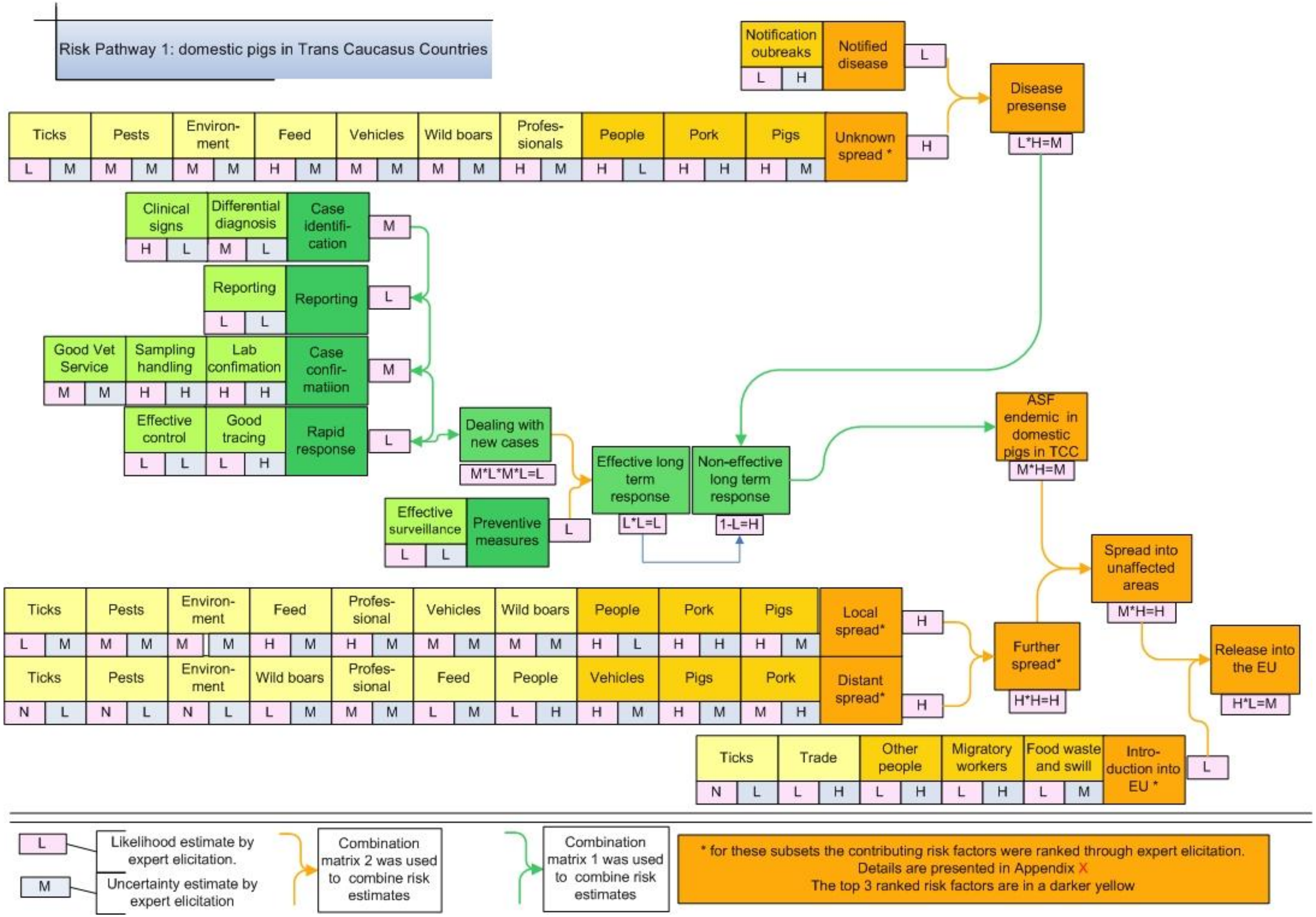


Figure 8: Risk pathway 1 for domestic pigs in the Trans Caucasus Countries

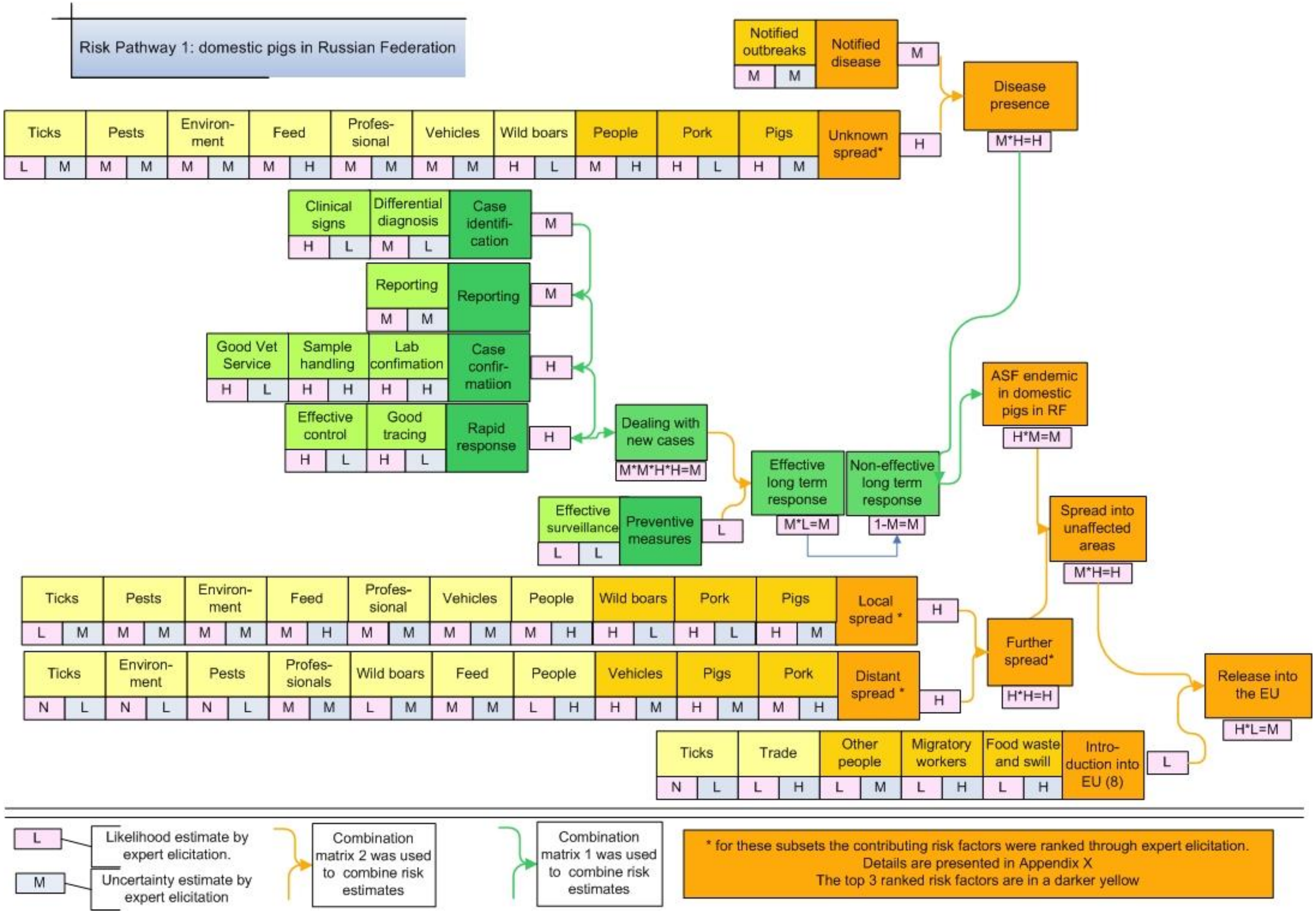


Figure 9: Risk pathway 1 for domestic pigs in the Northern Caucasus region (Russian Federation)

11.1.1. Discussion

11.1.1.1. Domestic pigs in the Trans Caucasus Countries (fig 8)

The risk assessment showed a high overall risk that ASF will remain endemic in the TCC.

The official disease situation suggests a low risk of presence of the disease. No outbreaks have been recently reported but the absence of disease has not been proved and therefore uncertainty of this estimate was considered high. To estimate the overall prevalence, unknown spread was included. The WG concluded that it is moderately likely that the disease is present and continues to spread undetected.

Outbreak response: Despite having good facilities to confirm cases, the current outbreak management is not effective; mainly due to the lack of compensation for slaughtered animals, leading to underreporting, the weak cooperation between veterinary service and national reference laboratories, and the lack of resources for adequate implementation of control measures. For example, it is difficult to control compliance with ban of animal movement. As it is, the outbreak response does not reduce the risk of the disease spreading further.

Local spread could occur mainly due to a lack of traceability, the non-compliance with ban of animal movement and meat products and due to direct contact of pigs in farms with poor biosecurity. Sale of diseased pigs has been reported in Georgia and infected pigs were transported over long distances in the TCC.

The likelihood of ASF introduction into the EU was considered low which led to a moderate overall risk for release of ASF into the EU.

Uncertainty: The estimates for presence of the disease were difficult to derive as limited data on the disease situation is available. Diagnostics: reports and data suggest that facilities to confirm cases are adequate, however these laboratories are not accredited or do not participate to inter-laboratory proficiency tests. Therefore these estimates are uncertain.

High uncertainty was present in estimates addressing spread. This was mainly due to lack of data. There is no surveillance in place.

11.1.1.2. Domestic pigs in the Russian Federation (fig 9)

The risk assessment showed a high overall risk that ASF will remain endemic in the Russian Federation and it is likely that the disease will spread to currently unaffected areas. Despite being in a known disease situation, spread continues, mainly due to non-compliance to movement bans and non-compliance with transport certificates.

Limiting factors of the outbreak management are delays in identification of new cases, which is associated with differential diagnosis and/or non-reporting of cases. The reporting system in the RF was considered more effective compared to that in TCC. There is only one laboratory for ASF diagnosis in the RF which is in collaboration with the EU CRL and the diagnostic capacities are good.

The measures put in place if outbreaks are detected seem often adequate but do sometimes lack effectiveness. Additional surveillance put in place is not sufficient and not risk-based and therefore a long-term response would not be able to prevent spread.

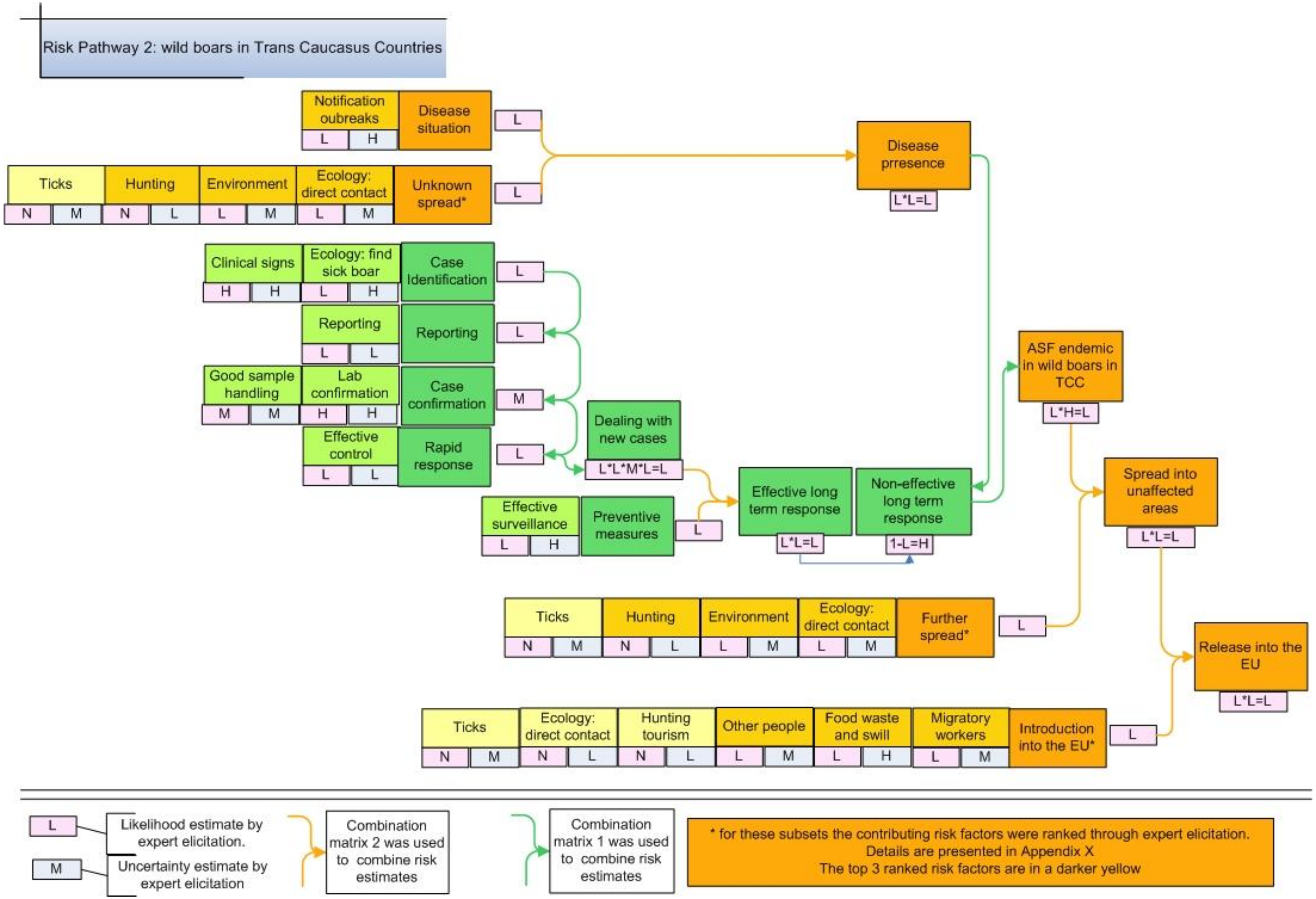
Local spread after detection occurs mainly due to non-compliance with movement bans and the structure of the husbandry systems. In areas with high wild boar densities, spread can also occur due to limited biosecurity on farms.

Distant spread is mainly associated with movement of pork products and movement of pigs.

Introduction into the EU could occur through food waste and swill, and illegal import of pork products by migratory workers and other people.

11.2. Risk question 2: What is the risk of ASF becoming endemic in wild boar in the Caucasus region and eastern neighbouring countries of the EU and what is the resulting risk of introduction of ASF into the EU?

Given differences in the current situation and preventive and control measures in place, the Caucasus region was divided in the southern Caucasus TCC (Georgia/Armenia) and Northern Caucasus (Russian Federation, RF). Figure 10 and 11 show the outline of the resulting risk pathway for risk question 2 for TCC and for the RF, respectively. For the part of the risk pathway addressing control of ASF, combination matrix 1 was applied, and as all other steps addressed steps involved in spread, combination matrix 2 was used. Table 35 shows the rationale for each risk estimate.

1966
1967


1968 **Figure 10:** Risk pathway 2 for wild boar in the Trans Caucasus Countries (TCC)

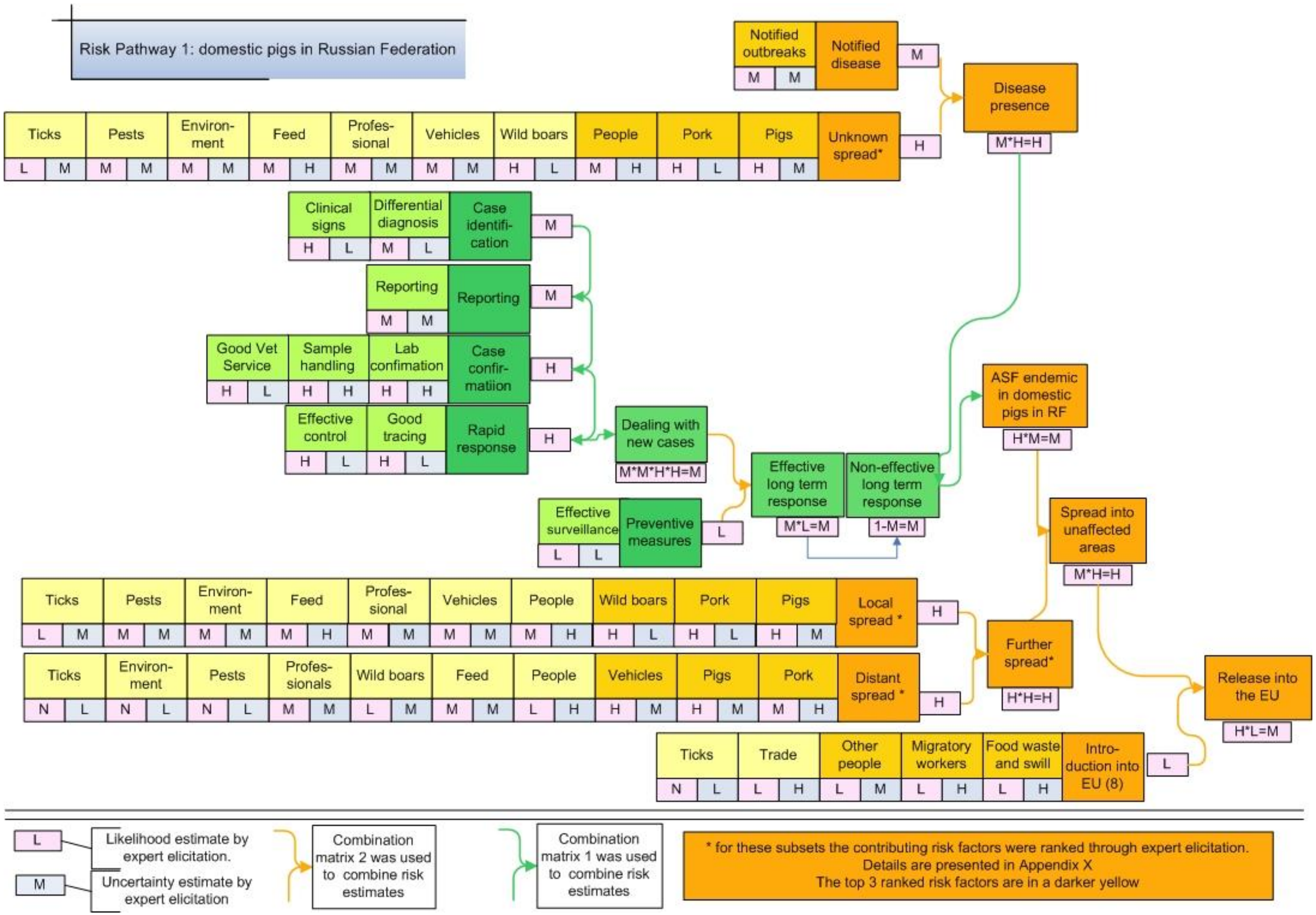


Figure 11: Risk pathway 2 for wild boar in the Northern Caucasus region (Russian Federation)

11.2.1. Discussion

11.2.1.1. Wild boar in TCC (fig.10)

It was very difficult to estimate the current prevalence of ASF in wild boar in the TCC as very little data is available. Disease is not recorded, however, the presence of disease is known. It was estimated that due to low population densities, there is a low risk of maintaining ASF in the wild boar population.

Overall, the effectiveness of the outbreak response was considered low as it is unlikely to identify infected boar and to implement any control measures or have good surveillance. It also needs to be highlighted that very little is known on the pathogenicity of the ASF strain currently circulating in wild boar and the severity of the clinical signs it causes. Based on the experience from current outbreaks, it was considered highly likely that all wild boar express clinical signs. Due to their behavioural patterns, it would be unlikely to find them if diseased. Currently, the only strength of the outbreak management was the satisfactory level of laboratory facilities that would allow confirmation of a suspicious case, if detected. ASF in wild boar is not notifiable in TCC and it is not compulsory to report any suspicious case.

It was considered unlikely that ASF would be introduced through any sources associated with wild boar into EU MS.

11.2.1.2. Wild boar in the RF (fig 11)

Based on official reports from different areas in the RF, it was estimated that it is likely that ASF is currently circulating in the wild boar population.

However as no surveillance data are available, it is difficult to make an informed estimate.

Given the ecology of wild boar and the low population densities it was considered unlikely that the disease would further spread if the cycle were not maintained through constant reintroduction from domestic pigs. It also needs to be highlighted that very little is known on the pathogenicity of the ASF strain currently circulating in wild boar and the severity of the clinical signs causes. Based on the experience from current outbreaks, it was considered highly likely that all wild boar express clinical signs. However, the behavioural patterns of wild boar make it difficult to find them if diseased.

Strict laws to report any suspected cases give higher likelihood that any cluster of wild boar found dead would be reported. The sample handling and laboratory capacities in place were positively rated and confirmation of cases seems very likely.

Control in wild boar population is currently not feasible and there is no effective surveillance in place which would help to better understand the current situation and what risk this poses for domestic pigs. Given the proximity of some currently affected areas with the EU MS and the possibility of the disease spreading into neighbouring countries through the connection of the wild boar populations, there is currently a risk that wild boar could release the disease into the EU. Considering the known distribution of wild boar, areas at risk are mainly Belarus (Poland) and Ukraine (Romania).

Overall the risk of ASF remaining endemic in wild boar in the RF was considered moderate and the likelihood of introducing the disease into the EU was moderate, resulting in an overall moderate risk.

11.3. Risk question 3: What is the risk of exposure of the susceptible domestic pig population in the EU following illegal import of food waste or swill?

Given the importance of variations in biosecurity in different pig production sectors, three different pig compartments were defined and the risk estimated for each of them independently. Three production sectors were defined: High Biosecurity (HB), Limited Biosecurity (LB) and Free Range (FR), definitions of each sector are given in chapter 4.1.2.

11.3.1. Discussion

The risk of ASF exposure to domestic pigs in the EU as a result of illegal introduction of swill is considered low for the LB and FR sector. For the FR production sector, access to swill exists and compliance with the swill feed ban cannot be guaranteed. Similarly, the swill feed ban for the LB sector is not considered to be 100% effective. For example, seasonal workers and/or legal or illegal immigration from eastern countries neighbouring the EU may bring along infected pork products which might be fed to swine in limited biosecurity production systems (see 7.2 and 7.3).

For the HB sector, the likelihood of exposure through swill feeding is negligible, due to highly effective biosecurity measures in this sector.

11.4. Risk question 4: What is the risk of ASF to become endemic in the domestic pig population in the EU?

Given the importance of variations in biosecurity in different pig production sectors, the risk of ASF becoming endemic was estimated for each of them separately. Three production sectors were defined: HB, LB and FR, definitions of each sector are given in chapter 4.1.2. The pathways model the risk of spread within a sector and spread to other production sectors.

Figures 12-14 outline the structure of the risk pathway and tables 37-39 present the rationale for the risk estimates for each pig production sector. For each sector, the risk of spill-over into any of the other sectors was assessed. To assess the resulting consequences, the overall risk estimates were considered for the overall conclusions.

Different risk factors for spread of ASF were considered and the risk estimate given is a combination of the frequency of the contact and the efficiency of disease transmission of the contact assessed.

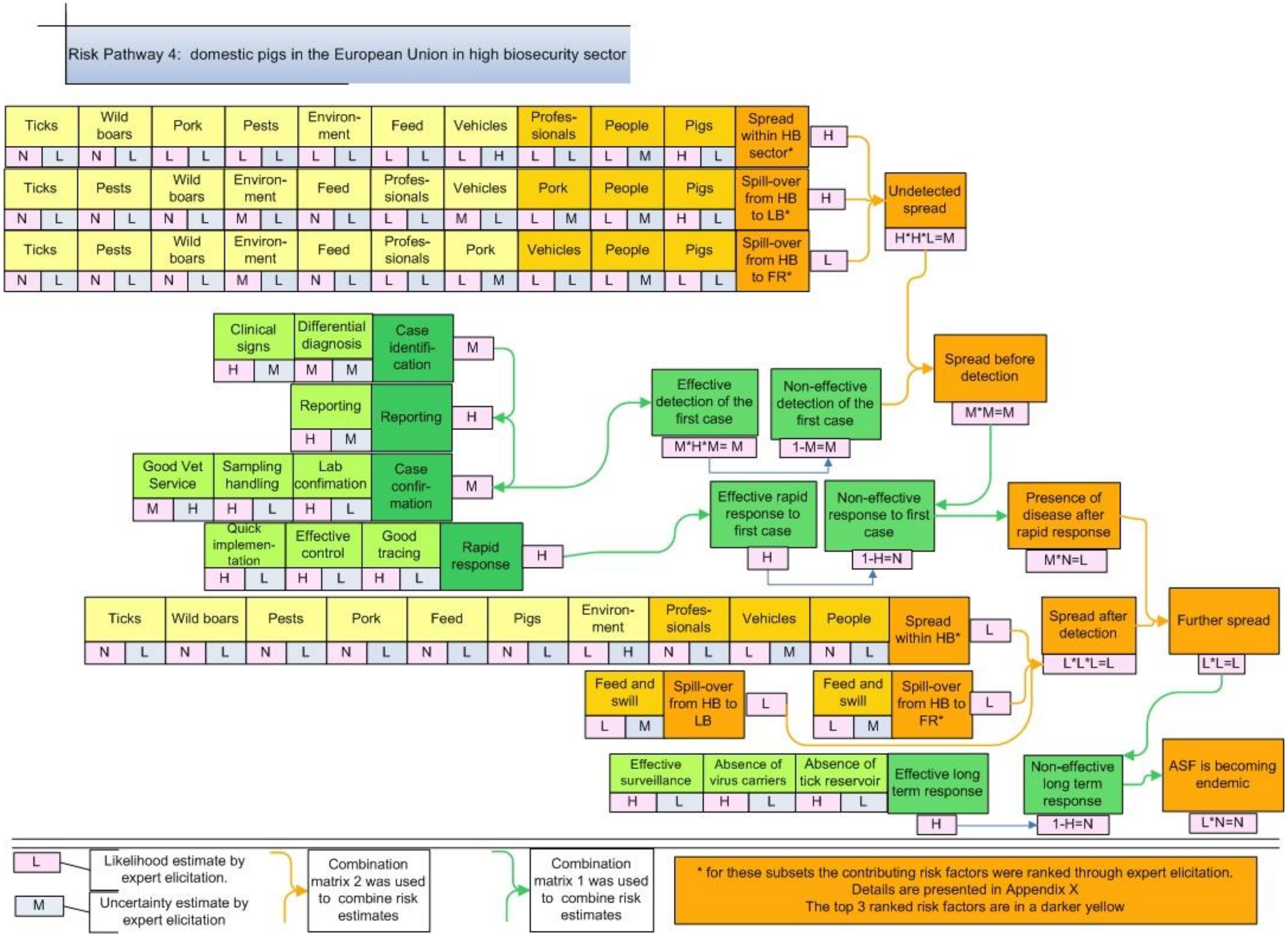


Figure 12: Risk pathway 4 for domestic pigs in the EU if ASF were introduced into the high biosecurity pig production sector**.**

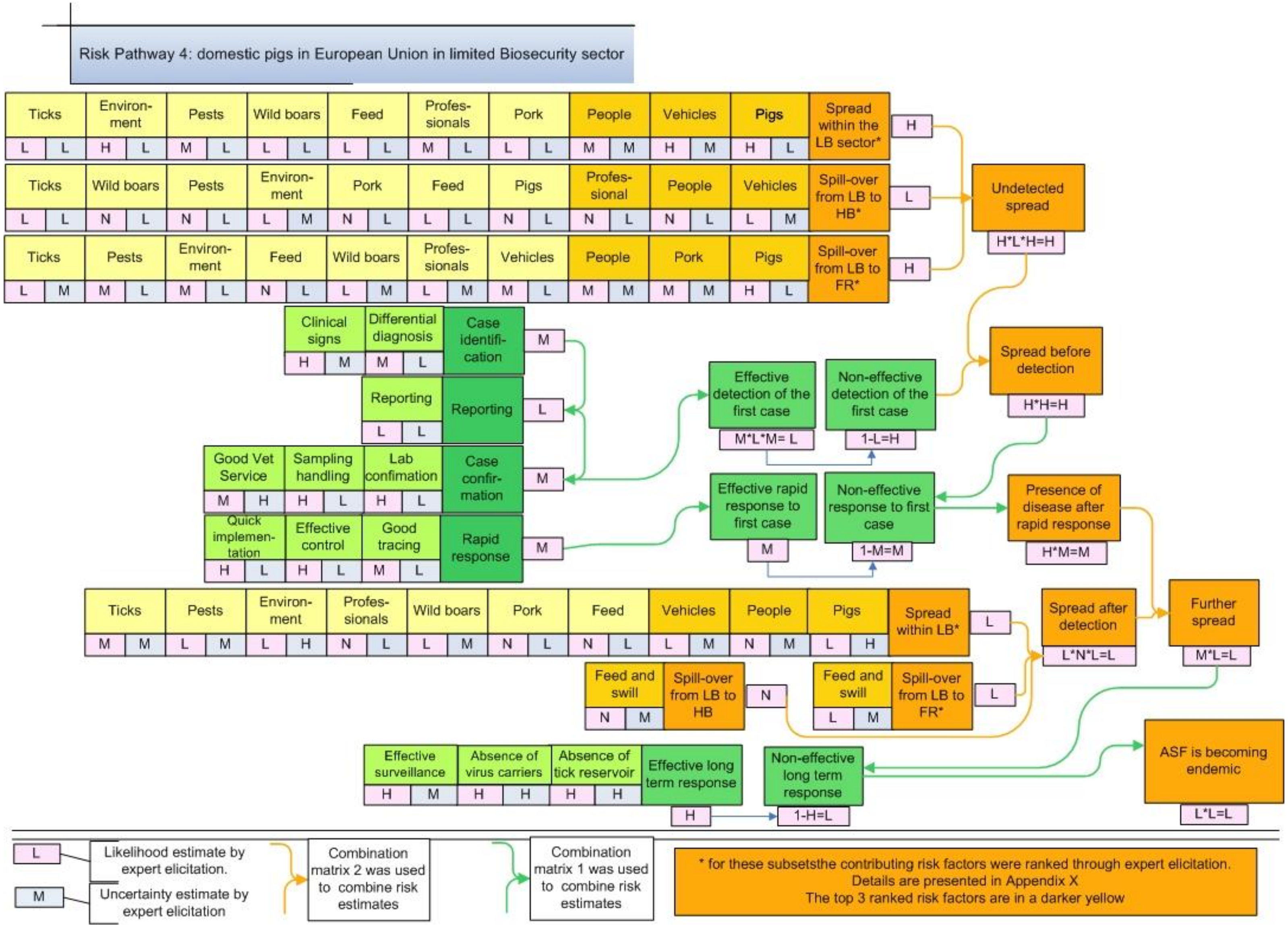


Figure 13: Risk pathway 4 for domestic pigs in the EU if ASF were introduced into the limited biosecurity pig production sector.

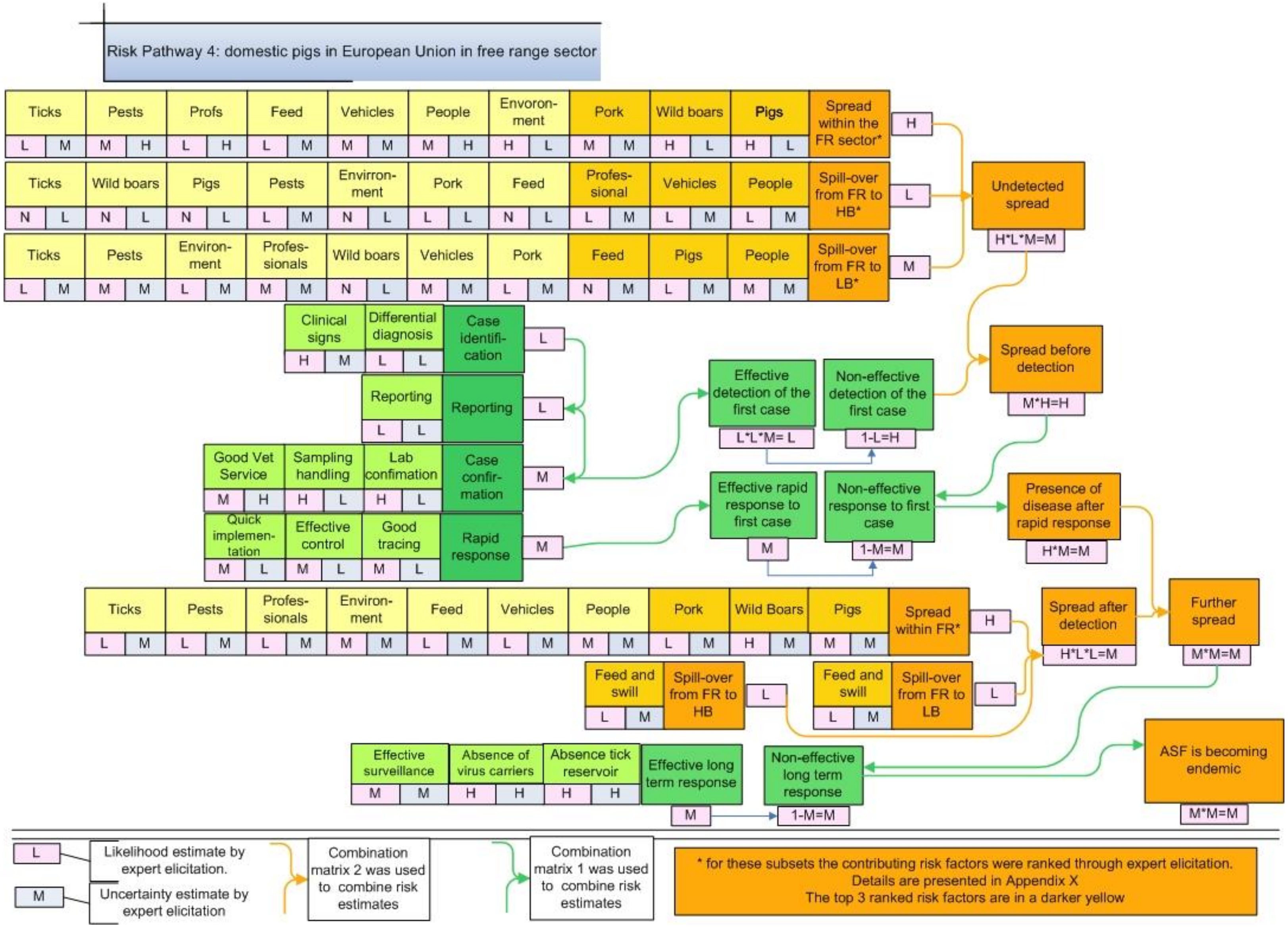


Figure 14: Risk pathway 4 for domestic pigs in the EU if ASF were introduced into the free range pig production sector

11.4.1. Discussion

Detection of disease introduction is critical. If there is a prolonged period before the detection, spread is likely to occur in all 3 production sectors.

For the HB production sector, the risk pathway addressing spread prior to detection indicated that disease misdiagnosis could delay the detection. The occurrence of clinical signs and the reporting of suspicious cases were considered highly likely in this sector. Available facilities in veterinary services and laboratories were considered adequate to identify an ASF outbreak. In spite of this, a delay in case identification is likely and spread may occur.

Within the HB sector, ASF could spread rapidly before it is detected, mainly through the movement of pigs. Movement of pigs was also considered as the main link to the pig production sector with limited biosecurity, because trade of pigs of HB to LB is very common. However, trade links between HB and FR sectors were considered less likely. This includes not only movements within a country, but most importantly, it includes movements of pigs to other MS (see chapter network analysis, trade of live pigs). Depending in which country the disease occurs; several countries are likely to become infected. For both sectors, the risk of spread prior to detection, was considered high. Given that the free-range production sector has a few links to the HB sector, the risk of spill-over was considered low.

The model indicates that after ASF introduction in the EU, it is likely to have several outbreaks and these might not necessarily be in one country.

Once an outbreak is detected, the implementation of a rapid response in the HB production sector is likely to occur without delay and should be very effective. A high level of biosecurity is in place and reasonable recording of pig movements is presumed. This facilitates tracing of dangerous contacts and is crucial to successfully contain the outbreak. Therefore it is also unlikely that further spread would occur once an outbreak is detected. However, this risk should not be neglected since indirect transmission through vehicles and through human error may occur. This could also lead to spill-over into the FR and LB production sectors.

The analysis of this pathway highlights the importance of timely detection of the outbreak because undetected spread may be considerable and may lead to extensive spread.

Recommendation: encourage MS to increase pig farmers' and vets' awareness of the disease to decrease the time to detection.

The risk pathway for the LB sector identified that spread within the sector prior to detection of the first outbreak as highly likely. This was mainly associated to the movement of pigs. The movement of pigs was also identified as the main reason for spill-over into the FR sector. However, the likelihood of spill-over into the HB sector is low due to the biosecurity measures in place.

Under-reporting was the key step leading to ineffective detection of the first case. Once the introduction of the disease is known, there is a moderate likelihood that the control measures implemented will be ineffective and therefore a moderate risk that more secondary outbreaks will occur. This is attributed mainly to the difficulties in tracing of all dangerous contacts in this sector. On-farm control measures, however, were considered effective. Further spread through pigs after detection cannot be excluded. The long-term response was considered likely to be effective. Consequently, the overall risk that ASF would become endemic in the EU if it were introduced into the LB sector is low.

It is highly likely that the disease would spread within the FR sector if introduced. Spill-over before outbreak detection to other production sectors was moderate for LB and low for HB. As for the other production sectors, mix-up with other diseases and lack of reporting impedes timely detection of the first outbreak. Implementation of effective control measures, short and long term, is more problematic in this sector. This leads to a moderate likelihood of further spread and consequently to a moderate risk of ASF becoming endemic within the EU.

11.5. Risk question 5: What is the risk of ASF to become endemic in wild boar in the EU?

Figure 13 outlines the risk pathway to address risk question 6. Table 40 contains details on the risk estimates and refers to other parts of the report. For the combination of risk estimates addressing control measures, risk matrix 1 was used. For the part of the pathway addressing spread of ASF to determine the risk of the disease becoming endemic, risk matrix 2 was used.

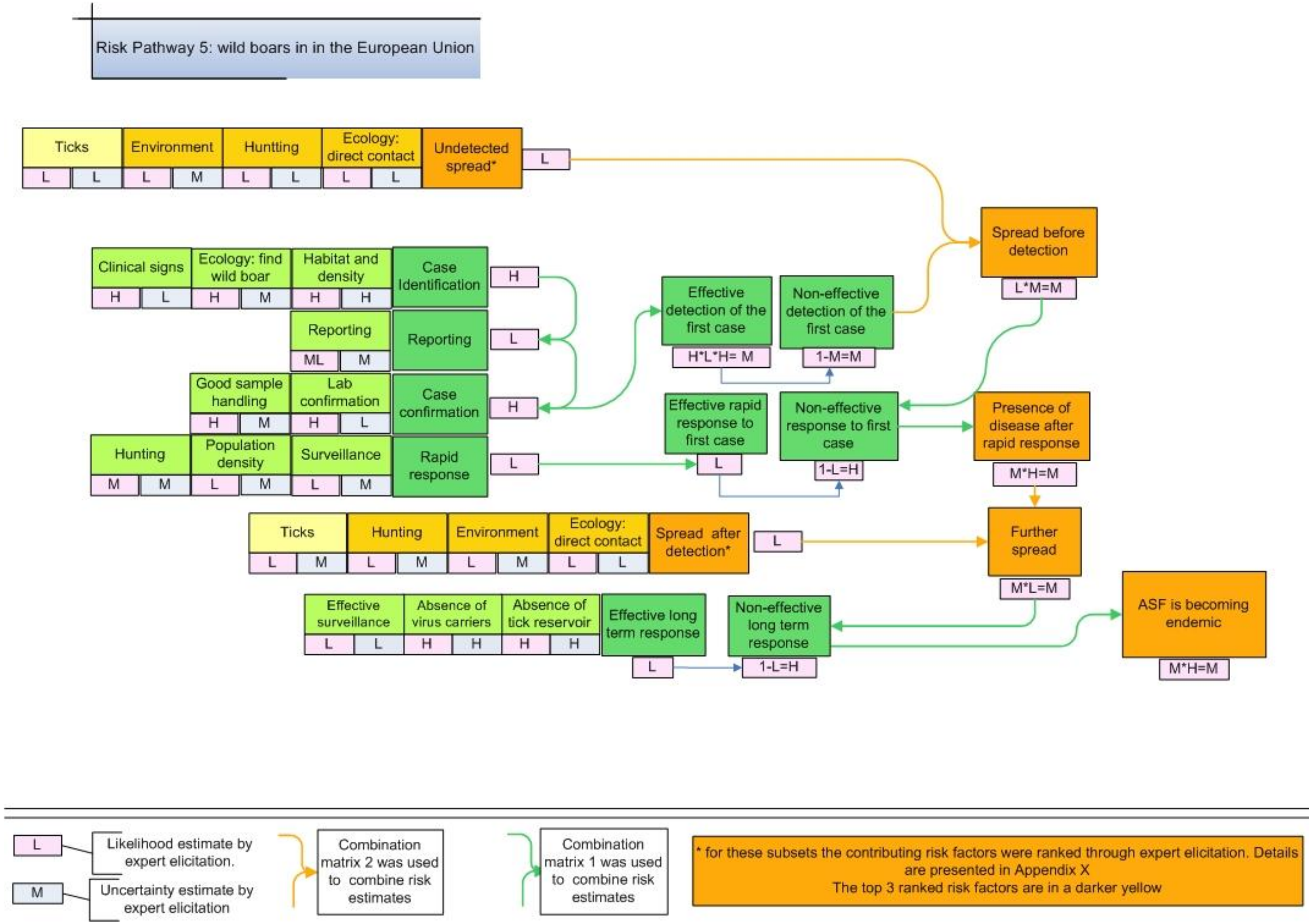


Figure 15: Risk pathway for spread of ASF within the EU wild boar population.

Conclusions and Recommendations

Conclusions

Chapter 2: Characteristics of ASFV strain currently circulating in the Trans Caucasus Countries and the Russian Federation

- The ASFV circulating in the Caucasus and the Russian Federation is a highly virulent virus and there is no scientific evidence that the virus has reduced its virulence since the first outbreak in 2007 in Georgia.
- Current isolates from the Caucasus and Russia have been typed as belonging to a single genotype II.
- The genetic conservation of the ASFV ds DNA genome, as indicated from previous studies, suggests there may be limited success in tracing outbreaks within a region by partial sequencing of genes.
- Experience from other regions where ASF is endemic suggests that the number of apparently healthy pigs that are in fact infected may increase over time in the TCC and the RF. Detection of these animals and their management will be of paramount importance in disease control.
- ASF virus is very resistant to inactivation in the environment.
- ASF virus may persist for several months in frozen or uncooked meat.
- No infectious ASF virus has been found in cooked or canned hams when heated at 70°C for 30 minutes.
- Several official commercial production procedures can inactivate ASFV.
- In domestic pigs and wild boar, the most effective routes of infection are through direct contact and ingestion of infected material.
- Indirect contact through people, vehicles, and fomites can play a role in disease transmission. These routes of transmission seem to be efficient only when high virus load is involved, such as infectious blood.

Chapter 3: Occurrence of ASF in the TCC and the RF

- Accurate assessment of the incidence and prevalence of ASF in the Trans Caucasus Countries and the Russian Federation is difficult due to limited availability of surveillance data.
- To understand the epidemiological role played by domestic pigs and wild boar is difficult since very little information is available on the geographical distribution and the population size of both free ranging pigs and wild boar.
- ASF has spread in the TCC and in the RF since 2007; measures put in place were not sufficient to control the spread.

Chapter 4: Characteristics of the swine populations and husbandry systems in the TCC, the RF and the EU

- There is wide variation in the size and distribution of the domestic pig and wild boar populations between and within the Caucasus, Russian Federation and the MS of the EU

- In the TCC and the RF, the size of the domestic pig population is greatest during late summer/early autumn and these are also higher risk periods for contact with wild boar

- In the TCC, the predominant pig production systems are backyard farming and FR farming systems, with only 1-2 pigs per owner. These systems rely on low inputs comprising swill-feeding, scavenging, no containment and almost no biosecurity.

- In the TCC, trade and traffic of backyard pigs is generally not controlled and involves informal markets and private transactions.

- In the TCC, pigs are usually slaughtered at home and often without veterinary inspection.

- In the RF, there are regional differences in pig husbandry systems, ranging from backyard to intensive pig farms. Free-range husbandry is prohibited, but still practiced.

- After the outbreaks of ASF in the TCC and RF, the pig population in affected areas has decreased drastically due to mortality and implementation of control measures and risk avoidance of farmers.

- In the EU, the biosecurity of pig production systems varies from area to area. The majority of the production systems in the MS have limited biosecurity.

- Movement of wild boar is limited geographically, although direct contact between wild boar groups is frequent due to their social behaviour.

- High densities of wild boar increase direct contacts with other wild boar, but reduce long distance dispersals.

- The little information available from Eastern Europe and the TCC indicates a very low density of wild boar, usually less than one head per km^2, although clustering in some areas of the TCC and the RF does occur.

- In the TCC and the RF, contact between domestic pigs and wild boar can be common due to FR husbandry systems.

- The TCC and the RF wild boar populations are linked with those of the EU through continuous corridors. In particular, Belarus is well connected with Poland and Lithuania, and Ukraine with Poland, Romania.

- Wild boar dwell in many European countries and high density populations are present in some areas, notably Germany [almost all forested areas], northern France and central Italy.

- Contact between domestic pigs and wild boar is well known in some EU MS or regions, such as Spain, Portugal, Romania and Sardinia.

Chapter 5: the role of ticks as vectors in the spread and the maintenance of ASF

- Bites from infected *Ornithodoros* ticks are efficient routes of transmission but their role in the current outbreaks in the TCC and the RF is unknown

- Of all the invertebrates tested up to the present, only the soft ticks of the genus *Ornithodoros* are susceptible to ASF virus infection either naturally or experimentally. Other soft ticks belonging to other genera remain untested under laboratory conditions. Hard ticks, or other blood feeding invertebrates, have not been shown to be a vector of ASFV.

- All the *Ornithodoros* species (*O. erraticus, O. moubata/porcinus, O. coreaceus. O. turicata, O. puertoricensis, O. parkeri* and *O. savignyi*) investigated so far can become infective and perhaps will be biological vectors of ASF and they may play various roles in the epidemiology. Of these species, some of them are found only in Afro-tropical and Neo-tropical regions.

- Only the *O. erraticus* complex is found in the EU, TCC and RF territories. Morphological characteristics alone are not sufficient to differentiate some of these Ornithodoros species.

- Because of its long life (up to 15 years), long survival without feeding and persistence of infection for up to 5 years, the *O. erraticus* complex may be important in maintaining the local foci of the ASFV (and lead to endemicity in a region). However, they do not play an active role in the geographical spread of the virus.

- Ornithodoros ticks feed mainly on animal species living in burrows, such as rodents and reptiles. Pigs are mostly accidental hosts, which can transmit the virus. The epidemiological role played by ticks may become important where pigs are managed under traditional systems, including old shelters/sties with crevices.

- Wild boar have never been found infested because, unlike warthogs, they normally do not rest inside protected burrows, which may be infested by ticks.

- Due to the limited available data on factors associated with the distribution of soft ticks, prediction of their potential distribution is difficult to construct.

- Eradication of *O. erraticus* from the old pig sties is invariably unsuccessful.

- The use of acaricides in pigs and around them can reduce the level of infestation in the premises but does not avoid that the pigs become infected by ASF virus if they are bitten by a virus infective tick.

Chapter 6: international spread of ASFV through trade of pigs and pig products

- According to the EU legislation, all trade of swine and their products between the TCC and the RF is banned. However, regional Border Inspection Posts face difficulties to effectively control movements of animals or animal products.

- Social and economical factors in the TCC and the RF may lead to illegal and uncontrolled movements of pigs and pork. These factors might play a key role in the persistence of ASFV in the area and in its spread to new regions.

- No legal base to control swill feeding has been established in the TCC and RF and swill feeding is still widely practised.

- According to the EU legislation, MS shall not authorize the importation of swine or pork meat unless they come from third countries which have been free of ASF for the previous 12 months.

- In most MS, the veterinary checks at the Border Inspection Posts are carried out adequately, although in a few MS a number of shortcomings were reported by the FVO.

- Illegal imports of swine and products thereof are impossible to quantify due to lack of data

- Large numbers of live pigs and large amounts of pig products are traded among the MS. The amount of this trade varies by the year and regions/country.

- The weight of pork (fresh and frozen pig meat) is even higher than the weight of live pigs traded among MS and the trade patterns for pork are more complex. MS at the centre of trade networks can be identified as target for specific surveillance activities.

Chapter 7: Incursion of ASFV into the EU through movement of people

- There is a considerable movement of people from the Eastern European countries to and from the EU MS that is difficult to control. They may bring along infected pork products. This movement is observed into all the EU MS, and not only into those MS situated in Eastern EU.

- Waste food from international means of transport is not always treated according to the EU legislation.

Chapter 8: Outbreak detection and response

- The chances of misdiagnosis by clinical signs only are very high and therefore lab confirmation is required.

- Passive surveillance plays a pivotal role in detecting the infection in domestic pigs and wild boar.

- The classical eradication strategies based on stamping out has been proven not to be applicable in backyard or in free range sectors.

- The eradication of ASF from Portugal and Spain proved that vaccination is not essential in the eradication of this complex disease, even in endemic countries.

- Contingency plans of the TCC and the RF are not according to the protocols for ASF contingency plans established by the OIE.

- In the TCC and the RF, the farmers' awareness of ASF and compliance with the control measures are not always sufficient.

- A coherent suspected case definition has been adopted recently. Strict procedures, however, to be applied when a clinical case fulfils the suspect case definition, still need to be developed in the TCC and the RF.

- TCC Veterinarians might be able to respond to limited scale outbreaks, however they are not prepared (in terms of both equipment and strategies) to cope with multiple and severe ASF outbreaks as occurred in 2007.

- Due to the lack of resources and limited compensation in the TCC and the RF, the stamping out policy is delayed. During this time delay it is almost impossible to guarantee the containment of ASFV in the affected farms.

- In the TCC, new outbreaks in previously unaffected areas may not be reported internationally. Virus exchange with international laboratories is not a routine procedure.

- In Georgia, poor cooperation between the national laboratory and the VS could create difficulties to achieve an optimal management of the suspected cases, outbreak response and the following surveillance activities.

- Contingency plans are available in the EU.

- In the EU, farmers and veterinarians may be reluctant to notify ASF suspicion because of the contingency measures that apply. It may take some weeks before laboratory confirmation, during which animal movements are maintained and ASFV is spread.

- Unusual clusters of high mortality in wild boar in the EU should initiate ASF testing, together with CSF testing.

Risk Assessment:

Risk Question 1: What is the risk of ASFV remaining endemic in domestic pigs in the Caucasus region and what is the resulting risk of introduction of ASFV into the EU?

- The risk of maintaining the ASF and its spread within the TCC and the RF is high with a medium level of uncertainty. The resulting risk of ASF introduction into the EU is moderate.

- The risk of spread into unaffected areas in the RF and the TCC is high.

Risk question 2: What is the risk of ASF remaining endemic in wild boar in the Caucasus region and spread to the eastern neighbouring countries of the EU and what is the resulting risk of introduction of ASF into the EU?

- Overall the risk of ASF remaining endemic in wild boar in the TCC was considered low, mainly due to the low swine population densities, resulting in non-maintenance of infection in this population. The likelihood of introducing the disease into the EU was low.

- The risk of ASF remaining endemic in wild boar in the RF was considered moderate.

- The likelihood of introducing the disease into the EU was moderate, given the proximity of some currently affected areas with the EU MS and the possibility of the disease spreading through the continuity of wild boar corridors. Considering the known distribution of wild boar, areas at risk are mainly Belarus (Poland), Ukraine (Romania), Lithuania, Latvia, Estonia.

Risk question 3: What is the risk of exposure of the susceptible domestic pig population in the EU following illegal import of food waste or swill?

- The risk of establishing the infection in the EU's susceptible pig population, following illegal importation of swill feed, was considered negligible in the HB sector and low in the LB and FR production sectors.

Risk question 4: What is the risk of ASF becoming endemic in the domestic pig population in the EU if it were introduced?

High biosecurity production sector

The risk of endemicity of ASFV is negligible because:

- If outbreaks occur, rapid action in HB system is considered very effective to contain the disease as the production sector is very well controlled. Therefore it is very unlikely, but not negligible, to have secondary spread of disease after detection. The risk of spread through vehicles, however, should not be excluded.

- The overall risk of ASF endemicity following introduction of ASFV into the HB production sector is negligible, with low uncertainty due to effective long term response.

Limited biosecurity production sector

The risk of endemicity of ASFV is low because:

- Spread is highly likely while the disease is not detected because of large trade volume within the sector. Delay in disease detection was mainly attributed to mix-up of diseases and failure to report from farmers and vets.

- If outbreaks occur, rapid action in LB system is considered very effective to contain the disease. A problem, however, may occur due to the poor animal movement record keeping in this sector. Secondary spread of the disease can occur, mainly due to non-compliance with animal movement ban.

- The overall risk of endemicity is low with medium uncertainty due to effective long term response. The uncertainty becomes high when considering the possibility of virus carriers and tick reservoirs.

Free range production sector

The risk of endemicity of ASFV is moderate.

- Spread is highly likely while the disease is not detected because of poor biosecurity and potential interaction with wild boar. Delay in disease detection was mainly attributed to mix-up of diseases and failure to report from farmers and vets.

- If outbreaks occur, rapid action in the FR system is considered difficult, due to constraints in implementation of control measures and poor animal movement record keeping. Secondary spread of disease is likely to occur, mainly due to non-compliance with animal movement bans and difficulties to access all free ranging pigs in an affected area. In areas with wild boar, potential interaction with this susceptible species may occur.

- The overall risk of endemicity is moderate with medium uncertainty because long term response is not likely to contain spread. This is due to difficulties to consistently implement effective control measures. The uncertainty becomes high when considering the possibility of virus carriers and tick reservoirs.

Risk question 5: What is the risk of ASF to become endemic in wild boar in the EU if it were introduced?

- The risk of ASFV becoming endemic in the EU is moderate. This is mainly due to spread in areas with high wild boar population. Disease control in wildlife is difficult in general and in particular if there is no vaccine available.

Table 20: Overview conclusions risk pathway 1 and 2

Risk question	***Region/ sector***	***Risk estimate***	***Main rational***
RP1: Risk of ASF remaining endemic in domestic pigs in the Caucasus	TCC	Moderate	Insufficient outbreak response
	RF	Moderate	Insufficient outbreak response
RP1: Risk of ASF spreading to unaffected area	TCC	High	Non-compliance with control measures
	RF	High	Non-compliance with control measures
RP1: Risk of ASF being released into the EU (domestic pigs)	TCC	Moderate	Illegal movement of swill and food waste
	RF	Moderate	Illegal movement of swill and food waste
RP2: Risk of ASF remaining endemic in wild boar in the Caucasus	TCC	Low	Low population density
	RF	Moderate	Connected wild boar populations
RP2: Risk of ASF release into the EU (wild boar)	TCC	Low	No connected wild boar populations
	RF	Moderate	Connected wild boar populations
RP3: Exposure of EU domestic pigs following illegal introduction of ASFV with swill	EU-HB	Negligible	Compliance with swill feed ban
	EU-LB	Low	Non-compliance with swill feed ban
	EU-FR	Low	Non-compliance with swill feed ban
RP4: Risk of ASF becoming endemic in domestic pigs in the EU	EU-HB	Negligible	Uncertainty in estimates
	EU-LB	Low	Uncertainty in estimates
	EU-FR	Moderate	Difficult to implement control measures
RP5: Risk of ASF becoming endemic in wild boar in the EU	EU	Moderate	High population density/connected populations in certain areas

RECOMMENDATIONS

- An integrated strategy involving the TCC, the RF and the EU should be developed to facilitate the trans-boundary control of ASF. This should include an information exchange platform and would be strengthened by identifying needs and gaps in knowledge.

- Knowledge and implementation of biosecurity principles, including mechanisms to reduce or prevent contact between domestic pigs and wild boar in the TCC, the RF and the EU should be promoted.

- Based on the risk assessment, reduction of the risk of ASFV to continue being endemic in the TCC and the RF and to spread to other regions could be achieved by:

    - improving early warning and preparedness in non-affected areas:

        - improving ASF awareness and enhancing passive surveillance activities;

        - developing appropriate contingency plans and testing them (desk top and integrated field simulations);

        - developing appropriate laboratory procedures to obtain a primary diagnosis, to dispatch infected/suspected samples and ASFV isolates to EU and OIE reference laboratories.

    - improving rapid control after outbreak confirmation, including strict procedures when a clinical case fulfils the ASF case definition.

    - providing training to improve epidemiological investigations of outbreaks (e.g. on gathering information on the origin and spread of the outbreaks, including the rate of contacts between wild boar and domestic pigs in outbreaks).

    - enhancing recording/monitoring of pig identification and movements, including veterinary checks at country borders.

  - improving long term control after outbreaks (targeted active surveillance).

- Data on distribution and practices of husbandry systems (HB, LB and FR) in the EU and neighbouring countries and trade data within, to and from the EU, should be available to assist with the development of improved surveillance and disease control.

- In the EU, preparedness should be improved through;

  - Enhanced passive surveillance of domestic pigs and wild boar in all MS;

  - systematic differential diagnosis for CSF and ASF. Incorporation of the main ASF diagnostic tests in the official labs in all MS (PCR, ELISA, WB);

  - implementation of active surveillance of wild boar in regions within ecological corridors (e.g. routine testing of hunting bags);

  - enhanced implementation of the EU legislation on destruction and disposal of waste food from international means of transport, e.g. by increasing the awareness of the official veterinarians at the BIPs and public awareness campaigns;

  - increased pig farmers' and veterinarians' awareness of the risk of ASF, the clinical signs, and the danger of swill feeding, especially in limited and free ranging production sectors. Informing farmers about the potential origins of infected products;

  - increased awareness of hunters in the EU, especially in regions within ecological corridors, to ensure immediate notification of mortality and clinical signs in wild boar;

  - increased biosecurity of outdoor pig farms, in particular in the high risk regions, where ASF can enter through wild boar contact;

  - development of a specific backyard disease eradication strategy.

- Molecular and genetic characteristics should be used for differential identification of the different species of the relevant soft ticks.

RECOMMENDATIONS FOR FURTHER RESEARCH

- Determine the potential carrier status of animals infected with ASFV currently circulating in the TCC and the RF because they could play a potential role in the development of endemicity.

- Study the pathogenesis in wild boar infected with the strain currently circulating in the TCC and the RF and modes of transmission.

- Further refinement of network analysis tools is required to analyse trade in pigs and pork products to enhance the implementation of specific surveillance activities.

- Further studies are required to improve the predictive value of models for tick distribution.

- Studies are required to evaluate the vector competence for ASFV of the soft ticks in the EU, the TCC and the RF, their excretion of the virus and their geographic distribution.

- Evaluate the host preferences of the relevant tick vectors.

- New measures to control ticks should be explored.

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GLOSSARY AND ABBREVIATIONS

Argasid ticks = soft ticks

Animal units or pig unit = 100 kg

BIP: Border inspection posts

Endemicity: uncontrolled and established infection (in this report)

Endophilic: when not feeding, endophilic ticks live in the nest of their hosts

Fennoscandia:is a geographic and geological term used to describe the Scandinavian Peninsula, the Kola Peninsula, Karelia and Finland.

FR: free range

Gonotrophic: cycle of feeding, digestion and oviposition.

HB: High biosecurity holding

LB: Limited biosecurity holding

MS: Member States

Nidicolous: living in the nest of the host

Synantropic: species of wild animals which live near, and benefit from, an association with humans and the habitats that humans create around them.

Sympatric: species that occur in the same geographic area

Swill: a mixture of solid and liquid food scraps fed to pigs

TCC: Trans Caucasus Countries

RF: Russian Federation

APPENDIX/APPENDICES

APPENDIX A: WILD BOAR POPULATION IN THE TRANS CAUCASUS COUNTRIES AND THE RUSSIAN FEDERATION

Table 21: Number of domestic pigs and wild boar in the South Russian Federation (SRF) in 2007

Republic, region or territory	Wild boar[1]		Domestic pigs[1]
	2007	2008	2009
1. The Chechen Republic	3	n.d.	0
2. Republic Ingushetia	0.5	0.5	0
3. R. Daghestan	4.09	2.85	1.5
4. R. Karachay-Cherkessia	3.28	3.21	52.8
5. R. Cabardino-Balkaria	4.11	3.95	42.5
6. R. North Ossetia-Alania	2.38	2	17.2
7. R. Adygea	1.8	1.84	21.9
8. Astrakhan Region	1.87	2.5	23
9. R. Kalmykia	0.8	0.83	29.5
10. Krasnodar Territory	12.53	11.44	1226.5
11. Stavropol Territory	1.16	1.21	479.0
12. Rostov Region	3.46	3.77	838.4
13. Volgograd Region	2.83	3.5	353.6
Total for SFR:	41.81	37.6	3085.9

Russian National Institute of Veterinary Virology and Microbiology, 2009; n.d.: not defined; [1] Unit = 1000 heads

Table 22: Wild boar in the Ukraine in 2008

Region	Surface[1]	Density[2]	Hunted wild boar	
			Animals	Ton
Crimea	19537	0.8	157	6701
Vinnytsia	21350	0.5	223	12681
Volyn	15837	0.3	138	6358
Dnipropetrovsk	25480	0.8	70	3144
Donetsk	20071	0.6	164	9976
Zhytomyr	22326	0.2	345	20682
Transcarpathian	10724	0.4	147	10420
Zaporizhia	21517	1.3	32	1638
Iv. Fravkivskyi	9687	0.6	53	2542
Kyiv	20844	0.2	1026	54858
Kirovograd	19821	1.3	56	5135
Lugansk	21289	0.9	108	5893
Lviv	17708	0.3	371	13521
Mykolaiv	20683	2.5	57	3337
Odessa	24169	0.6	63	4124
Poltava	19052	0.3	348	19278
Rivne	14249	0.3	234	18026
Sumy	20517	0.4	164	6206
Ternopil	9121	1.4	40	2680

Kharkiv	26395	0.4	246	9110
Kherson	21965	2.5	21	1140
Khmelnytskyi	15754	0.8	56	2513
Cherkasy	16151	0.5	289	18316
Chernivtsi	6428	0.7	117	3737
Chernigiv	28119	0.3	661	35417
Sevastopol	525	2.3	57	3083
Ukraine	469319		5243	280516

Source: State Committee of Forestry of Ukraine; [1]: surface: in km^2; [2]: number of wild boar per km^2

Table 23: Wild boar in Belarus in 2008.

Region	Surface[1]				Density[2]
	Total	Forest	Field	Aquatic	
Brest	26337	11373	1270	2264	0.3
Vitebsk	34366	13284	18097	2985	0.4
Gomel	30075	14967	13477	163.1	0.3
Grodno	18726	6891	11057	778	0.3
Minsk	31436	13125	17246	1065	0.3
Mogilev	24379	10327	13033	1019	0.3
Total	165319	69967	8561	9742	0.3

[1]: surface: in km^2; [2]: number of wild boar per km^2

APPENDIX B: OUTBREAKS OF ASF IN THE TRANS CAUCASUS COUNTRIES AND RUSSIAN FEDERATION FROM APRIL 2007 TO PRESENT

Table 24: Time line of events

Country	Time	Village, District/region	Events	Host[1]	Source	Remarks
Georgia	Apr.07- Jun. 07		High pig mortality, suspicion of circovirus	d	PromedMail	
	5 Jun.07		ASF reported after diagnosed in Ref. Lab. Pirbright	d	OIE	Start of events on 23 April 2007
	2008		16 outbreaks	d	PromedMail	many only clinically diagnosed
	2009 (<24 Mar.)		37 suspected cases; all lab negative.	d	PromedMail	
	11Mar.08	Lelian, Tianeti		d	Official case (not internationally reported)	
	Nov.08				Vet. services	
S. Ossetia			Approximately 40000 pigs culled			
Abkhazia	4.Jul.08	2 villages, Gulripish	2 outbreaks	d	OIE	
Armenia	2007	7 regions	111 outbreaks: 5975 pigs infected and 12 501 culled.	d	National Compensation data base, PromedMail	
	2008	8 regions	29 outbreaks: 225 dead animals and 518 culled	d	National Compensation data base, PromedMail	
	26 Feb.08		OIE final report		OIE	
	5 May.08	Arcvanik, Kapan, Syunik	20000 pigs died and culled	d	PromedMail	Last reported case
	5 Jun.08	Shikahog Natural Preserve		w	PromedMail	Last reported case
Nogorno-Karabakh	Nov.07 - Apr. 08	Especially regions: Martakert, Askeran, Hadrut	8500 pigs died (1/4 of population)	d	PromedMail	
Azerbaijan	29 Jan.08	Nidzh Gabalinskiy region	98 died, 4734 culled	d	OIE	
Russian Federation	Nov. 07 - Jan. 08	Chechnia	54 outbreaks	w	OIE	
	Jun. 08- Dec. 08	Ingushetia	9 outbreaks	w	OIE	
		Orenburg	1 outbreak	w	OIE	

	08 Aug.08	Tjumen		d	OIE
	Jun. 08-Feb 09	N. Ossetia	65 outbreaks	d, w	OIE
	Sept. 08 - Feb. 09	Kabardino-Balkaria	3 outbreaks	w	OIE
	Oct.08 - May 09	Stawropol	15 outbreaks	d, w	OIE
	Jan. 09	Krasnodar	2 outbreaks	d	OIE
	Jan. 09	Rostov	1 outbreak	d	OIE
	Sep. 09	Dagestan	1 outbreak	w	OIE
	Sep.09-Oct. 09	Kalmykiya	1 outbreak	d	OIE
	Sep.09-Oct. 09	Chechnia	1 outbreak	w	OIE
	Sep.09-Oct. 09	Rostov,	10 outbreaks	d, w	OIE
	Oct. 09	Leningrad	1 outbreak	d	OIE

[1]D=domistic pig, W= wild boar

Table 25: Lab results

	2007		2008		2009		Source
	tested	positive	tested	positive	tested	positive	
Georgia [1]	1151	187	52	0	106	0	National Vet. Lab. (LMA)
Armenia							
Azerbaijan[2]	164 sera	0					National Vet. Lab.
Russian Federation							

[1] identification of pathogen
[2] serology

APPENDIX C: EXPORT OF SWINE AND PRODUCTS THEREOF FROM THE TRANS CAUCASUS COUNTRIES AND THE RUSSIAN FEDERATION

Table 26. Export of live swine from TCC and RF

Period	Exporter	Partner	Net Weight (kg)
2006	Armenia	World	4,925
2006	Armenia	Georgia	4,925
2006	Russian Federation	World	8,596
2006	Russian Federation	Mongolia	4,512
2006	Russian Federation	Kazakhstan	4,084
2007	Russian Federation	World	42,708
2007	Russian Federation	Kazakhstan	2,720
2007	Russian Federation	Georgia	39,988
2008	Russian Federation	World	8,362
2008	Russian Federation	Kazakhstan	8,362

Source: United Nations Comtrade database. Standard International Trade Classification code 0013.

Table 27. Volumes of fresh or chilled swine meat exports from TCC

Period	Exporter	Partner	Net Weight (kg)
2006	Armenia	World	210
2006	Armenia	United Arab Emirates	210
2006	Georgia	World	700
2006	Georgia	Cyprus	261
2006	Georgia	Liberia	250
2006	Georgia	Malta	20
2006	Georgia	Marshall Isds	30
2006	Georgia	Russian Federation	90
2006	Georgia	Ukraine	25
2006	Georgia	China	24
2007	Armenia	World	160
2007	Armenia	United Arab Emirates	160
2008	Armenia	World	135
2008	Armenia	United Arab Emirates	135

Source: United Nations Comtrade database. Standard International Trade Classification code 01221

Table 28: Volumes of frozen swine meat exports from Caucasus

Period	Exporter	Partner	Net Weight (kg)
2006	Georgia	World	36,082
2006	Georgia	Armenia	36,032
2006	Georgia	Russian Federation	50
2006	Russian Federation	World	104,085
2006	Russian Federation	Germany	98,151
2006	Russian Federation	Kazakhstan	1,058
2006	Russian Federation	Georgia	4,876
2007	Armenia	World	10
2007	Armenia	United Arab Emirates	10
2007	Georgia	World	47,972
2007	Georgia	Armenia	47,972
2007	Russian Federation	World	90,469
2007	Russian Federation	Germany	21,901
2007	Russian Federation	Kazakhstan	38,553
2007	Russian Federation	Netherlands	4,970
2007	Russian Federation	USA	20,082
2007	Russian Federation	Areas, nes	4,963
2008	Georgia	World	25,998
2008	Georgia	Armenia	25,998
2008	Russian Federation	World	59,951
2008	Russian Federation	Spain	40,000
2008	Russian Federation	Germany	18,804
2008	Russian Federation	Azerbaijan	1,117
2008	Russian Federation	Rep. of Korea	30

Source: United Nations Comtrade database. Standard International Trade Classification code 01222

Table 29. Volume of edible offal of swine exports from Caucasus

Period	Exporter	Partner	NetWeight (kg)
2006	Georgia	World	105
2006	Georgia	China	75
2006	Georgia	Russian Federation	15
2006	Georgia	Cyprus	15
2006	Russian Federation	World	521,183
2006	Russian Federation	Germany	358,605
2006	Russian Federation	Poland	96,297
2006	Russian Federation	New Zealand	39,827
2006	Russian Federation	Armenia	19,760
2006	Russian Federation	Lithuania	4,579
2006	Russian Federation	Kazakhstan	1,130
2006	Russian Federation	Kyrgyzstan	985
2007	Russian Federation	World	61,614
2007	Russian Federation	Italy	20,000
2007	Russian Federation	Netherlands	35,000
2007	Russian Federation	Germany	6,614
2008	Russian Federation	World	155,817
2008	Russian Federation	Germany	100,691
2008	Russian Federation	Denmark	44,499
2008	Russian Federation	Australia	10,627

Source: United Nations Comtrade database. Standard International Trade Classification code 0125.

APPENDIX D: NETWORK ANALYSIS ON THE MOVEMENT OF LIVE PIGS AND PIG MEAT IN THE EUROPEAN UNION

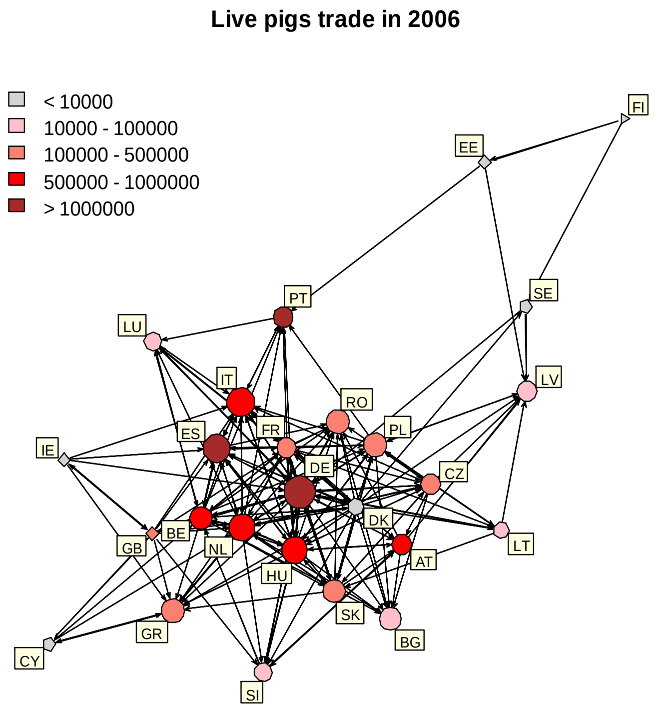


Figure 16: Network representation of movement of live pigs in the EU in 2006 (data source Eurostat).

Each EU MS is represented as a vertex, whose number of sides is equal to three plus the number of countries from which pigs were imported. Finland, as an example, did not import live pigs from other MS in 2006, and it is consequently represented as a triangle. Furthermore, the size of the vertexes is proportional to the number of countries from which pigs were imported. The color of the vertexes indicates the number of imported pigs. The lines among vertexes represent pig movements, and the arrows indicate the direction from exporting to importing countries. Vertexes which are located approximately at the center of the network represent MS having relatively great numbers of trading partners, either as importers or as exporters. As an example, Germany, in 2006, imported live pigs from 17 MS and exported to 17 MS, whereas Denmark imported live pigs from 4 MS and exported to 18 MS. In the graph, distance between any two vertexes is generally shorter if trade of live pigs occurred between the corresponding MS.

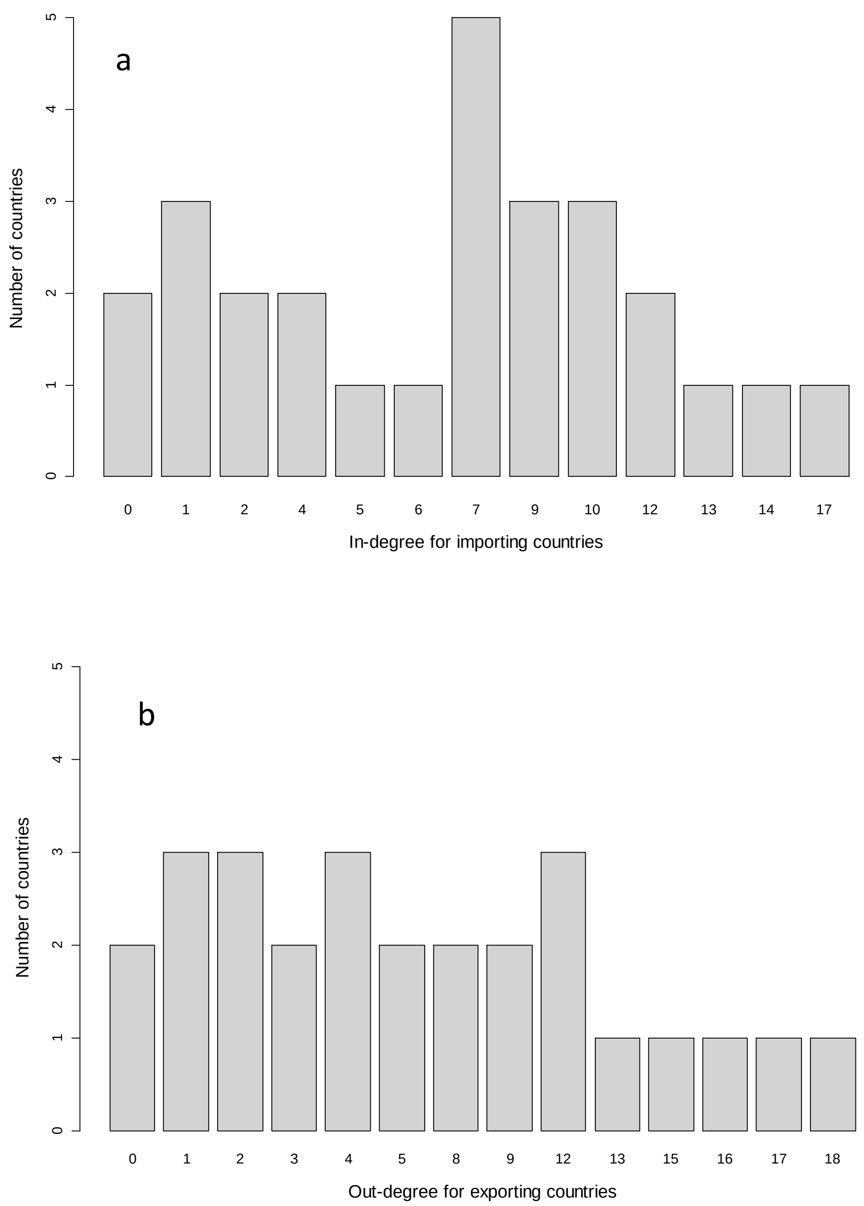


Figure 17. Frequency distribution of the number of countries from which each country imported (a) live pigs, and of the number of countries to which each country exported live (b) pigs, in the EU in 2006.

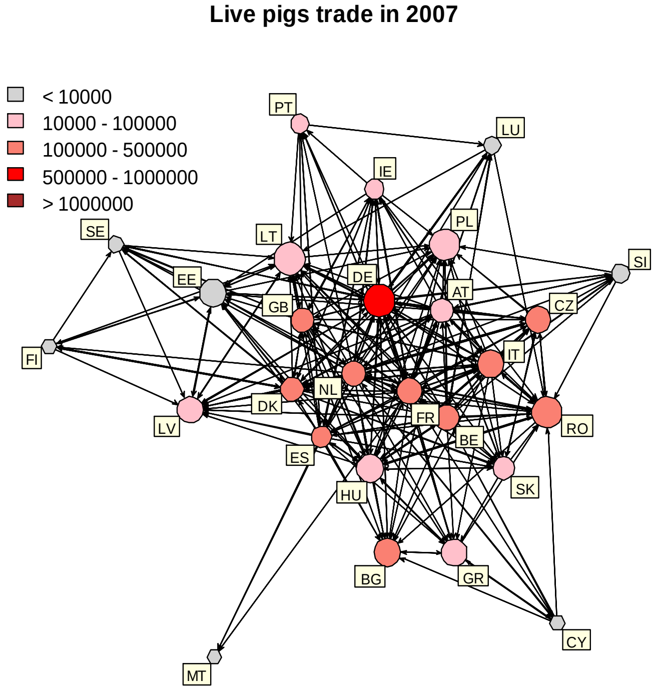


Figure 18. Network representation of movement of live pigs in the EU in 2007 (data source Eurostat).

Each EU MS is represented as a vertex, whose number of sides is equal to three plus the number of countries from which pigs were imported. Finland and Malta, for example, imported live pigs from three other MS in 2007; consequently, these two countries are represented as vertexes with six sides. Furthermore, the size of the vertexes is proportional to the number of countries from which pigs were imported. The color of the vertexes indicates the number of imported pigs. The lines among vertexes represent pig movements, and the arrows indicate the direction from exporting to importing countries. Vertexes which are located approximately at the center of the network represent MSs having relatively great numbers of trading partners, either as importers or as exporters. As an example, Germany, in 2007, imported live pigs from 17 MS and exported to 23 MS, whereas The Netherlands imported live pigs from 11 MS and exported to 26 MS.

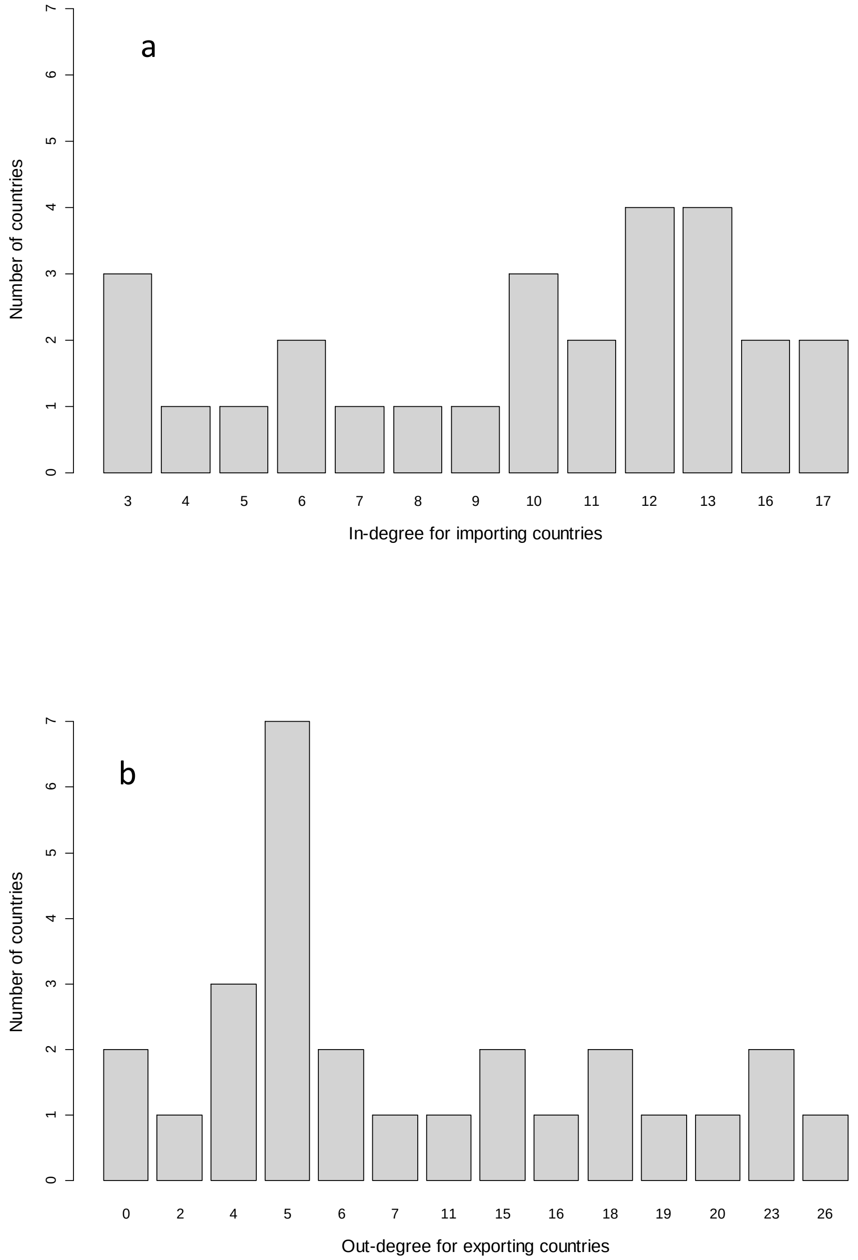


Figure 19. Frequency distribution of the number of countries from which each country imported (a) live pigs, and of the number of countries to which each country exported live (b) pigs, in the EU in 2007.

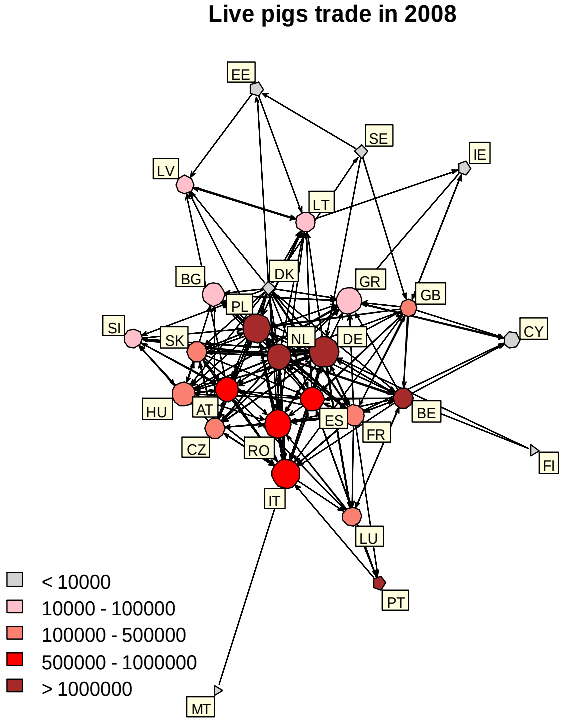


Figure 20. Network representation of movement of live pigs in the EU in 2008 (data source Eurostat).

Each EU MS is represented as a vertex, whose number of sides is equal to three plus the number of countries from which pigs were imported. Denmark, for example, imported live pigs from one other MS in 2008, and it is, consequently, represented as a square. Furthermore, the size of the vertexes is proportional to the number of countries from which pigs were imported. The color of the vertexes indicates the number of imported pigs. The lines among vertexes represent pig movements, and the arrows indicate the direction from exporting to importing countries. Vertexes which are located approximately at the center of the network represent MS having relatively great numbers of trading partners, either as importers or as exporters. As an example, Poland, in 2008, imported live pigs from 14 MS and exported to 11 MS, whereas The Netherlands imported live pigs from 11 MS and exported to 15 MS. Italy had the same number of trading partners as Poland, but since trade occurred with different MS, Italy is placed in a different position in the graph.

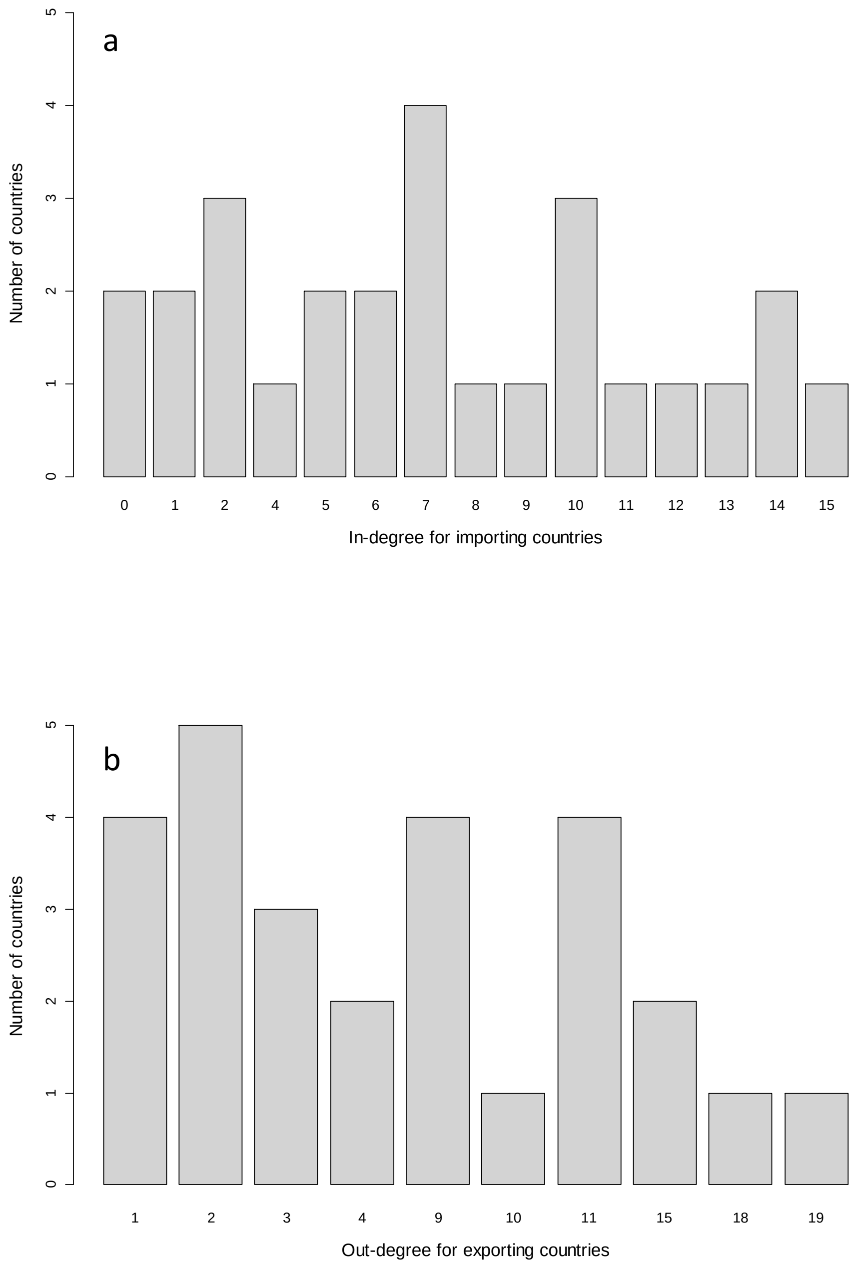


Figure 21. Frequency distribution of the number of countries from which each country imported (a) live pigs, and of the number of countries to which each country exported live (b) pigs, in the EU in 2008.

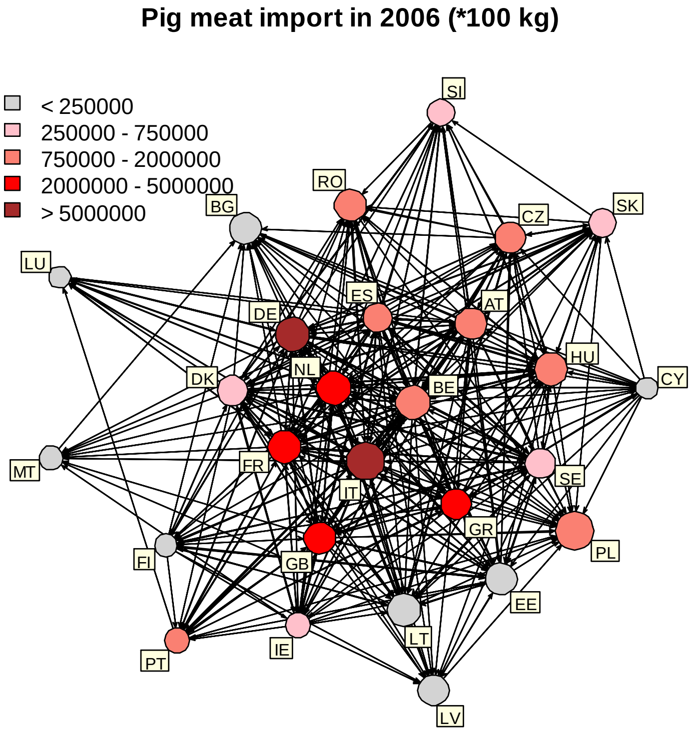
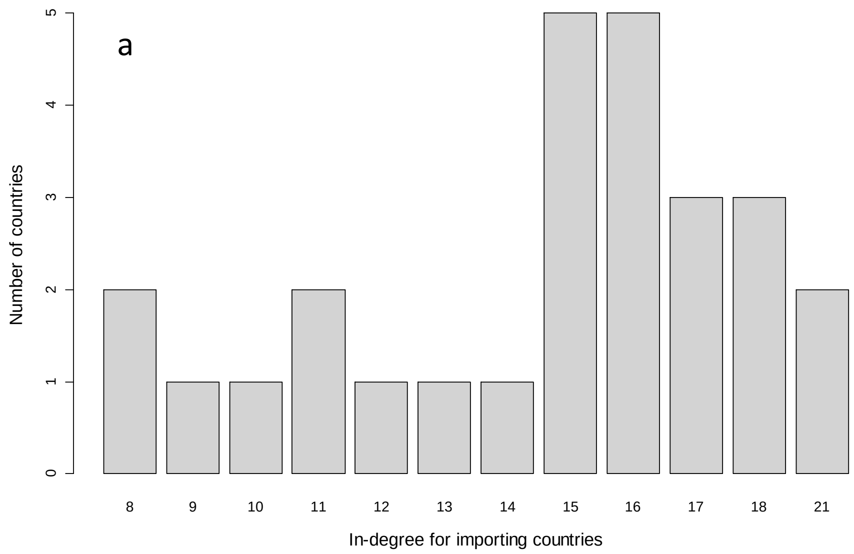


Figure 22. Network representation of movement of fresh and frozen pig meat in the EU in 2006.

Circles represent countries (MS). The size of the circle is proportional to the number of countries from which pigs were imported. The color of the circles indicates the number of imported pigs. The lines among circles represent pig meat movements, and the arrows indicate the direction from exporting to importing countries.



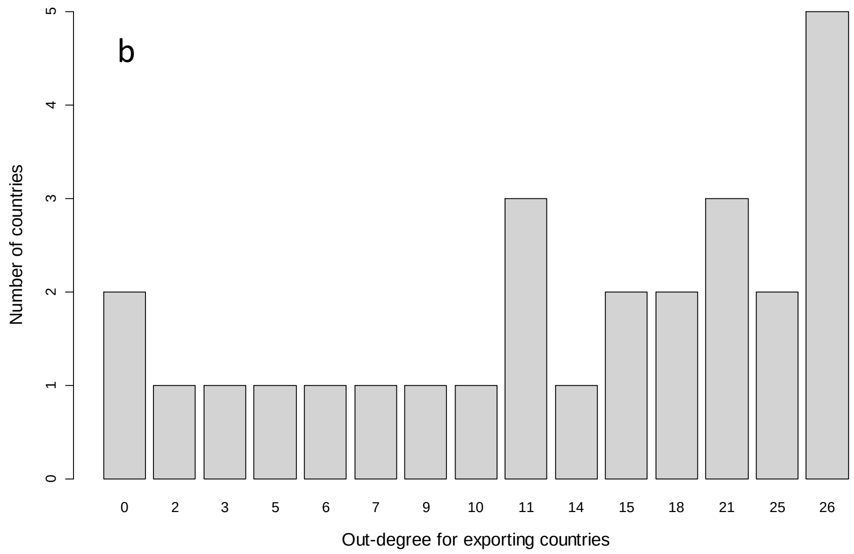


Figure 23. Frequency distribution of the number of countries from which each country imported

(a) fresh and frozen pig meat, and of the number of countries to which each country exported (b) fresh and frozen pig meat, in the EU in 2006.

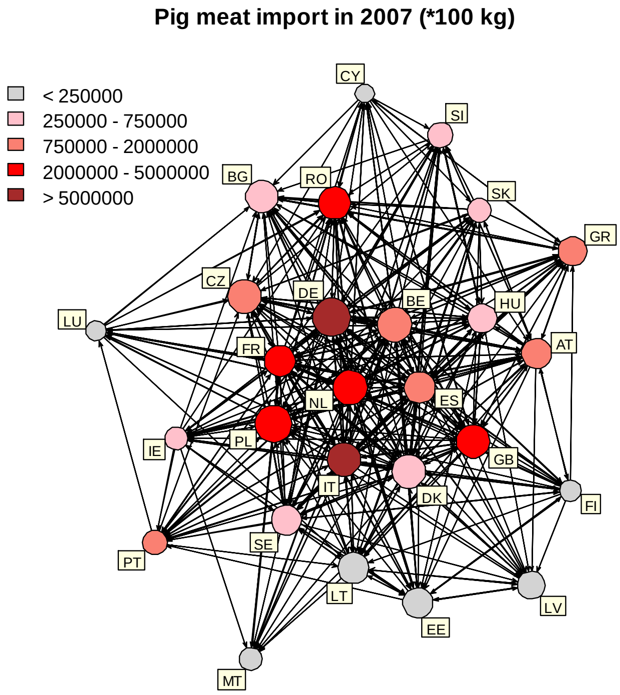
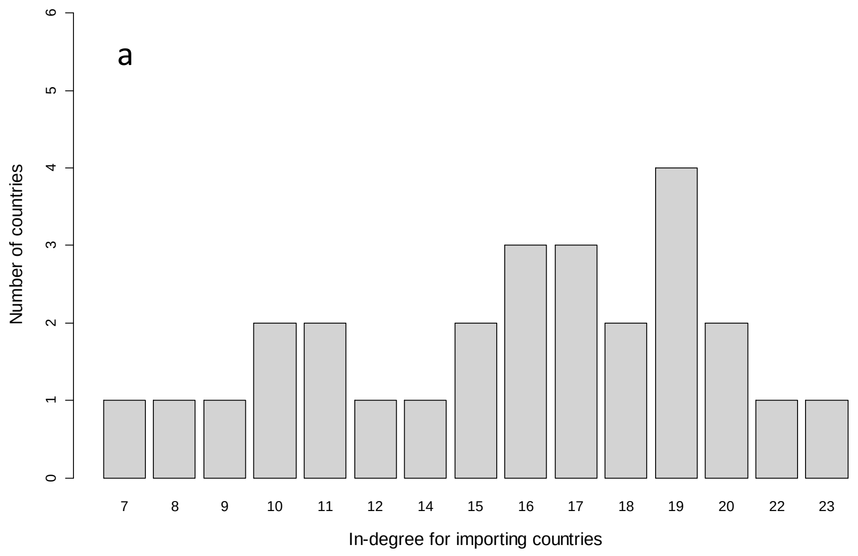


Figure 24. Network representation of movement of fresh and frozen pig meat n the EU in 2007.

Circles represent countries (MS). The size of the circle is proportional to the number of countries from which pigs were imported. The color of the circles indicates the number of imported pigs. The lines among circles represent pig meat movements, and the arrows indicate the direction from exporting to importing countries.



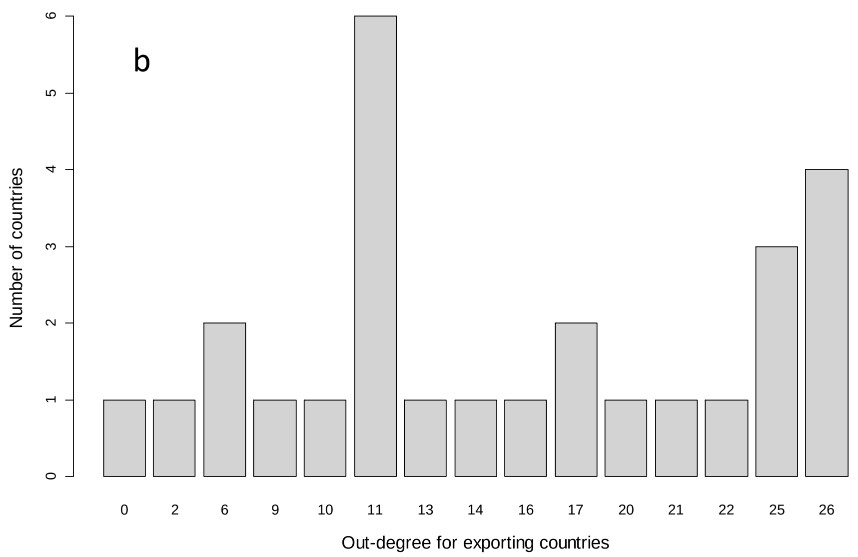


Figure 25. Frequency distribution of the number of countries from which each country imported (**a**) fresh and frozen pig meat, and of the number of countries to which each country exported (**b**) fresh and frozen pig meat, in the EU in 2007.

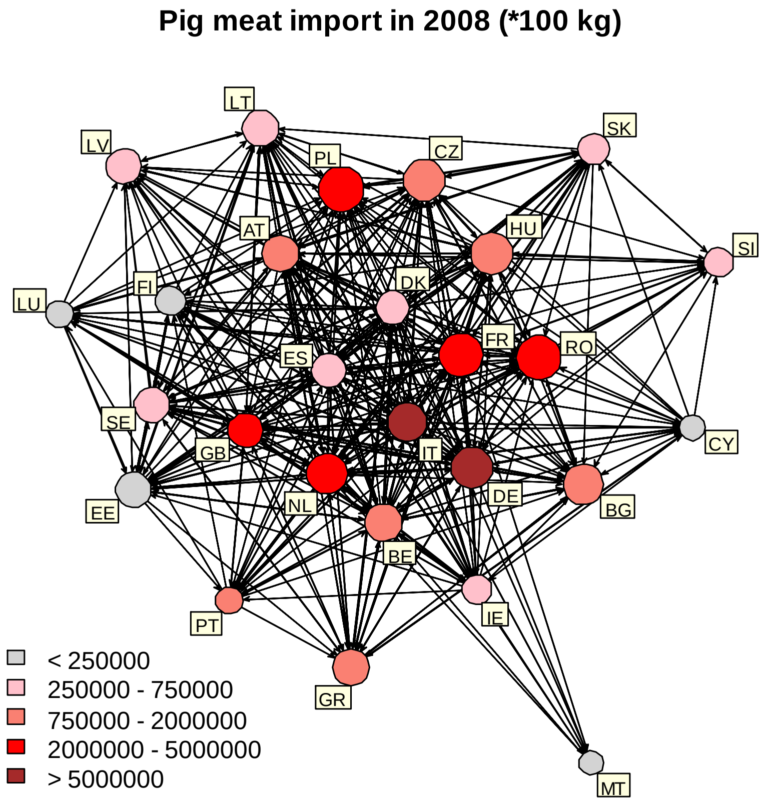


Figure 26. Network representation of movement of fresh and frozen pig meat n the EU in 2008.

Circles represent countries (MS). The size of the circle is proportional to the number of countries from which pigs were imported. The color of the circles indicates the number of imported pigs. The lines among circles represent pig meat movements, and the arrows indicate the direction from exporting to importing countries.

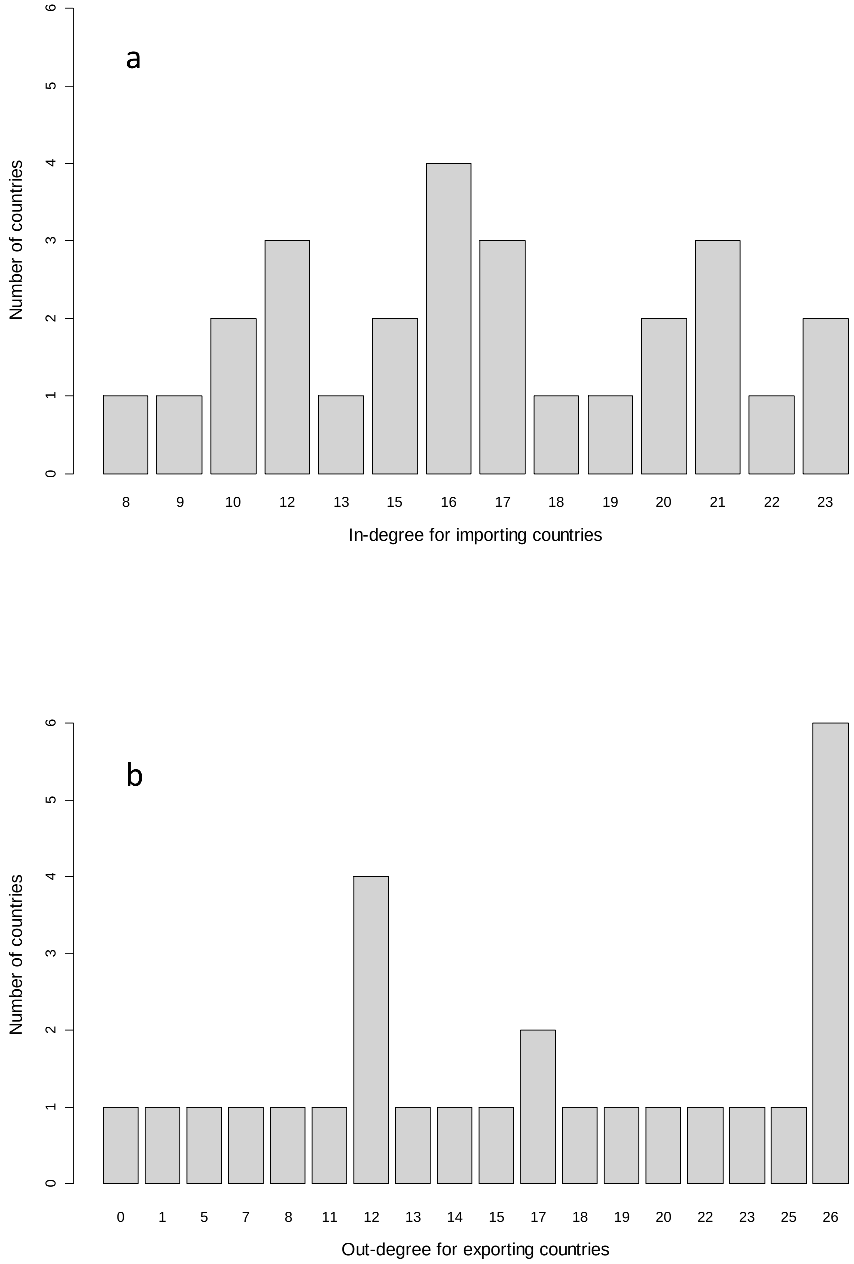


Figure 27. Frequency distribution of the number of countries from which each country imported**.** (**a**) fresh and frozen pig meat, and of the number of countries to which each country exported (**b**) fresh and frozen pig meat, in the EU in 2008.

APPENDIX E: IMPORTS AS REPORTED IN EUROSTAT

Table 30: Imports of live swine as reported in EUROSTAT- Comext database by Combined Nomenclature (CN8)

PERIOD	PARTNER/ REPORTER	EU27	AT	BE	CZ	DE	DK	EE	FI	FR	GB	GR	HU	IE	IT	LT	NL	PL	RO	SE	SI
Jan.-Dec. 2006	EU27_EXTRA	5953	5			82	35	16	140	32	221		2		10			256		4726	428
	NORWAY	4884						16	140				2							4726	
	CANADA	306	1			58	8			32	95				6			106			
	ALBANIA	218																			218
	NOT SPECIFIED	213												3							210
	UNITED STATES	165				12	27				126										
	RUSSIAN FEDERATION	150																150			
	SWITZERLAND	20	4			12									4						
Jan.-Dec. 2007	EU27_EXTRA	1793				178	49	29	249		132	42		267		135		166		546	
	NORWAY	838						29	249									14		546	
	CANADA	623				130	49				45			267				132			
	RUSSIAN FEDERATION	135														135					
	UNITED STATES	87									87										
	SWITZERLAND	48				48															
	ALBANIA	42										42									
	BELARUS	20																20			
Jan.-Dec. 2008	EU27_EXTRA	1685		124		231		20	62	6	233					544		343		122	
	RUSSIAN FEDERATION	792														544		248			
	CANADA	517		124		190				6	148							49			
	NORWAY	250						20	62									46		122	
	UNITED STATES	126				41					85									0	
	NOT SPECIFIED	23			23																
Jan.-Oct. 2009	EU27_EXTRA	2404	1			103		28	60	10	264					1322	5	423		188	
	RUSSIAN FEDERATION	1482														1322		160			

	NOT SPECIFIED	360																	360		
	CANADA	309				57		7		10	193						5	37			
	NORWAY	306						21	60									37		188	
	NOT SPECIFIED	189																189			
	UNITED STATES	106				35					71										
	SWITZERLAND	12	1			11															

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Table 31: Imports of fresh or chilled meat as reported in EUROSTAT Comext database by Combined Nomenclature (CN8)

PERIOD	PARTNER/ REPORTER	EU27	AT	BE	CZ	DE	DK	ES	FR	GB	GR	IE	IT	NL	PL	RO	SE
Jan.-Dec. 2006	EU27_EXTRA	60684	304	1182		3329	5044	13	353	44970			219	3184	2016		70
	UNITED STATES	52474		1182		2785			353	44970				3184			0
	NORWAY	5127					5044	13									70
	BELARUS	1831													1831		
	SWITZERLAND	763				544							219				
	RUSSIAN FEDERATION	200	200														
	NOT SPECIFIED	236										51			185		
	CROATIA	104	104														
Jan.-Dec. 2007	EU27_EXTRA	59606	30	821		3730	4840	9	14083	33003		776	259	1838		187	30
	UNITED STATES	52182		821		2492			14074	32953			4	1838			
	NORWAY	4879					4840	9									30
	SWITZERLAND	1706	30			1238							251			187	
	JAPAN	776										776	0				
	AUSTRALIA	53								50			3				
	NOT SPECIFIED	18									1	3		14			
	GABON	9							9								
	KOREA, REPUBLIC OF	1											1				
Jan.-Dec 2008	EU27_EXTRA	127253	90	798		2718	3135	81	44021	73071	7	1141	291	1890			10
	UNITED STATES	120492		798		906			44019	72872	7			1890			
	NORWAY	3228				2	3135	81									10

	SWITZERLAND	2103				1810			2				291				
	JAPAN	913										913					
	NOT SPECIFIED	909			2						892	0		15			
	BRAZIL	228										228					
	CHINA (PEOPLE'S REPUBLIC)	172								172							
	CROATIA	90	90														
	AUSTRALIA	27								27							
Jan.-Oct 2009	EU27_EXTRA	45725	31	331		911	1376	11	1837	39404		437	326	584	450		27
	UNITED STATES	41499		331			0		1837	39163				168			
	NORWAY	1394					1376	11									7
	SWITZERLAND	1259	31			911							317				
	CANADA	416												416			
	NOT SPECIFIED	413												10	403		
	MOLDOVA, REPUBLIC OF	260													260		
	COTE D'IVOIRE	243										243					
	CHILE	241								241				0			
	JAPAN	203										194	9				
	UKRAINE	190													190		
	RUSSIAN FEDERATION	20															20

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Table 32: Imports of frozen meat as reported in EUROSTAT Comext database by Combined Nomenclature (CN8)

PERIOD	PARTNER/ REPORTER	EU27	A	BE	BG	C	DE	DK	ES	FI	FR	GB	G	IE	IT	LT	LV	NL	PL	PT	RO	SE	SI
Jan-Dec. 2006	EU27_EXTRA	891482	7	1724	80186		35445	1427	6938	27	3309	14215		10516	26144			6907	3716		697226	27	
	CANADA	503729			15571																488158		
	UNITED STATES	201004		1119	5192		1951	0			10	517		0	3574			3724	2161		182756		
	CHILE	101761					24346		4542			13698		10363	21760			965			26087		
	BRAZIL	59648			59423																225		
	AUSTRALIA	14600		157			9148				2273				804			2218					

	NORWAY	4384						1427	1149	27												15
	KOREA, REPUBLIC OF	2506	2	448					458		660											72
	BELARUS	901							375										526			
	RUSSIAN FEDERATION	840	1						214		208								220			
	ALBANIA	600																	600			
	CROATIA	500	2						200						6							
	JAPAN	489																				48
	NOT SPECIFIED	362												153					209			
	SINGAPORE	92									92											
	CHAD	66									66											
Jan-Dec. 2007	EU27_EXTRA	199813		2354	1298	1	40786	3019	8031	48	18772	12108	4	11729	77475	19	1	5487	1230 7	1	4803	48
	CHILE	123231					25866		3514			10949	4	11729	65168			723			4803	
	UNITED STATES	47606		1373			1681	0	1689		16128	1159			11587			3163	1082 5	1		
	AUSTRALIA	19177		981			13239				2636				720			1601				
	NORWAY	3415						3019	170	21												9
	KOREA, REPUBLIC OF	1595							1595													
	BELARUS	1482																	1482			
	BRAZIL	1298			1298																	
	RUSSIAN FEDERATION	976							783							19						
	NEW ZEALAND	480																				48
	JAPAN	327							64	26												
	CROATIA	216							216													

	NOT SPECIFIED	161										1										
	SEYCHELLES	8								8												
	SWITZERLAND	1			1																	
	UKRAINE	1														1						
Jan.-Dec. 2008	EU27_EXTRA	302491	4	7758		76225	3966	1745 0	22	41764	26315	1	561	108446	0		15580		1	1201	68	
	CHILE	171417				62124		8234			9553	1	561	83086			5129			480	33	
	UNITED STATES	109015		7410		3732	101	8034	22	38822	16513			24116			9346			721		
	AUSTRALIA	15538		148		10351				2700	246			988			1105					
	NORWAY	4367					3865	148			3										35	
	RUSSIAN FEDERATION	1412	4	200				809														
	CROATIA	411						200		211												
	EGYPT	252												252								
	NOT SPECIFIED	77										5					24					
	JAPAN	30						25		5												
	KOREA, REPUBLIC OF	26	0							26												
	SWITZERLAND	18				18																
	ALBANIA	4												4								
	SOUTH AFRICA	1																	1			
Jan.-Oct. 2009	EU27_EXTRA	200915	2	3230		51948	4621	1535 7		1641	27023	4	33463	45576			12484	3727		482	94	1
	CHILE	141654				47093		1266 1			25467		4866	42579			8028			482	47	
	JAPAN	16727								70			16657									
	UNITED STATES	14998		1289		1306	261	1180		390	1530	4	407	2197			2894	3540				
	RUSSIAN	9057		327				240					8490									

	FEDERATION														
	AUSTRALIA	6731		1215	3524			540	25		317	1110			
	NORWAY	4674			0	4360	301		1					12	
	HONG KONG	1583								1583					
	KOREA, REPUBLIC OF	1583	2				471	442						45	
	CHINA	1457								1457					
	CANADA	935									483	452			
	BELARUS	599		399			200								
	CROATIA	502					104	199							1
	UKRAINE	200					200								
	NOT SPECIFIED	187											187		
	SWITZERLAND	25			25										
	JAMAICA	3								3					

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Table 33: Imports of offal as reported in EUROSTAT Comext database by Combined Nomenclature (CN8)

PERIOD	PARTNER/ REPORTER	EU27	AT	BE	BG	CZ	DE	DK	ES	FI	FR	GR	IE	IT	LT	NL	PL	RO	SE	SI
Jan.-Dec. 2006	EU27_EXTRA	126428	598	221	14059		87081	984	225	208	206	153					177	18541	3851	124
	SWITZERLAND	87568					87081				197							290		
	UNITED STATES	15053			1350													13703		
	CANADA	11396			9444													1952		
	NORWAY	5268						984	225	208									3851	
	CROATIA	3686		221	3265													200		
	CHILE	2396																2396		
	RUSSIAN FEDERATION	598	598																	
	BELARUS	177															177			
	ARGENTINA	153										153								
	FYROM	124																		124
	URUGUAY	9									9									

Jan.-Dec. 2007	EU27_EXTRA	103271	611			97392	1638	364	150	501			93	5	394		2123	
	SWITZERLAND	97194				97189								5				
	NORWAY	3911					1638		150								2123	
	RUSSIAN FEDERATION	1311	611					190		417			93					
	BELARUS	394													394			
	UNITED STATES	203				203												
	NOT SPECIFIED	135			13 5													
	LIECHTENSTEIN	100						100										
	JAPAN	74						74										
	ARGENTINA	44								44								
	BRAZIL	40								40								
Jan.-Dec. 2008	EU27_EXTRA	121216	203	206		115985	1335	2056				78	203				1150	
	SWITZERLAND	116053				115975						78						
	NORWAY	2485					1335										1150	
	RUSSIAN FEDERATION	1670	203	206				1058					203					
	HONG KONG	748						748										
	PHILIPPINES	250						250										
	NOT SPECIFIED	149														149		
	NEW ZEALAND	10				10												
Jan. Oct. 2009	EU27_EXTRA	142327	212	69		132391	1176	901			5511	428		120	205		1199	115
	SWITZERLAND	132132				131954						178						
	RUSSIAN FEDERATION	3018	212	69		205		207			1880				205		240	
	CHINA	2194									2194							
	NORWAY	2135					1176										959	
	JAPAN	1422				230					1192							
	HONG KONG	735						490			245							
	CONGO, DEMOCRATIC REPUBLIC OF	250										250						
	SERBIA	202						202										
	CROATIA	120												120				

	FYROM	115			115
	COLOMBIA	2		2	
	INDIA	2	2		

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2896 # APPENDIX F: DETAILED RISK QUESTIONS AND ANSWERS

2897 **Table 34:** Risk estimates and rationale for risk pathway of ASF to remain endemic in domestic pigs in the Southern and Northern Caucasus region and the risk of release of
2898 ASF into the EU.

Risk pathway 1	Risk questions and answers	L[1]	U[2]	Rank	Description/ data need
Notification outbreaks	How likely is it that a domestic pig in the TCC and RF is infected with ASF, based on the notification of outbreaks?				
	G/A: presence is likely: past outbreaks are proof of presence of virus	L	H		3
	RF: daily repeated outbreaks over the last months	M	M		
Unknown spread	How likely is it that ASF will spread in the TCC and RF before detection of the virus?				
Pigs	How likely is spread through pig movement, resulting in direct contact between pigs (intentional through transport or unintentional through free ranging)				
	G/A: there is mainly FR, small scale pig production with low level of biosecurity, even in larger holdings limited biosecurity measures is in place. There is evidence of previous outbreaks and movement of piglets from outbreak regions to unaffected regions (related to value chain). The level of risk may have seasonal variation. The number of livestock markets and the population density has decreased since 2007 by 80%. There is a large movement of domestic pigs in Georgia and Armenia. There are pig movements associated with on-going political conflicts	H	M	1	6.1.1
	RF: regional differences exist. Backyard production is associated with cheap feed availability (wheat production). There is less FR than before as FR is officially banned, but occasionally FR farms do still occur. The main movement is from small farms to markets and slaughter houses. Villages are traditionally involved in animal trade in the areas affected with ASF. Transport of pigs is not sufficiently controlled.	H	M	1	
Pork	How likely is spread through pork products resulting in indirect contact between pigs (for example, swill feeding)				
	G/A: there is evidence of previous outbreaks, where movement of pork products was observed	H	H	2	6.1.2
	RF: movements of army (carrying pork) associated with ongoing political conflicts. Illegal transport of products has occurred.	H	L	2	
People	How likely is spread through movement of non-professional people and associated fomites resulting in indirect contact				
	GA: no measures are taken between visits, increased movement between farms when mortality in pigs increases	H	L	3	4.1.2.5
	RF: no measures are taken between visits	M	H	3	
Professionals	How likely is spread through movement of professional people, such as veterinarians, and associated fomites resulting in indirect contact				

	GA: biosecurity measures not respected between visits of farms	H	M	4	4.1.2.5
	RF: veterinarians go to different farms in crisis situation without taking appropriate measures	M	M	6	
Wild boar	How likely is spill-over into wild boar populations, which results in direct or potentially indirect contact				
	G/A: interface domestic/wildlife (see maps). The husbandry system facilitates contact with wild boar. There is a higher likelihood in winter (wild boar looking for food). Wild boar approach closer to villages in late summer.	M	M	5	4.2.2.1
	RF: there is evidence of mixed-breeds. There is a higher likelihood in winter (wild boar looking for food). Wild boar approach closer to villages in late summer.	H	L	4	
Vehicles	How likely is spread through movement of vehicles between farms (for example, transport lorries) resulting in indirect contact				
	GA: depending on farm type, there is a lot of movement on a farm and on and off driving on farms is not restricted. Movement of vehicles is happening, but it is not very efficient mode of transmission	M	M	6	4.1.2.2
	RF: there is unregulated movement of pigs and other vehicles. Movement of vehicles is happening, but not very efficient mode of transmission	M	M	5	
Feed	How likely is contamination of feed resulting in indirect contact				
	GA: Swill feeding is common, small scale farming associated with low cost inputs	H	M	7	4.1.2.2
	RF: Connection through feed supply has been suggested in recent outbreaks (sale of left over feed of affected farms), swill feeding is practised	M	H	7	
Environment	How likely is it that ASF is transmitted indirectly due to the persistence of the virus in the environment?				
	G/A and RF: there is historical evidence of tenancy of the virus in European outbreaks. see also report, but little is known on the efficiency of the transmission	M	M	8	2.2
Pets and pests	How likely is spread through pets and pests which act as mechanical vector resulting in indirect contact				
	GA and RF: Possible, not very efficient transmission	M	M	9	2.3
Ticks	How likely is it that ASF becomes established in soft ticks?				
	G/A: due to short feeding periods it is unlikely that ticks contribute to the spread of ASF, however, it can not be excluded	L	M	10	5
	RF: due to short feeding periods it is unlikely that ticks contribute to the spread of ASF however, it can not be excluded	L	M	10	
Detection of new cases	How likely is it that an infected animal will be detected and effective, rapid response will take place?				
Identification of cases	How likely is it that an infected animal will be detected through passive surveillance?				

Clinical signs	How likely is it that an outbreak results in noticeable clinical signs?				
	G/A and RF: high pathogenicity reported	H	L		2.1.1
Differential diagnosis	How likely is it that clinical signs are not misinterpreted as other diseases?				
	G/A and RF: disease has same clinical signs as other diseases	M	L		8.1.2.4
Disease reporting	How likely is it that a suspect case is reported to the veterinary service?				
	G: no compensations scheme in place, lack of awareness of farmers for responsibility of disease spread, disbelief, no clear chain of command; low number of reported/investigated suspected cases G/A Long time between entry of virus in farm and implementation of control measures: high risk period is long	L	L		8.1.1.1
	RF: delay is possible, but cases have to be reported, social control	M	M		
Case confirmation	How likely is it that an infected animal will be confirmed?				
Veterinary service	When the case is reported, how likely is that that vets/vet service are efficient enough to take appropriate samples?				
	G/A: when the official vets come they will take appropriate samples	M	M		8.2.2
	RF: Vet Service has necessary experience with the disease and in taking samples (hip bones for virus isolations)	H	L		
Handling and shipment of samples	How likely is it that samples do get to the national laboratory as required for adequate analysis?				
	G/A: shipment within country is no problem, however international shipment could cause problems	H	H		8.1.2.1
	RF: shipment within country is no problem, however international shipment could cause problems, diagnosis by PCR, quality of samples is secondary	H	H		
Laboratory confirmation	How likely is it that diagnostic laboratories do have the ability to perform adequate tests?				
	Georgia: satisfactory results in ring tests, (extensive training of staff, adequate equipment. Armenia: they can do the diagnosis when they receive samples	H	H		8.1.3.1
	RF: collaboration with Valdeolmos (confirmation of results and visit on site), regional staff trained in national laboratory	H	H		
Rapid response	How likely is that rapid response actions applied for confirmed cases are efficient to contain the outbreak?				
Effective control measures	How likely is that control measures applied for confirmed cases are effective to contain the outbreak?				
	G/A: no clear chain of command, etc., limited transparency to report cases of diseases of high political importance	L	L		8.2.2.1

	RF: Vet Service has necessary experience with the disease and in taking samples Different policy is applied in different regions in relation to the importance of the pig production	H	L		
Tracing	How likely is it that prevention and control measures in place will identify dangerous contacts and therewith hamper containment of the outbreak?				
	Georgia: depends on international intervention, lack of human resources in veterinary service, serious communication gap between labs and veterinary service in Georgia, delay in implementation of control measures	L	H		8.2.3.1
	Armenia: weak follow up from veterinary services	L	H		
	RF: experience of past outbreaks, measures implemented as defined in Order. Different policy is applied in different regions in relation related to the importance of the pig production	H	L		
Preventive measures	How likely is it that an infected animal will be detected through effective surveillance?				
Effective surveillance	How likely is it that an infected pig will be sampled? In Georgia and Armenia there is currently no active surveillance in place, therefore sensitivity of this surveillance component is nil. Only in the Russian Federation active monitoring in commercial farms is carried out.				8.2.4.1
	G/A: The low number of reported/investigated suspected cases could represent an indicator of the very poor level of surveillance in place in both countries	L	L		
	RF: 2008/09: 15000 samples collected in affected areas in the context of a monitoring programme, samples from commercial farms, each region must submit samples for PCR and serology. Amount of samples was considered to be too low to be effective.	L	L		
Further spread	How likely is that the disease becomes endemic in eastern EU neighbouring countries? Risk factors to consider				
Local spread (within 10km)					
Movement of pigs	Pig movement resulting in direct contact between pigs (intentional through transport or unintentional through free ranging)				
	G/A: there is mainly FR, small scale pig production with low level of biosecurity, even in larger holdings limited biosecurity measures is in place. There is evidence of previous outbreaks and movement of piglets from outbreak regions to unaffected regions (related to value chain). The level of risk may have seasonal variation. The number of livestock markets and the population density has decreased since 2007 by 80%. There is a large movement of domestic pigs in Georgia and Armenia. There are pig movements associated with on-going political conflicts	H	M	1	6.1.1
	RF: regional differences exist. Backyard production is associated with cheap feed availability (wheat production). There is less FR than before as FR is officially banned, but occasionally FR farms do still occur. The main movement is from small farms to markets and slaughter houses. Villages are traditionally involved in animal trade in the areas affected with ASF. Transport of pigs is not sufficiently controlled.	H	M	1	
Pork products	Pork products resulting in indirect contact between pigs (for example, swill feeding)				
	G/A: there is evidence of previous outbreaks, where movement of pork products was observed	H	H	2	
	RF: movements of army (carrying pork) associated with ongoing political conflicts. Illegal transport of products has	H	L	2	

	occurred.				
People (Non-professionals)	Movement of vehicles between farms (for example, transport lorries) resulting in indirect contact				
	GA: no measures taken between visits, increased movement between farms when mortality in pigs increases	H	L	3	6.1.2
	RF: no measures taken between visits	M	H	4	
Wild boar	Spill-over into wild boar populations which results in direct or potentially indirect contact				
	G/A: interface domestic/wildlife (see maps). The husbandry system facilitates contact with wild boar. There is a higher likelihood in winter (wild boar looking for food). Wild boar approach closer to villages in late summer.	M	M	4	4.1.2.1
	RF: there is evidence of mixed-breeds. There is a higher likelihood in winter (wild boar looking for food). Wild boar approach closer to villages in late summer.	H	L	3	
Vehicles	Movement of vehicles between farms (for example, transport lorries) resulting in indirect contact				
	GA: depending on farm type, there is a lot of movement on a farm and on and off driving on farms is not restricted. Movement of vehicles is happening, but it is not very efficient mode of transmission	M	M	5	4.2.2.1
	RF: there is unregulated movement of pigs and other vehicles. Movement of vehicles is happening, but not very efficient mode of transmission.	M	M	5	
Professionals	Movement of professional people, such as veterinarians, and associated fomites resulting in indirect contact				
	GA: biosecurity practice not sufficient between visits of farms	H	M	6	4.2.2.1
	RF: vets go to different farms in crisis situation without taking appropriate measures	M	M	6	
Feed	Contamination of feed resulting in indirect contact				
	GA: swill feeding is common, small scale farming is associated with low cost inputs	H	M	7	4.1.2.2
	RF: connection through feed supply has been suggested in recent outbreaks (sale of left over feed from affected farms), swill feeding is practised	M	H	7	
Environment	How likely is it that ASF is transmitted indirectly due to the persistence of the virus in the environment?				
	G/A and RF: historical evidence of tenancy of the virus in European outbreaks, but little is known on the efficiency of this mode of transmission	M	M	6	4.1.2.2
Pets and pests	Spread through pets and pests which act as mechanical vector resulting in indirect contact				
	GA and RF: possible, not very efficient mode of transmission	M	M	9	4.1.2.2
Ticks	How likely is it that ASF becomes established in soft ticks?				5
	G/A: due to short feeding periods it is unlikely that ticks contribute to the spread of ASF, however, it can not be excluded.	L	M	10	
	RF: due to short feeding periods it is unlikely that ticks contribute to the spread of ASF however, it can not be excluded.	L	M	10	

Distant spread: beyond local spread.	How likely is long distance spread				
Pork products	Spread through pork products resulting in indirect contact between pigs (for example, swill feeding)				
Risk estimate considers frequency of risk event and efficiency of transmission	G/A: Legal trade is banned but uncontrolled trade is likely. Caucasus region only imports, very little or no export from this region. Local production mostly for local consumption. Veterinary Service at airports do not allow introduction of pork products. Spread to neighbouring countries: mainly to north and south Ossetia, Russian Federation and other countries. Tourism, Belarus open border, Ukraine easy accessible.	M	H	1	6.1.1
	RF: Unregulated transport has been observed.	M	H	1	
Movement of pigs	Spread through pig movement, resulting in direct contact between pigs (intentional through transport or unintentional through free ranging)				
	GA: movement of pigs has been observed, even in outbreak situations. There is evidence of former outbreaks. Movement of piglets from outbreak regions to unaffected regions (related to value chain). The level of risk may have seasonal variation and are related to the livestock markets. The population density has decreased since 2007 by 80%. Movements may be associated with ongoing political conflicts.	H	M	2	6.1.2
	RF: main movement from small farms to markets and slaughter houses. Villages are traditionally involved in animal trade (areas affected with ASF) with uncontrolled transport of pigs.	H	M	2	
Vehicles	Movement of vehicles between farms (for example, transport lorries) resulting in indirect contact				
	GA: depending on farm type, a lot of movement on a farm may exist. On and off driving on farms not restricted	H	M	3	
	RF: unregulated movement of pigs. Event is happening, but not very efficient mode of transmission	H	M	3	
People	Spread through movement of non-professional people and associated fomites resulting in indirect contact				
	GA/RF: not much movement, but poor biosecurity	L	H	4	4.1.2.2
Feed	Contamination of feed resulting in indirect contact				
	RF: feed contamination can happen, seems less likely over large distances	L	M	5	
	GA: feed not very commercialised	M	M	5	
Professionals	Spread through movement of professional people, such as veterinarians, and associated fomites resulting in indirect contact				
	GA: Veterinarians of national service travel long distances, visit several farms a day	M	M	6	4.1.2.2
	RF: Veterinarians of national service travel long distances, visit several farms a day	M	M	7	
Wild boar:	Spill-over into wild boar populations, which results in direct or potentially indirect contact				
	GA: wild boar do not move over long distances	L	M	7	4.1.2.2
	RF: wild boar do not move over long distances	L	M	6	
Environment	How likely is it that ASF is transmitted indirectly due to the persistence of the virus in the environment?				
	GA: Unlikely that environment gets contaminated on long distances	N	L	8	4.2.2.1
	RF: Unlikely that environment gets contaminated on long distances	N	L	9	
Pets and pests	Spread through pets and pests which act as mechanical vector resulting in indirect contact				2
	GA Unlikely that pests move over long distances and it would not be an efficient mode of transmission	N	L	9	

	RF: Unlikely that pests move over long distances and it would not be an efficient mode of transmission	N	L	8	
Ticks	How likely is it that ASF becomes established in soft ticks?				
	G/A: due to short feeding periods it is very unlikely that ticks contribute to the long distance spread of ASF	N	L	10	5
	RF: due to short feeding periods it is very unlikely that ticks contribute to the long distance spread of ASF	N	L	10	
Introduction into the EU					
Feed and swill	Illegal import of feed and swill (incl. dumping of waste in harbours)				
	G/A, RF: Dumping of swill cannot be excluded	L	M	1	7.2
	Non-EU countries: Dumping of swill cannot be excluded	L	H	1	
Migratory workers	Migratory workers (associated with pig production, leading to indirect contact)				
	G/A, RF: people emigrate for work, most in RF some in EU, working in seasonal agriculture. Migratory workers could bring pork products for own consumption and feed waste to pigs.	L	H	2	7.3
	Non-EU countries: known that there are migratory workers from Ukraine	L	H	2	
Other people	Other people (tourists)				
family visits)	G/A, RF: little tourism, individual tourism with tight contact to locals. They may bring pork products as souvenir.	L	H	3	7.1
	Non-EU countries: a lot of tourism but not associated with pig industry. Illegal import of pork products is likely	L	M	3	
Trade (incl. boats)	Trade (illegal movement of live animals and animal products)				
	G/A, RF: illegal trade is possible, but seems unlikely because there is little pork left, and the little that is left is more expensive	L	H	4	6.2
	Non-EU countries: illegal trade is happening with Belarus, Ukraine (Eurostat) but difficult to quantify	L	H	4	
Ticks	Spill-over into ticks which results in direct contact;				
	G/A, RF due to short feeding periods it is very unlikely that ticks contribute to the introduction of ASF	N	L	5	5
	RF: due to short feeding periods it is very unlikely that ticks contribute to the introduction of ASF	N	L	5	

[1]L likelihood (H= High, M= Moderate, L=Low, N= Negligible), [2]U: uncertainty (H= High, M= Medium L=Low); G: Georgia, A: Armenia, RF: Russian Federation

Table 35: Risk estimates and rationale for risk pathway of ASF to remain endemic in wild boar in the Southern and Northern Caucasus region and the risk of release of ASF into non-infected areas.

Steps in risk pathway 2	Risk questions and answers	L[1]	U[2]	Rank	Description/ data need
Disease situation	How likely is it that a wild boar in the TCC and RF is infected with ASF based on the notifications to OIE				
	GA: no more outbreaks were reported to OIE, but there is high uncertainty due to potential under-reporting and insufficient surveillance activities	L	H		3
	RF: presence proved through recently confirmed sporadic cases. The presence in wild boar in areas without domestic pigs may indicate far spread through wild boar or introduction from Georgia. There is high uncertainty because we don't know much about pathogenicity of the circulating virus strain in wild boar neither of the epidemiology of ASF in wild boar. No sero-survey is carried out. Experience in Sardinia indicate that there may be a low risk that wild boar will act as a reservoir.	M	H		
Unknown spread	What is the risk that an ASF outbreak spread before it is detected in boar?				
Ecology	Ecology scribing the behaviour of wild boar which results in direct contact between wild boar groups, including scavenging behaviour				
	GA: Low population density. Wild boars moved daily only a distance of a few km as long as groups are not disturbed. There is more movement in mating season, but generally little contact with other groups. Contact between groups may exist also through scavenging on dead wild boar.	L	M	1	4.2.2.1
	RF: Low population density. Wild boars moved daily only a distance of a few km as long as groups are not disturbed. There is more movement in mating season, but generally little contact with other groups. Contact between groups may exist also through scavenging on dead wild boar.	L	M	1	
Environment	Contamination of the environment which results in indirect contact				
	G/A: There is historical evidence of tenancy of the virus in European outbreaks. Little is known on efficiency of transmission.	L	M	2	2.3
	RF: There is historical evidence of tenancy of the virus in European outbreaks. Little is known on efficiency of transmission.	L	M	3	
Hunting	Hunting practice which results in indirect contact between areas; Spill-over into ticks which results in direct contact				
	GA: hunting does not result in an increased risk for disease spread. In Armenia hunting is prohibited, in Georgia hunting not very popular but it does occur.	N	L	3	4.2.2
	RF: attempts to decrease population density and therefore hunting frequent, however, hunting increases movement only temporary and do not increase risk of spread of ASF	N	L	2	

Ticks	Spill-over into ticks which results in direct contact				
	GA/RF: Wild boar have never been found infested because they normally do not rest inside protected burrows, which may be infested by ticks.	N	M	4	5
Outbreak response	How likely is it that the outbreak will be managed effectively?				
Case identification	Russian Federation: of all dead wild boar found, samples must be submitted to the national laboratory for ASF testing				
Clinical signs	How likely is that an infected wild boar does show clinical signs?				
	G/A: no healthy carriers seen so far, fatal in wild boar, dead wild boar found near villages where ASF outbreaks occurred	H	H		4.2
	RF: no healthy carriers observed so far, fatal in wild boar, dead wild boar found near villages where ASF outbreaks had occurred.	H	H		
Ecology of wild boar	How likely is it that dead/sick wild boar will be found?				
	G/A: remote area, presence of predators, cannibalism of wild boar, low animal density.	L	H		4.2
	RF: remote area, presence of predators, cannibalism of wild boar, low animal density.	L	L		
Reporting by hunters, game wardens	How likely is that dead wild boar found will be reported?				
	G/A: in Georgia dead wild boar will not be reported as system not able to cope, no interest to deal with the situation, in Armenia could be reported.	L	L		8.1.1.1
	RF: in most regions dead wild boar will be reported. There is good evidence that system is working, but differences in areas exist.	H	M		
Case confirmation	How likely is that a positive case will be confirmed?				
Handling of samples	How likely is that samples do get to the lab as required for adequate analysis?				
	G/A: shipment within the country is no problem, however international shipment could cause problems.	M	M		8.1.2.1
	RF: shipment within the country is no problem, however international shipment could cause problems, diagnosis by PCR, quality of samples is secondary.	H	L		
Laboratory confirmation	How likely is it that diagnostic laboratories do not have the ability to perform adequate tests?				8.1.3.1
	G/A: satisfactory results in ring tests (Georgia), extensive training of staff, adequate equipment.	H	H		
	RF: collaboration with Valdeolmos (confirmation of results and visit on site), regional staff trained in national laboratory.	H	H		

Rapid response	How likely is that rapid response actions applied for confirmed cases are efficient to contain the outbreak?				
	Georgia: Veterinary Services are inexistent, no control measures possible (no vaccine available) Armenia: no measures possible (no vaccine available)	L	L		
	RF :no measures possible (no vaccine available)	L	L		
Effective surveillance	How likely is it that active surveillance is will take place?				
	G/A: no active surveillance of wild boar	L	L		8.2.4.1
	RF: very limited active surveillance of wild boar	L	L		
Further spread					
Ecology , direct contact	Do population density and social behaviour favour direct contact between groups/families?				
	GA: Low population density. Wild boars moved daily only a distance of a few km as long as groups are not disturbed. There is more movement in mating season, but generally little contact with other groups. Contact between groups may exist also through scavenging on dead wild boar.	L	M	1	4.2.2
	RF: Low population density. Wild boars moved daily only a distance of a few km as long as groups are not disturbed. There is more movement in mating season, but generally little contact with other groups. Contact between groups may exist also through scavenging on dead wild boar.	L	M	1	
Role of environment/persistence in	How likely is it that ASF is transmitted indirectly due to the persistence of the virus in the environment?				
environment	G/A: There is historical evidence of tenancy of the virus in European outbreaks. Little is known on efficiency of transmission.	L	M	2	2.3
	RF: There is historical evidence of tenancy of the virus in European outbreaks. Little is known on efficiency of transmission.	L	M	2	
Role of hunting	How likely is that disease is further spread through hunting?				
	GA: hunting does not result in an increased risk for disease spread. In Armenia hunting is prohibited, in Georgia hunting not very popular but it does occur.	N	L	3	4.2.2
	RF: attempts to decrease population density and therefore hunting frequent, however, hunting increases movement only temporary and do not increase risk of spread of ASF	L	L	3	
Ticks	How likely is it that the virus becomes established in soft ticks?				
	GA/RF: Wild boar have never been found infested because they normally do not rest inside protected burrows, which may be infested by ticks.	N	M	4	5
Introduction into the EU					
Migratory workers	How likely is that the virus originating from wild boar is introduced into the EU by migratory workers?				
	Caucasus: people emigrate for work, mostly to the RF, some to EU, working in seasonal agriculture. Migratory workers may bring pork products for own consumption and feed wastes to pigs	L	M	1	7.3

	Non-EU countries: known that there are migratory workers from Ukraine	L	H	4	
Hunting tourism	How likely is it that ASF is introduced into the EU through hunting tourism?				
	Armenia: hunting prohibited, Georgia: hunting not very popular but does occur	N	L	4	7.1.1
	RF: attempts to decrease population density and therefore hunting frequent, however, increased movement only temporary	L	M	2	
Illegal feed and swill	How likely is that the virus is introduced into the EU though illegal feed and swill import?				
	GA: Dumping of swill cannot be excluded	L	H	2	6.2, 7.2
	RF: Dumping of swill cannot be excluded	L	H	3	
Other people	How likely is that the virus is introduced into the EU by people movement non related to the pig industry?				
	G/A, RF: little tourism, individual tourism with tight contact to locals. They may bring pork products as souvenir.	L	M	3	7.1, 7.4
	Non-EU countries: a lot of tourism but not associated with pig industry. Illegal import of pork products is likely.	L	M	5	
Ecology, direct contact	How likely is that the disease will spread to the EU through movement of wild boar?				
	GA: Not connected wild boar populations through continuity of their habitat.	N	L	3	4.2.2
	RF, Ukraine: has continuity of habitat and connected wild boar populations with Poland and Rumania.	M	L	1	
Ticks	How likely is it that vectors are introduced into the EU?				
	G/A, RF: due to short feeding periods it is very unlikely that ticks contribute to the introduction of ASF	N	M	6	5

[1]L=likelihood (H= High, M= Moderate, L=Low, N= Negligible), [2]U=uncertainty (H= High, M= Medium L=Low); G: Georgia, A: Armenia, RF: Russian Federation.

Table 36: Detailed risk pathway for the exposure of domestic pigs in the EU following illegal import of feed or swill**.**

Risk pathway 3	**Risk questions and answers**	**L**	**U**	**Description**
Swill feeding	How likely it that an EU pig are swill fed?			
	The risk to feed swill is non negligible in the limited and free range production sector despite official swill feed ban in the EU because swill feeding can not be controlled.	HB: N LB: L FR: L	M	4.1.2
Survival of virus	How likely is it that the virus survives in swill?			
	Virus can survive a very long time in uncooked products, lower risk of cured products (Parma and Iberian ham) if products are not put on the market before 100 days (which has been shown in survival time studies of ASFV in Parma and Iberian ham)	H	L	2.2
Infection following swill	How likely is it that infection occurs following swill feeding?			

feeding				
	Very high, low uncertainty. scientific evidence	H	L	2.3

[1]L=likelihood (H= High, M= Moderate, L=Low, N= Negligible), [2]U=uncertainty (H= High, M= Medium L=Low); HB: high biosecurity, LB: low biosecurity, FR: free range

Table 37: Risk estimates and rationale for risk pathway 'spread in the EU' in the pig production sector with high biosecurity**.**

Steps in risk pathway 4 a high biosecurity	**Risk questions and answers**	**L**	**U**	**Rank**	**Description**
Risk of undetected (silent) spread (local and distant)					
Within HB sector					
Movement of pigs	Movement of pigs between farms is very likely and the resulting contact is highly efficient (for example movement from breeding farms to fattening farms, movement to slaughterhouse, movement for breeding replacement gilts)	H	L	1	4.1.2
Non-professional people	Farms often have their own tools, same procedures as for professional visitors apply for any visitors (supervised)	L	M	2	
Professional people	There is movement of people, but because of high biosecurity measures the risk is low (good procedures in place: change of clothes, clothes remain on premises, footwear provided, sometimes masks, overalls)	L	L	3	
Vehicles	Lorries should be routinely cleaned between visits. At least 2 lorries visiting the farm per week, loading of pigs low risk. Indirect transmission isunlikely.	L	H	4	
Feed	No sharing of feed	L	L	5	
Environmental contamination	Low risk through slurry disposal and waste water from washing of lorries that may lead to environmental contamination.	L	L	6	
Pets and pests	Pest control is rigorously applied	L	L	7	
Pork	No swill feeding in HB farms	L	L	8	
Spill-over to wild boar	No contact with wild boar	N	L	9	
Ticks	Due to high biosecurity the risk of ticks infestation on farm is negligible and therefore risk of spread through ticks negligible.	N	L	10	
Spill over from HB to LB sector					
Movement of animals	Movement of pigs between farms is very likely and the resulting contact is highly efficient (for example movement from breeding farms to fattening farms, movement to slaughterhouse, movement for breeding, replacement gilts)	H	L	1	4.1.2
Non-professionals	Due to strict biosecurity procedures in place in HB the risk is low but not negligible due do human factor, indirect transmission through specialised tools possible.	L	M	2	

Pork products	Swill feeding unlikely	L	M	3	
Vehicles	Experience from other infectious disease outbreaks with contaminated vehicles showed there is a clear possibility that ASF may spread through vehicles before detection	M	L	4	
Professionals	Due to strict biosecurity procedures in place in HB the risk is low but not negligible due do human factor	L	L	5	
Feed	No sharing of feed between HB and LB	N	L	6	
Environment	Medium risk through slurry disposal and waste water from washing of lorries may lead to environmental contamination.	M	L	7	
Wild boar	No contact of wild boar with HB, so they can not spread it to LB	N	L	8	
Pets (dogs) and pests	Pest control is rigorously applied in HB, so they can not spread it to LB	N	L	9	
Ticks	Due to high biosecurity the risk of tick infestation on farm is negligible and therefore risk of spread through ticks negligible.	N	L	10	
Spill over from HB to FR sector					
Movement of animals	Movement of pigs from HB to FR is a rare event. There is little interactions of sectors.	L	L	1	4.1.2
Non-professionals	Due to strict biosecurity procedures in place in HB the risk is low, but indirect transmission through specialised tools may be possible.	L	M	2	
Vehicles	Experience from other infectious disease outbreaks	L	L	3	
Pork products	Free range farmers would not buy pork from HB, home production, however we cannot exclude that contaminated meat will not be swill fed to free range pigs (despite prohibition of swill feeding)	L	M	4	
Professionals	Due to strict biosecurity procedures in place in HB the risk is low but not negligible due do human factor	L	L	5	
Feed	No sharing of feed between HB and LB	N	L	6	
Environment	Medium risk through slurry disposal and waste water from washing of lorries leads to environmental contamination, which may infect FR pigs.	M	L	7	
Wild boar	No contact with wild boar with HB, so they can not spread it to FR	N	L	8	
Pets (dogs) and pests	Pest control is rigorously applied in HB, so they can not spread it to FR	N	L	9	
Ticks	No ticks in HB, so they can not spread it to LB	N	L	10	
Outbreak detection	Likelihood of effective detection (on time)				
Case identification					
Clinical Signs	How likely is that an outbreak does result in noticeable clinical signs? High pathogenicity reported	H	M		2.1.2
Differential diagnosis	How likely is it that clinical signs are not misinterpreted as other diseases? Presented signs are common to several diseases, most likely CSF and other haemorrhagic diseases. Medium uncertainty in case of primary outbreak	M	M		8.1.2.4
Reporting					
Farmer reports	How likely is it that farmers/producers recognise clinical signs and contact their veterinarians?	H	M		8.1.1.2

	Depends of number of animals affected: as expected morbidity is high, low risk that vets will not be contacted				
Case confirmation					
Good vet service	How likely is that the veterinarian will inform the veterinary service immediately? They may try antibiotics first when primary outbreak. There was disagreement among the experts (high uncertainty)	M	H		8.1.3
Good sample handling	How likely is it that the veterinary service is efficient enough to take appropriate samples and that the samples do not reach the laboratory? Veterinarians are well trained in all EU countries and there are good veterinary services in all EU countries	H	L		
Laboratory confirmation	How likely is it that diagnostic laboratories have the ability to perform adequate tests? Ring tests: variable performance of laboratories in ring test, but generally correct diagnosis	H	L		
Rapid outbreak response	Likelihood of effective rapid outbreak response				
Quick implementation of control measures	People involved are well trained (Veterinary Service, legislation, contingency plan in place)	H	L		8.1.2
Effective control measures on farm	People involved are well trained (Veterinary Service, legislation, contingency plan in place)	H	L		
Good tracing of the dangerous contacts	Procedures in place, rigorous record keeping of movements and contacts on HB farms	H	L		
Spread to unaffected areas					
Non-professional people	Rigorous biosecurity measures after case confirmation	N	L	1	4.1.2
Vehicles	Low risk for lorries used for disposal of carcasses due to human risk factor and negligible risk for normal farm traffic (because there isn't any)	L	M	2	
Professional people	Rigorous biosecurity measures after case confirmation	N	L	3	
Environment	There is no evidence from past outbreaks, but difficult to completely exclude (p.e. disposal of carcasses), human risk factor while disposal of carcasses	L	H	4	
Movement of pigs	Movement ban being followed	N	L	5	
Feed	Rigorous biosecurity measures after case confirmation	N	L	6	
Pig products	Because of tracing, potentially infected meat is confiscated	N	L	7	
Dogs, pests	Rigorous biosecurity measures after case confirmation	N	L	8	
Spill-over into wild boar through direct contact	No contact of wild boar with HB	N	L	9	
Spill-over to ticks -> become reservoir	No ticks in HB	N	L	10	
Spill over to LB	Risk is non-negligible due to human factor	L	M		
Spill over to FR	Risk is non-negligible due to human factor	L	M		
Long term action	Likelihood of effective long term response				

Effective Surveillance	After first outbreak it has been proven in the past that control of ASF in HB farms can be efficient but there could be a potential difference between member states. Virus will be easily detected with the actual virus strain in a virgin population in HB sector.	H	L		8.2.3
Absence of virus carriers	We consider only the actual “Caucasian strain”, which is highly virulent and spreads slowly, so it was considered that there is no more virus present on the HB farm after control measures were applied	H	L		2.1.1
Absence of tick reservoir	Not likely that ticks will play a role in the HB sector.	H	L		5

[1]L=likelihood (H= High, M= Moderate, L=Low, N= Negligible), [2]U=uncertainty (H= High, M= Medium L=Low); HB: high biosecurity, LB: low biosecurity, FR: free range

Table 38: Risk estimates and rationale for risk pathway ‘spread in the EU’ in the pig production sector with limited biosecurity.

Steps in risk pathway 4b (Limited biosecurity)	Risk questions and answers	L	U	Rank	Description/ data need
Risk of undetected (silent) spread (local and distant)					
Within the LB sector					
Movement of pigs	There is a lot of movement of pigs in this sector, disease might lead to quick sale of pigs (premature slaughter). A lot of movement of weaners and fattening pigs.	H	L	1	4.1.2
Vehicles	Lorries should be routinely cleaned between visits, but this is less controlled and less rigorously applied than for HB farms. More frequent vehicle movement.	H	M	2	
Non-professional people	Uncertain biosecurity procedures in place, gaps in biosecurity possible	M	M	3	
Pig products	No swill feeding in LB farms (but can not be excluded)	L	L	4	
Professional people	Uncertain biosecurity procedures in place, gaps in biosecurity possible	M	L	5	
Feed	No sharing of feed between epidemiological units	L	L	6	
Spill-over to wild boar	Feed can get contaminated and is then accessible to wild boar	L	L	7	
Pets and pests	Feed can get contaminated and is then accessible to pests and could lead to transmission to neighbouring farm, dogs and cats can easily move between farms.	M	L	8	
Environmental contamination	High risk through slurry disposal and waste water from washing of lorries leads to environmental contamination. High risk of survival of virus	H	L	9	
Ticks	Not likely that ticks will play a role in spread of virus	L	L	10	
Spill over to HB sector					
Vehicles	Different vehicles used in the two production systems	L	M	1	4.1.2
Non-professionals	HB farms have strict procedures, same rules as for professional visitors apply for any visitors (supervised)	N	L	2	
Professionals	There is movement of people, but because of high biosecurity risk is low (days pig free or good procedures in	N	L	3	

	place: change clothes, clothes remain on premises, footwear provided, sometimes masks, overalls)				
Movement of animals	Pest control is rigorously applied in HB	N	L	4	
Pork products	No swill feeding in HB farms	N	L	5	
Feed	No sharing of feed between sectors	N	L	6	
Environment	Low risk through slurry disposal and waste water from washing of lorries may lead to environmental contamination.	L	M	7	
Pets (dogs) and pests	Pest control is rigorously applied in HB	N	L	8	
Wild boar	HB no contact with wild boar	N	L	9	
Ticks	Ticks not involved in spread	L	L	10	
Spill over to FR sector					
Movement of animals	Very likely that pigs are sold to free range farms	H	L	1	4.1.2
Pork products	Tight contact of LB and FR and swill feeding in free range cannot be excluded despite swill ban	M	M	2	
Non-professionals	Uncertain biosecurity procedures in place, gaps in biosecurity possible	M	M	3	
Vehicles	Lorries should be routinely cleaned between visits, but less controlled and rigorously applied than for HB farms. More frequent vehicle movement.	M	L	4	
Professionals	Little veterinary contact in with FR	L	M	5	
Wild boar	Feed can get contaminated and is then accessible to wild boar	L	M	6	
Feed	No shared feed distribution/source between LB and FR	N	L	7	
Environment	Medium risk through slurry disposal and waste water from washing of lorries leads to environmental contamination. High risk of survival of virus.	M	L	8	
Pets (dogs) and pests	Feed can get contaminated and then is accessible to pests and could lead to transmission to neighbouring farm, dogs and cats can easily move between farms.	M	L	9	
Ticks	Not likely that ticks will play a role in the spread of virus	L	M	10	
Outbreak detection					
Case identification					
Clinical Signs	How likely is that an outbreak does result in noticeable clinical signs?	H	M		2.1.2
	high pathogenicity reported				
Differential diagnosis	How likely is it that clinical signs are not misinterpreted as other diseases?	M	L		8.1.2.4
	Presented signs are common to several diseases, most likely CSF and other haemorrhagic diseases. low uncertainty in case of primary outbreak.				
Reporting					
Farmer reports	How likely is it that farmers/producers recognise clinical signs and contact their veterinarian?	L	L		8.1.1.2
	Will not suspect ASF in case of primary outbreak.				
Case confirmation					

Good vet service	How likely is that the veterinarian will inform the veterinary service immediately? They may try antibiotics first when primary outbreak There was disagreement among the experts (high uncertainty)	M	H		8.1.3
Good sample handling	How likely is that the veterinary services are efficient enough to take appropriate samples and that the samples do reach the laboratory? Veterinarians are well trained in all EU countries and there are good veterinary service in all EU countries	H	L		
Laboratory confirmation	How likely is it that diagnostic laboratories have the ability to perform adequate tests? Ring tests: variable performance of laboratories in ring test	H	L		
Rapid response	Likelihood that rapid response is effective				
Quick implementation of control measures	People involved are well trained (Vet Service, legislation, contingency plan in place)	H	L		8.2.2
Effective control measures on farm	Disinfection more difficult, but has been shown to be efficient in past outbreaks. People involved are well trained (Veterinary Service, legislation, contingency plan in place. Low where ticks are epidemiological relevant (outdoor production)	H	L		
Good tracing of dangerous contacts	Incomplete compliance with record keeping must be assumed	M	L		
Spread to unaffected areas					
Within LB					
Movement of pigs	Movement ban being followed in general, but non negligible due to non compliance	L	H	1	4.1.2
Non-professional people	Rigorous biosecurity measures applied after case confirmation	N	M	2	
Vehicles	Low risk for lorries used for disposal of carcasses and negligible risk for normal farm traffic (because there isn't any)	L	M	3	
Feed	Rigorous biosecurity measures after case confirmation	N	L	4	
Pig products	Because of tracing, potentially infected meat is confiscated	N	L	5	
Spill-over into wild boar through direct contact	No contact with wild boar with HB, but can not be excluded	L	M	6	
Prof. people	Rigorous biosecurity measures after case confirmation	N	L	7	
Environment	There is no evidence from past outbreaks, but difficult to completely exclude (e.g. disposal of carcasses), human risk factor while disposal of carcasses	L	H	8	
Pets (dogs) and pests	Pest control, but dogs generally still move freely	L	M	9	
Spill-over to ticks -> become reservoir	Ticks do not play a role in the spread of ASF	N	M	10	
Spill-over to HB					
	Rigorous biosecurity measures applied in HB, especially after case confirmation in LB	N	M		4.1.2
Spill-over to FR					
	Environmental contamination, infected pork products are still circulating and end up in swill	L	M		4.1.2

Long term response					
Effective Surveillance					
	Although ASFV survival in LB sector is possible, effective surveillance is still likely to detect the virus in confined animals.	H	M		8.2.3
Absence of virus carriers					
	We consider only the actual “Caucasian strain”, which is highly virulent and spreads slowly. It is not known if the virus strain will not change and healthy carriers may play a role in the future so uncertainty is high	H	H		2.1.1
Absence of tick reservoir					
	Could be important in some areas where ticks and virus overlap geographically and where buildings with cracks occur. There are a lot of unknowns concerning the role of the tick vectors, that is why the uncertainty was high	H	H		5

[1]L=likelihood (H= High, M= Moderate, L=Low, N= Negligible), [2]U=uncertainty (H= High, M= Medium L=Low); HB: high biosecurity, LB: low biosecurity, FR: free range

Table 39: Risk estimates and rationale for risk pathway ‘spread in the EU’ in the pig production sector with free ranging production system

Risk pathway 4c (Free ranging pig production sector)	Risk questions and answers	L	U	Rank	Description/ data need
Risk of undetected (silent) spread (local and distant)					
Within FR sector					
Movement of pigs	Direct contact with other free-ranging pigs	H	L	1	4.1.2
Spill-over to wild boar	In areas where wild boar occur, linked to population densities, contact occurs	H	L	2	
Pig products	Swill feeding is not unknown in countries where FR production occurs	M	M	3	
Environmental contamination	Shared environment of pigs of different farms/owners, consider density of free ranging pigs	H	L	4	
Non-professional people	Difficult to estimate, but no biosecurity measures in place	M	H	5	
Vehicles	Does not occur frequently	M	M	6	
Feed	No sharing of feed between FR herds	L	M	7	
Prof. people	Veterinary and other animal health presence is very low	L	H	8	
Pets and pests	Feed can get contaminated and then is accessible to pests and could lead to transmission to neighbouring farm, dogs and cats can easily move between farms.	M	H	9	
Ticks	In places where soft-ticks occur and free range pigs have premises/shelter with cracks/brick built, transmission occurs	L	M	10	

Spill over to HB sector					
Non-professionals	Biosecurity in place in HB, but possibility of non-conforming	L	M	1	4.1.2
Vehicles	Shared lorries very unlikely and biosecurity measures on HB farms	L	M	2	
Professionals	Biosecurity in place in HB, but possibility of non-conforming	L	M	3	
Feed	definitely not going from FR to HB	N	L	4	
Pork products	no swill feeding in HB farms	L	L	5	
Environment	biosecurity on HB farm. high agreement between experts (Low uncertainty	N	L	6	
Pets (dogs) and pests	pest control in HB	L	M	7	
Movement of animals	No movement of pigs likely from FR to HB	N	L	8	
Wild boar	Wild boar not in contact with HB	N	L	9	
Ticks	Ticks do not play a role in spread of ASF	N	L	10	
Spill over to LB sector					
Non-professionals	Can happen and limited biosecurity in LB enables introduction	M	M	1	4.1.2
Movement of animals	Low Risk, but cannot be excluded (for example neighbouring to free range farm), very limited movement of pigs between production systems	L	M	2	
Feed	no sharing of feed likely	N	M	3	
Pork products	accidental feeding of pork products cannot be excluded	L	M	4	
Vehicles	event happening but not very efficient mode of transmission	M	M	5	
Wild boar	Not likely that infected wild boar will enter LB farm	L	L	6	
Professionals	limited biosecurity in both production systems, increase veterinary intervention leads to increased movement of professionals between farms, for example vaccination campaigns against any pig disease increases, close contact with animals of professionals, workers with free range farms at home	M	M	7	
Environment	LB fenced, introduction through feed (for example cut grass or acorn)	L	M	8	
Pets (dogs) and pests	Pest control difficult	M	M	9	
Ticks	Not likely that ticks will play a role in spread of virus	L	M	10	
Outbreak detection	Likelihood of effective detection (on time)				
Case identification					
Clinical Signs	How likely is that an outbreak does result in noticeable clinical signs? high pathogenicity reported	H	M		2.1.2
Differential diagnosis	How likely is it that clinical signs are not misinterpreted as other diseases? A lot of other diseases, infectious diseases very common	L	L		8.1.2.4
Reporting					
Farmers report	How likely is it that farmers/producers recognise clinical signs and contact their vets ? Owners of free ranging pigs may not recognise the disease or not report it to their vet	L	L		8.1.1.2

Case confirmation					
Good vet service (Vetreports)	How likely is that the vet will inform the veterinary service immediately?	M	H		8.1.3
	They may try antibiotics first when primary outbreak There was disagreement among the experts (high uncertainty)				
Good sample handling (official sample)	How likely is that the vet service is efficient enough to take appropriate samples and that the samples do not reach the laboratory?	H	L		
	in all EU countries, well educated vets and good veterinary service in all EU countries				
Laboratory confirmation	How likely is it that diagnostic laboratories have the ability to perform adequate tests?	H	L		
	Ring tests: variable performance of laboratories in ring test				
Rapid outbreak response	Likelihood of effective outbreak response				
Quick implementation of control measures	Contingency plans in place, legislation is followed, variation between countries. Based on experience of response to previous outbreaks of exotic diseases, delay has been a problem in cases of first occurrence of a disease	M	L		8.2.2
Effective control measures on farm (Stamping out, disinfection)	Difficulties to implement control measures as they should be done, access to all pigs might be a problem, disinfection of farm/holding and the environment is difficult and takes time to proof absence of ASF	M	L		
Good trace of the dangerous contacts	lack of knowledge of pig roaming activities, contact with wild boar,	M	L		
Spread to unaffected areas					
Within FR sector					
Movement of pigs	No movement officially allowed, but some free range pigs are difficult to catch	M	M	1	4.1.2
Spill-over into wild boar through direct contact	Wild boar might be attracted by the carcasses, difficult to avoid contact and difficulties to confine all free ranging pigs due to limited facilities, contaminated environment, see above: control measures are not efficient	H	M	2	
Pig products	Meat is confiscated, non-compliance possible	L	M	3	
Non-professional people	Officially restrictions put in place during an outbreak situation	M	M	4	
Vehicles	Vehicles movement on and off farm restricted	L	M	5	
Feed	Feed is confiscated, non-compliance possible	L	M	6	
Environment	Contaminated areas, pigs not caught, difficult to disinfect	M	M	7	
Prof. people	Biosecurity measures put in place	L	M	8	
Dogs, pests	Needs to be considered in high density areas, pest control applied during outbreak as part of control measures	L	M	9	
Spill-over to ticks -> become reservoir	Unlikely to play a role in the spread of ASF	L	M	10	
Spill-over to HB		L	M		
	All factors low: high biosecurity, compliance with biosecurity will even be better than usually,				4.1.2
Spill-over to LB		L	M		
	All factors low: compliance with biosecurity will be better than usually,				4.1.2

Long term response					
Effective Surveillance	Most animals are not identified in FR sector, non compliance is possible. Effective surveillance is difficult.	M	M		8.2.3
Absence of virus carriers	We consider only the actual "Caucasian strain", which is highly virulent and spreads slowly. It is not known if the virus strain will not change and healthy carriers may play a role in the future so uncertainty is high.	H	H		2.1.1
Absence of tick reservoirs	Possible only if old premises are present in the free range area and distribution of ticks overlap the geographical distribution of this production sector. There are a lot of unknowns concerning the role of the tick vectors, that is why the uncertainty was high	H	H		5

[1]L=likelihood (H= High, M= Moderate, L=Low, N= Negligible), [2]U=uncertainty (H= High, M= Medium L=Low); HB: high biosecurity, LB: low biosecurity, FR: free range

Table 40: Detailed risk pathway for ASF to become endemic in wild boar in the EU

Steps in risk pathway 5 Risk of spread in EU Wild boar population	Risk questions and answers	R	U	Rank	Description
Undetected Spread					
Ecology, direct contact	How likely is it that an infected wild boar come into contact with other wild boar? Includes direct contact and feeding on carcasses. Depends on density: some high population density in parts of Europe.	L	L	1	4.2.2
Hunting	How likely is it that hunting further increases the chance of spread? Hunting only temporarily increases home range. Indirect transmission through meat, boots, clothes, cars etc. can lead to distant spread	L	L	2	4.2.2
Environment	How likely is it that ASF is transmitted indirectly due to the persistence of the virus in the environment? Indirect transmission: the virus can stay infectious in the environment for a long time, indirect contact occurs but transmission efficiency is very low	L	M	3	2.2
Ticks	How likely is it that the virus becomes established in soft ticks? Areas with wild boar and ticks: Spain, Portugal. Not important for silent spread and not important in wild boar	L	L	4	5
Outbreak detection	Likelihood of effective detection (on time)				
Case identification					
Clinical signs (appearance of outbreaks)	How likely is that an infected wild boar show clinical signs? Affected wild boar will show clinical signs, also consistent with observations in the Caucasus	H	L		2.1.2
Ecology : find sick wild boar	How likely is it that behaviour of sick wild boar will make it more easy to find it? Sick wild boar have different behaviour towards people, they will not hide and are not fit enough to run away	H	M		4.2.2
Habitat and density	In general high risk to be found as most wild boar are in areas with high boar and human population density	H	H		4.2.2

	and where boar are easy visible. More difficult to find in areas with thick forests and areas where hunters and the public have no easy access, and areas with low boar density which are remote from human settlements (Danube Delta, Transylvania, swamps in Baltic countries).				
Reporting					
Reporting (by hunters, game wardens)	How likely is that a dead/sick wild boar found will be reported? in some countries dead found wild boar are being tested for ASF. The first observed cases will probably not be reported, once cases confirmed, hunters, forest wardens will report. Depends on public awareness	M /L	M		8.1.1.2
Case confirmation					
Handling and shipment of samples	How likely is it that appropriate samples are taken and sent to the laboratory? Sample quality not critical as diagnosis is done by PCR	H	M		8.1.3
Laboratory confirmation	How likely is it that diagnostic laboratories have the ability to perform adequate tests? Ring tests, see above.	H	L		
Rapid Response	Likelihood of effective rapid outbreak response				
Hunting practise	Change hunting practise in order to reduce risk: see CSF/ASF regulation (animals not cleaned in field, etc), avoid food and water supply.	M	M		8.2.2
Change population density	Hunting to reduce population density and to reduce possibilities of contact between boar is difficult to implement. Hunters don't want to reduce the population, though outcomes of studies have not clearly demonstrated this.	L	M		
Surveillance	It is important to increase disease awareness and prevention of spill-over to domestic pigs, to know the situation. Efficiency depends on the collaboration of hunters, even though there are regulations that samples of hunted wild boar are submitted for diagnostics. Useful tool, but will not control ASF directly.	L	M		
Spread to unaffected areas					
Ecology, direct contact	Includes direct contact and feeding on carcasses. Most important risk factor for spread. Depends on density: high population density in parts of Europe	L	L	1	4.2.1
Environment	Indirect transmission: the virus can stay in the environment for a long time, indirect contact occurs but transmission efficiency is very low	L	M	2	
Hunting	Hunting reduced and hunters more vigilant to reduce risk of transmission. Temporarily increases home range, disruption of population. Indirect transmission through meat, boots, clothes, cars etc. can lead to distant spread	L	M	3	
Tick	Not important for silent spread and not important in wild boar	L	M	4	
Long term response					
Effective Surveillance	Disease control and surveillance in wildlife is difficult.	L	L		8.2.3

Absence of virus carriers	We consider only the actual "Caucasian strain", which is highly virulent and spreads slowly. It is not known if the virus strain will not change and healthy carriers may play a role in the future so uncertainty is high	H	H		2.1.1
Absence of tick reservoir	Wild boar do not rest in burrows which my be infested by ticks	H	H		5

[1]L=likelihood (H= High, M= Moderate, L=Low, N= Negligible), [2]U=uncertainty (H= High, M= Medium L=Low)

APPENDIX G: RANKING OF IMPORTANCE OF RISK FACTORS THAT CONTRIBUTE TO SPREAD OF ASF IN THE DOMESTIC AND WILD BOAR POPULATIONS IN THE EU, TCC AND RF

When more than three factors contributed to spread in a risk pathway, the factors were ranked according to their importance. The ranking was done independently of the likelihood estimates or the assigned uncertainty. The ranking was performed by expert opinion elicitation, collected with questionnaires, results of which are presented here. Experts for this task were solicited within the WG members.

Table 41: Ranking of factors contributing to spread of ASF in domestic pig populations

Factors contributing to spread of ASF in domestic pig populations											Uncertainty		
Risk factors	Pigs	Pork	Feed	Vehicles	Profes-sionals	People	Pests	Environ-ment	Ticks	Wild Boar	Not sure	Pretty sure	Very sure
RP 1, TCC: unknown spread													
Rank	1	2	7	6	4	3.	9	8	10	5	4	9	0
Median	1.00	2.00	7.00	5.00	4.00	4.00	9.00	8.00	10.00	5.00			
Mean	1.31	2.00	6.25	5.17	4.75	3.83	9.00	7.17	9.27	4.83			
Std Dev	0.48	0.76	1.97	1.30	1.50	1.14	1.12	1.60	1.23	2.15			
RP 1, TCC: local spread													
Rank	1	2	7	5	6	3	9	8	10	4	7	6	0
Median	1.00	2.00	6.50	5.00	5.50	3.50	9.00	7.50	10.00	3.50			
Mean	1.23	2.15	6.23	5.23	5.46	3.92	8.69	7.31	9.42	4.08			
Std Dev	0.44	0.80	1.74	1.36	1.85	1.19	1.32	1.44	1.24	2.29			
RP 1, TCC: distant spread													
Rank	2	1	5	3	6	4	9	8	10	7	6	6	0
Median	2.00	1.00	5.00	3.00	6.00	4.00	9.00	8.00	10.00	6.00			
Mean	2.31	1.77	6.15	3.62	5.38	4.23	8.46	7.92	9.15	5.46			
Std Dev	1.65	1.17	2.03	1.26	2.14	1.54	1.20	1.26	1.34	2.03			
RP1, RF: unknown spread													
Rank	1	2	7	5	6	4	9	8	10	3	7	6	0
Median	1.00	2.00	6.00	5.00	6.00	4.00	9.00	8.00	10.00	5.00			
Mean	1.46	2.00	5.77	4.77	5.54	4.23	8.38	7.46	9.58	4.23			

Std Dev	0.88	0.71	2.01	1.24	1.61	1.36	1.89	1.98	0.79	2.20			
RP 1, RF: local spread													
Rank	1	2	7	5	6	4	9	8	10	3	6	6	0
Median	1.00	2.00	7.00	5.00	6.00	4.00	9.00	7.00	10.00	3.00			
Mean	1.23	2.23	6.38	5.31	5.92	4.46	8.31	6.69	9.67	3.46			
Std Dev	0.44	0.73	1.76	1.32	1.75	1.33	1.89	2.06	0.65	2.15			
RP 1, RF: distant spread													
Rank	2	1	5	3	7	4	8	9	10	6	7	6	0
Median	2.00	1.00	5.00	3.00	6.00	5.00	9.00	9.00	10.00	6.00			
Mean	2.46	1.62	5.08	3.62	5.69	4.77	8.46	8.54	9.31	5.00			
Std Dev	1.71	1.12	1.50	1.26	1.80	1.64	1.20	1.33	0.95	2.00			
RP 4, HB: undetected spread within HB													
Rank	1	8.	5	4	3	2	7	6	10	9	5	7	0
Median	1.00	7.00	6.00	3.00	4.00	3.00	6.00	6.00	10.00	9.00			
Mean	2.25	6.18	5.27	3.73	3.64	3.17	6.27	5.75	9.18	8.82			
Std Dev	2.73	2.60	1.74	1.95	1.63	1.99	1.74	2.18	1.25	1.08			
RP 4, HB: undetected spill-over from HB to LB													
Rank	1	3	6	4	5	2	9	7	10	8	6	6	0
Median	1.00	3.50	6.00	4.00	5.00	4.00	8.00	6.50	10.00	8.00			
Mean	1.17	4.25	5.75	3.75	4.50	4.08	8.00	7.00	9.42	6.83			
Std Dev	0.39	2.49	1.42	1.36	2.20	1.38	0.95	1.41	1.44	2.89			
RP 4, HB: undetected spill-over from HB to FR													
Rank	1	4	6	3	5	2	9	7	10	8	5	7	0
Median	1.00	4.50	6.00	3.50	5.00	3.50	8.50	7.00	10.00	8.00			
Mean	1.58	4.25	5.50	3.83	4.25	3.75	8.50	6.92	9.17	6.75			
Std Dev	1.24	2.26	1.73	1.85	1.76	1.14	1.17	2.07	1.47	2.83			
RP 4, HB: spread after detection within HB													
Rank	5	7	6	2	5	1	8	4.00	10	9	5	8	0
Median	5.00	5.50	5.00	3.00	3.50	2.50	7.00	4.00	10.00	8.50			

Mean	3.92	5.25	5.00	2.83	4.17	2.83	6.83	4.92	8.92	7.50			
Std Dev	2.78	2.42	1.41	1.40	2.48	2.48	1.99	2.99	1.88	2.58			
RP 4, LB: undetected spread within LB													
Rank	1	4	6	2	5	3	9	8	10	7	6	7	0
Median	1.00	4.00	5.00	3.50	5.00	4.00	8.50	8.00	10.00	5.50			
Mean	1.08	4.42	5.55	3.91	5.27	4.36	8.09	7.55	8.82	5.64			
Std Dev	0.29	2.23	1.81	1.22	2.28	1.96	1.58	2.11	2.18	2.91			
RP 4, LB: undetected spill-over from LB to HB													
Rank	4	5	6.	1	3	2	8	7	10	9	5	5	0
Median	4	5	5	2	3	2	7	6	10	8			
Mean	4.42	5.17	5.18	2.83	3.64	2.92	6.53	6.08	9.00	7.91			
Std Dev	3.32	1.90	1.17	1.64	2.66	2.35	2.58	2.07	1.84	1.64			
RP 4, LB: undetected spill-over from LB to FR													
Rank	1	2	7	4	5	3	9	8	10	6	6	5	0
Median	1.00	3.00	6.00	4.00	5.50	3.00	8.50	7.50	10.00	6.00			
Mean	1.42	3.58	6.33	4.67	5.58	3.75	7.42	6.92	9.00	5.83			
Std Dev	1.16	1.88	1.56	1.50	2.27	2.38	2.54	2.43	2.13	2.55			
RP 4, LB: spread after detection within LB													
Rank	1	5	4	3	7	2	9	8	10	6	6	7	0
Median	2.00	4.00	4.00	4.00	6.00	3.00	8.00	6.50	10.00	5.00			
Mean	3.08	4.46	4.23	4.08	5.69	3.38	7.46	6.00	9.75	5.69			
Std Dev	2.81	2.30	1.79	1.85	2.50	2.02	1.33	2.52	0.62	2.93			
RP 4, FR: undetected spread within FR													
Rank 23	1	3	7	6	8	5	9	4	10.	2	6	7	0
Median	1.00	4.00	6.50	6.00	8.00	5.00	9.00	4.00	9.50	2.00			
Mean	1.23	4.23	6.33	6.31	7.77	5.15	8.00	5.00	8.25	2.38			
Std Dev	0.44	1.54	2.23	1.60	2.01	1.57	1.83	2.55	2.26	1.19			
RP 4, FB: undetected spill-over from FR to HB													
Rank	8	5	4	2	3	1.	7	6	10	9	6	6	0

Median	7.00	5.50	4.50	2.00	3.50	1.00	6.50	6.00	10.00	8.50			
Mean	6	5	4	2	3	2	6	6	9	7			
Std Dev	2.61	2.39	1.85	1.30	2.81	1.77	1.96	1.60	1.54	2.42			
RP 4, FR: undetected spill-over from FR to LB													
Rank	2	4	3	5	7	1	9	8	10	6	6	6	0
Median	3.00	4.50	4.00	5.00	5.00	3.00	8.00	7.00	10.00	5.00			
Mean	3.23	5.00	4.77	4.38	5.38	3.00	7.54	6.69	9.08	5.31			
Std Dev	2.24	2.80	1.92	2.14	2.26	1.91	2.07	2.56	1.62	3.12			
RP 4, LFR spread after detection within FR													
Rank	1	3	6	5	8	4	9	7	10	2	5	7	0
Median	1.00	4.00	5.50	5.00	8.00	5.00	9.00	7.00	10.00	2.00			
Mean	1.46	4.77	5.83	4.85	7.62	4.77	7.85	6.15	9.08	2.38			
Std Dev	0.88	2.55	2.08	0.80	1.80	1.83	2.30	2.38	1.31	1.12			

Table 42: ranking of factors contributing to spread of ASF in wild boar populations

	Factors contributing to spread of ASF in wild boar populations				Uncertainty		
Risk factors	Ecology	Hunting	Ticks	Environment	Not sure	Pretty sure	Very sure
RP2, TCC: Unknown spread							
Rank	1	3	4	2			
Median	1.00	3.00	4.00	2.00	3	8	0
Mean	1.00	2.58	3.91	2.50			
Std Dev	0.00	0.51	0.30	0.67			
RP2, TCC: Further spread							
Rank	1	2	4	3			
Median	1.00	2.00	4.00	3.00	4.00	8.00	0.00
Mean	1.08	2.46	3.92	2.54			
Std Dev	0.28	0.52	0.29	0.78			
RP2, RF: Unknown spread							

Rank	1	3	4	2			
Median	1.00	3.00	4.00	2.00	3.00	9.00	0.00
Mean	1.23	2.62	3.75	2.38			
Std Dev	0.44	0.87	0.62	0.77			
RP2, RF: further spread							
Rank	1	3	4	2			
Median	1.00	3.00	4.00	2.00	3	9	0
Mean	1.00	2.77	3.83	2.38			
Std Dev	0.00	0.60	0.39	0.65			
RP5: undetected spread							
Rank	1	2	4	3			
Median	1.00	3.00	4.00	2.00	4	9	0
Mean	1.00	2.54	3.92	2.54			
Std Dev	0.00	0.52	0.29	0.66			
RP5: spread after detection							
Rank	1	3	4	2			
Median	1.00	3.00	4.00	2.00	4	9	0
Mean	1.00	2.77	3.83	2.38			
Std Dev	0.00	0.60	0.39	0.65			

Table 43: Factors contributing to the introduction of ASFV in the EU from domestic pigs

	Factors contributing to the introduction of ASFV in unaffected areas from domestic pigs					Uncertainty		
	Feed & Swill	Trade	Ticks	Migratory workers	Other people	Not sure	Pretty sure	Very sure
RP1, TCC: introduction into EU								
Rank	1	4	5	2	3			
Median	2.00	3.00	5.00	2.00	3.00	5	6	2
Mean	2.31	3.08	4.77	2.23	2.69			
Std Dev	1.44	0.95	0.93	1.36	0.95			
RP1, RF: introduction into EU								
Rank	1	4	5	2	3			

Median	2.00	3.00	5.00	2.00	3.00	6.00	6.00	1.00
Mean	2.15	3.17	5.00	2.17	2.67			
Std Dev	1.21	0.99	0.00	0.90	1.20			

Table 44: factors contributing to the introduction of ASFV in the EU from wild boar

	Factors contributing to the introduction of ASFV in unaffected areas from wild boar						Uncertainty		
	Boar movement	Feed & Swill	Hunting Tourism	Migratory worker	Other people	Ticks	Not sure	Pretty sure	Very sure
RP2, TCC: introduction into EU									
Rank	3	2	1	4	5	6			
Median	3.00	2.00	2.00	3.00	4.00	6.00	5	8	0
Mean	3.00	2.54	2.54	3.31	3.62	5.92			
Std Dev	1.58	1.61	1.56	1.18	1.19	0.28			
RP2, RF: introduction into EU									
Rank 14	1	3	2	4	5	6			
Median	1.00	2.00	2.00	4.00	4.00	6.00	6.00	7.00	0.00
Mean	2.31	2.77	2.62	3.69	3.85	5.69			
Std Dev	1.65	1.48	1.33	1.38	1.21	0.85			

APPENDIX G: RANKING OF RISK FACTORS THAT CONTRIBUTE TO ENDEMICITY OF ASF IN THE DOMESTIC AND WILD BOAR POPULATIONS IN THE EU

To identify the factors affecting the effectiveness of long term control measures for the different production sectors in the EU and to derive the likelihood estimates, experts were asked to complete a questionnaire and to give their rationale for the estimates.

To identify the factors affecting the effectiveness of long term control measures for the different production sectors in the EU and to derive their likelihood estimates, the working group experts were asked to complete a questionnaire and to rank the factors that may lead to endemicity of ASFV according to their importance.

Table 45: Overall likelihood for non-effective long term response to ASF outbreaks in the EU

	Negligible	**Low**	**Medium**	**High**	**Total**
High bio-security sector	9	0	0	0	9
Limited bio-security	4	6	1	0	11
Free range pigs	0	4	4	2	10
Wild boar	0	6	3	1	10

Table 46: Importance of factors which may contribute to ASFV becoming endemic in the EU in the HB sector

High bio-security sector:	**Not important**	**Important**	**Very important**	**Total**
Non-compliance with movement-ban and failure of TRACES to track all trade of animals and pork between EU MS	7	1	0	8
Non-effectiveness of control measures on farm (wrong measures or non-compliance)	7	1	0	8
Poor communication and coordination of efforts between EU MS	8	1	0	9
Non-detection of infected animals (due to non-identification, deliberate non-reporting or failure of active surveillance to identify infected animals, incl. healthy carriers	7	0	1	8
Survival of virus in the environment	6	1	1	8
Failure of surveillance to proof freedom from disease (sampling, sensitivity of diagnostic tests)	5	3	0	0
Tick reservoir	6	1	1	
Absence of virus carriers		1	0	1

Table 47: Importance of factors which may contribute to ASFV becoming endemic in the EU in the LB sector

Limited bio-security	**Not important**	**Important**	**Very important**	**Total**
Non-compliance with movement-ban and failure of TRACES to track all trade of animals and pork between EU MS	2	6	0	8
Non-effectiveness of control measures on farm (wrong measures or non-compliance)	4	4	0	8
Poor communication and coordination of efforts between EU MS	6	3	0	9
Non-detection of infected animals (due to non-identification, deliberate non-reporting or failure of active surveillance to identify infected animals, incl. healthy carriers	3	4	1	8
Survival of virus in the environment	3	3	2	8
Failure of surveillance to proof freedom from disease (sampling, sensitivity of	5	3	0	8

diagnostic tests)				
Absence of tick reservoir	2	5	1	8
Absence of virus carriers		1	0	1

Table 48: Importance of factors which may contribute to ASFV becoming endemic in the EU in the FR sector

Free range sector	Not important	Important	Very important	Total
Non-compliance with movement-ban, resp. failure of TRACES to track all trade of animals and pork between EU MS	0	6	2	8
Non-effectiveness of control measures on farm (wrong measures or non-compliance)	0	5	3	8
Poor communication and coordination of efforts between EU MS	6	3		9
Non-detection of infected animals (due to non-identification, deliberate non-reporting or failure of active surveillance to identify infected animals, incl. healthy carriers	0	3	5	8
Survival of virus in the environment	2	3	3	8
Failure of surveillance to proof freedom from disease (sampling, sensitivity of diagnostic tests)	3	2	3	8
Absence of tick reservoir	1	4	3	8
Absence of virus carriers	0	1		1