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Review

Four years of African swine fever in Poland. New insights into epidemiology and prognosis of future disease spread

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Abstract

Four and a half years of African Swine Fever (ASF) in population of free-ranging wild boars and domestic pigs revealed a number of novel insights into the disease epidemiology. Until November 20th, 2018, in total 3048 cases in wild boars and 213 outbreaks in domestic pigs have been confirmed. In spite of low contagiosity as well as low rate of ASF spread in wild boars the disease has an enormous socio-economical impact on the production of pigs in Poland. One of the most important aspects which directly influences the dynamics of ASF spread is the unpredictable human activity. Another important factor responsible for continuous ASF spread is fast recovery of wild boar population in spite of efforts taken by hunters. Assuming our scientific opinion ASF seems to be present in wildlife for the incoming few or several years. Therefore, extraordinary measures should be prepared and undertaken to limit the risk of the occurrence of future outbreaks in domestic pigs. One of the most crucial issues is implementation of strict biosecurity measures in all domestic pigs holdings.

Key words: African swine fever, wild boar, epidemiology, prognosis, biosecurity measures

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Introduction

African swine fever (ASF) has emerged in Poland and Baltic states in the beginning of 2014 (Pejsak et. al. 2014, Woźniakowski et. al. 2016). Until now (20/11/2018) 3048 cases in wild boars and 213 outbreaks in pigs have been confirmed. African swine fever virus (ASFV) is non-infectious for humans but lethal for both wild boars and domestic pigs. The ASFV infection may progress as an acute, chronic or persistent form (Blome et al. 2012). The most important measures which are crucial to limit ASF spread are based on control and prevention methods including administrative regulations, stamping out the infected pigs, implementation of sufficient biosecurity conditions as well as reduction of wild boar population supported by disposal of wild boar carcass (Sánchez-Vizcaíno and Arias 2012).

ASFV reservorir and source

In terms of ASF source spread the main reservoir of the virus in all European countries represents wild boar (*Sus scrofa scrofa*). However, wild boars are not long-distance runners and may migrate no farther than 1-5 km in case of accessibility to water and feed (Lange and Thulke 2017). The animal infected by ASFV is unable to move farther than 0.5-1 km. Apart from the role of wildlife the second and the most unpredictable way of ASF spread is related to human activity.

ASF cases in Poland

All ASF cases and outbreaks in Poland were located in 43 counties in the area of 4 voivodeships (podlaskie, lubelskie, mazowieckie and warmińsko-mazurskie). The dynamics of ASF spread in Poland in the first three years was considerably lower than in Latvia, Lithuania or Estonia (Śmietanka et al. 2016, Woźniakowski et. al. 2016). Unfortunately, in 2017 (third quarter) and during the first and second quarter of 2018, the rate of ASF spread in the wild boar population has significantly increased. The number of ASF cases in particular years was as follows: 2014 – 46 cases, 2015 – 67 cases, 2016 – 75 cases, 2017 – 724 cases (Fig. 1A) and until November 20th, 2018 – 2299 cases (Fig.1B).

In December 2017, ASFV crossed the Vistula River. In January 2018 the virus reached a range of about 40 km to the west of our largest river. Currently (November 2018), seven active ASF clusters might be distinguished in Poland (Fig. 2).

ASF surveillance

The laboratory examinations conducted in the National Veterinary Research Institute in Pulawy (NVRI) indicate the importance of passive surveillance of wild boars found dead. The current ratio of positive wild boars found dead within part II and part III accordingly to the appendix of the decision 2014/709/EU is 78 percent. Inversely, the number of hunted wild boars which are positive for ASF virus reaches below 2 percent. In case of wild boars from car accidents this value is below 20 percent. Currently, ASFV is circulating in wild boar population within 7 different clusters which presents a serious risk of its spread into the pig holdings. Due to the presence of ASFV in the wild boar population there is still a serious threat of ASFV introduction from abroad, especially from the territory of Belarus, the Ukraine and finally Russia (Kaliningrad Oblast). An example of this phenomenon is the increasing number of cases of ASF in a population of wild boars in the north of Poland.

Wild boar population

The rapidly growing population of wild boars not only in Poland but practically all over Europem may present a huge problem (Pietschmann et al. 2015). Meanwhile, despite the expanded hunting bag from 1975 till 2015 for wild boars in Poland their population continuously recovers (Fig. 3). Accordingly to the estimates conducted in 2017 the population of wild boars in Poland reaches about 228.000 heads but might be higher. The increasing number of wild boars might be caused by good conditions for reproduction and survival of wild boars with parallel lack of the effective control over the population growth. There is no doubt that wild boars will remain the main source of ASF for the next years not only in Poland, but most likely also in other European ASF-affected countries. Without a quick and comprehensive change in the way of wild boar hunting the number and density of wild boar population will consistently grow.

Wild boars – cannibals vs scavengers

The recently conducted studies in Germany showed that wild boars are scavengers but not cannibals (Probst et.al. 2017). Wild boars were interested in carcass of other animals but not in the carcass of their dead relatives. The main interests of wild boars were maggots present under carcasses in the soil during summer season. This may explain the sudden increase in ASF cases number observed in Poland and Baltic states at that

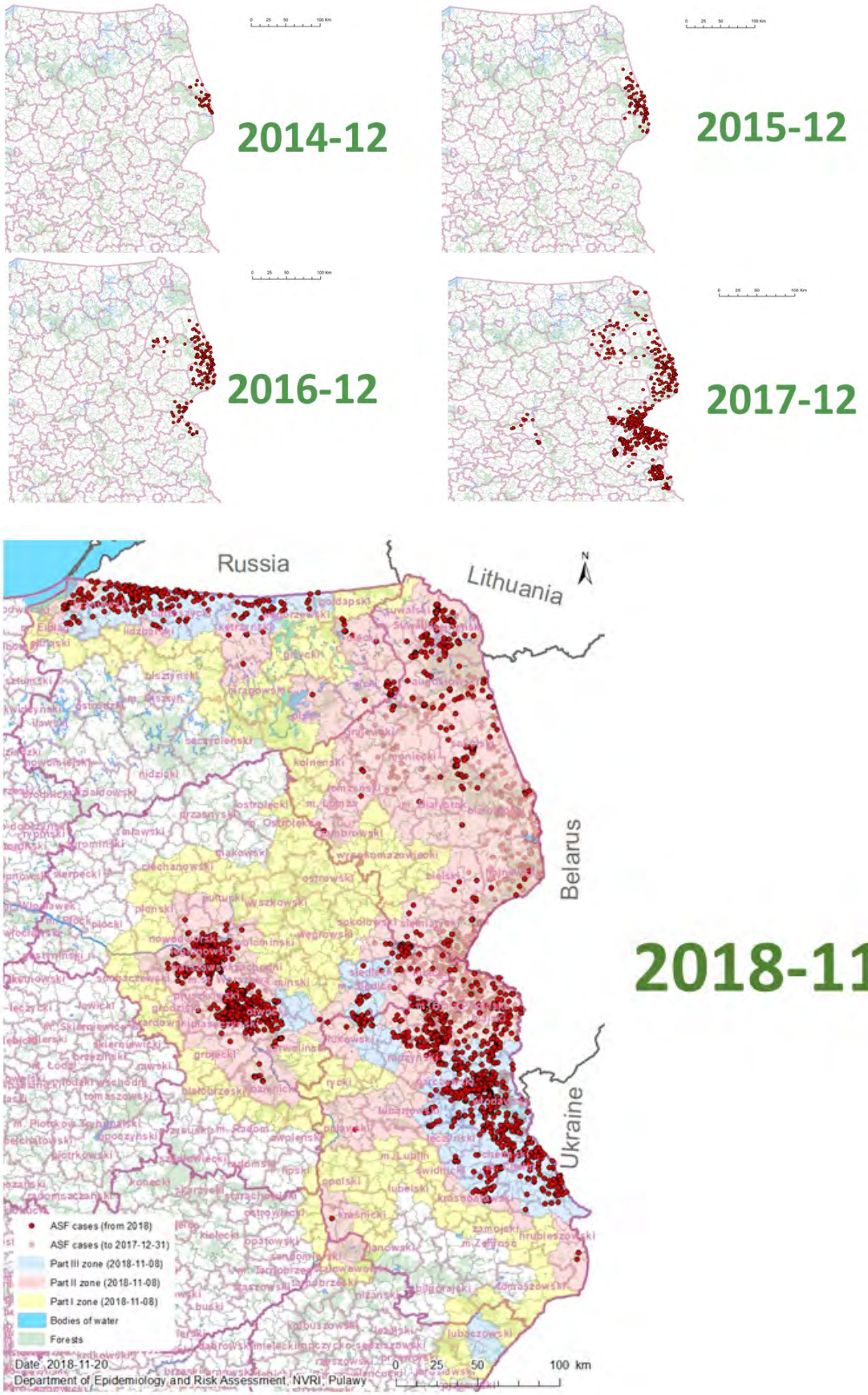

Fig. 1. The number of ASF cases in Poland. The figure shows the distribution of cases as follows: 2014 - 46 cases, 2015 – 67 cases, 2016 – 75 cases, 2017 – 724, 2018 - 2299 cases. The situation updated for 20/11/2018.

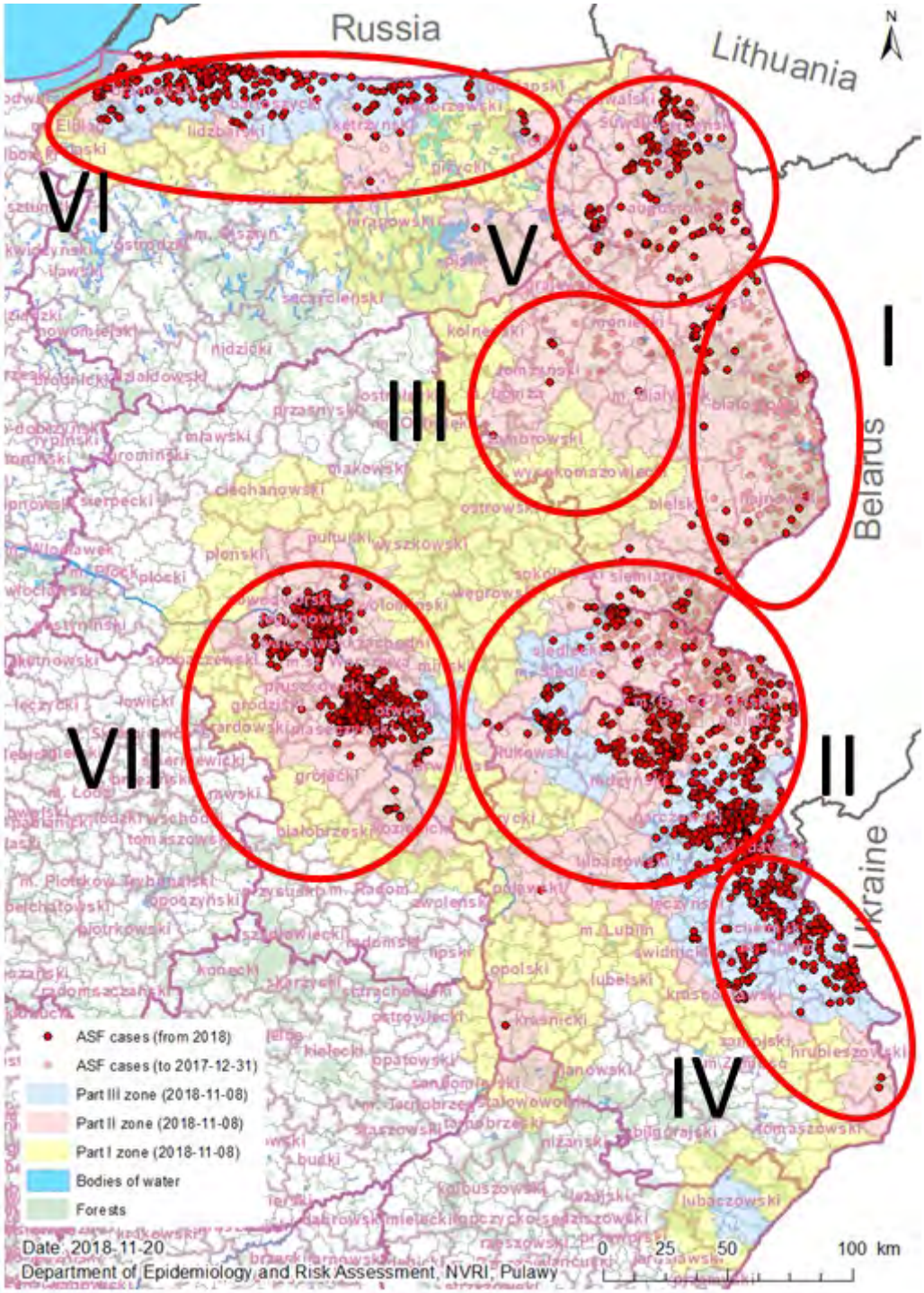

Fig. 2. Active clusters of African swine fever (ASF) in Poland. Currently (17/07/2018) seven epidemiologically active areas are distinguished. The colors reflect part I – yellow, part II – red and part III – light blue accordingly to the appendix to the Decision EU Commission - 2014/709/EU.

time (Woźniakowski et al. 2016, Probst et al. 2017,). Consequently, other sensitive individuals are infected, which sustains the presence, circulation and spread of the virus to other ASF-free areas. Accordingly to data presented in EFSA report from 2015 (EFSA, 2015), the average rate of disease spread is about 50 km/year, which relates to 5 km/month. This fact justifies the burning need to organize as early as possible the actions of wild boar carcass removal and disposal in the ASF affected area.

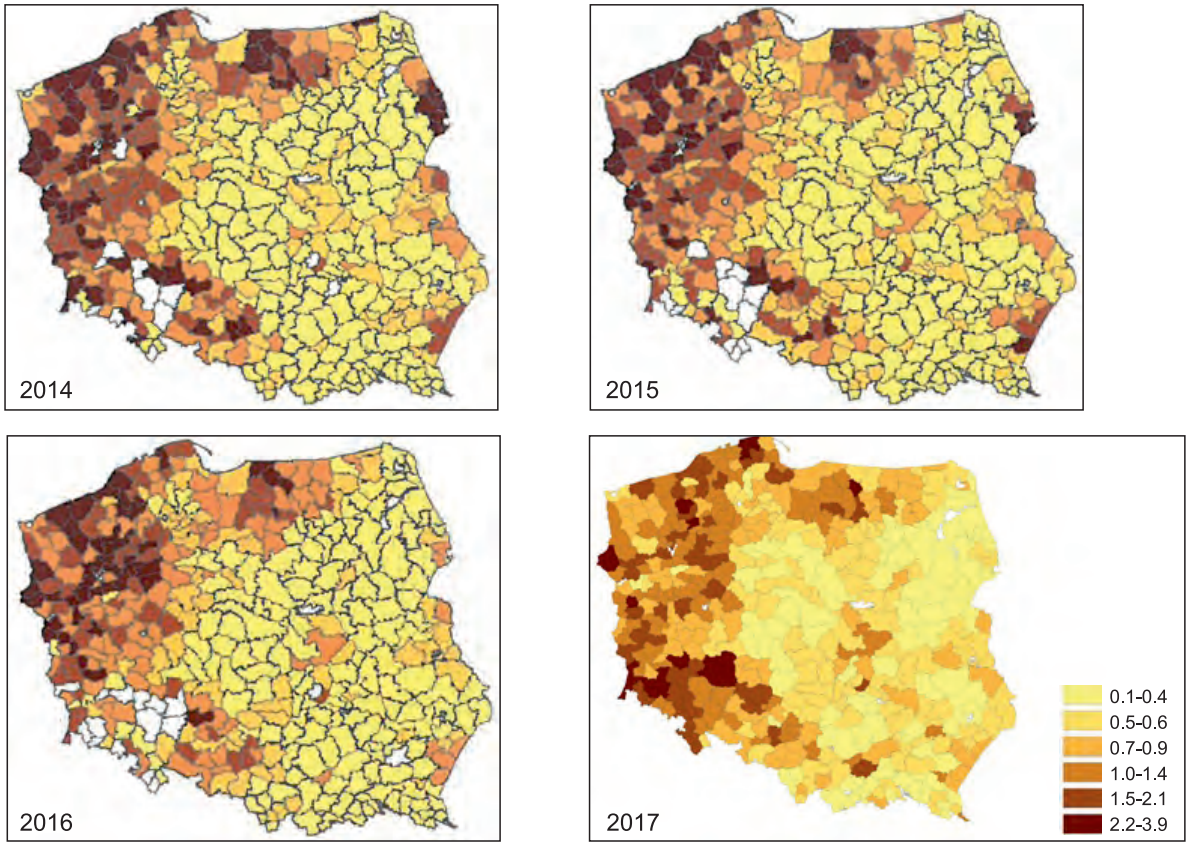

Fig. 3. Population of wild boars in Poland. Particular parts of the figure show heat-maps reflecting the current density of wild boars. The legend shows the range of wild boar density per square km.

ASFV infectivity

Depending on the environmental conditions ASFV may remain infectious for several days to several months or even longer. The ASFV is effectively transmitted through blood and meat. It can persist infectious for over a year in a blood at 4°C, a few months in raw meat and a few years in frozen corpses of wild boar or pig. The results of studies conducted at NVRI in Pulawy showed that ASFV persists infectious at 22°C up to 7 days (NVRI, unpublished data). Still very little is known about the potential infectivity of ASFV – contaminated soil, straw, hay or grain. Another important factor limiting ASF spread presents disinfection which is exceptionally important in biosecurity of pig holdings.

Scenarios of ASF spread

A few years ago, two scenarios of ASF spread related to wild boars have been formulated. The first one assumed that, due to high ASFV virulence, the disease will spread rapidly, causing enormous mortality in wild boars which means the epidemic finish. The second scenario claimed the quick jump of epidemic towards the western border of Poland. By the way, none of these hypotheses were precise. Accordingly to German experts, the risk of ASF introduction into the previously ASF-free area of Poland and Germany is assessed as considerable (Depner et al. 2016). As has been previously stated the main problem in combat against ASF seems the long persistence of ASFV in wild boar carcass, especially in humid conditions of meadows or forests.

The role of wild boar carcass in ASF spread

Previously, Depner et al. (2016) showed that total distribution of fresh carcasses is dependent from thermal conditions and may last up to 3 months. Indeed, ASFV is a very resistant and stable virus thus, it maintains its pathogenic status in contaminated field or forest environment. Due to its high resistance to environmental conditions, the ASFV spreads by carcasses is considered more important than the direct contact of wild boars with susceptible animals of the same species. Shedding of ASFV with faeces, urine or saliva is limited (Lange and Thulke 2017). Wild boars are omnivorous and it has been shown that more than

85% of their diet is plant feed. Therefore, wild boars living in areas with a rich food base (maize) are not interested in consuming carrion or doing it exceptionally. German authors confirmed that in case of favorable conditions for the availability of plant feed for wild boars, their use of carcasses as food does not seem to play a substantial role.

Pathogenicity of ASFV isolates

According to data from Blome et al. (2012) and Pietschmann et al. (2015) ASFV strains that cause the current Eurasian epidemic are usually highly pathogenic and in experimental conditions cause an acute disease, usually leading to death in wild boars and domestic pigs. However, very small titers of the virus, which do not cause clinical trials of wild boars and pigs, may cause asymptomatic carrier and virus shedding in animals. Oral and nasal infections with low doses of the virus occur primarily in wild boars on the occasion of contacts with the carcasses remains. From the epidemiological point of view, the ASFV carriage of asymptomatic carriers in wild boars creates a special threat in the sense of long-term persistence of ASF without awareness of this type of situation. In regards to the above statement Bosch et al. (2017) from the National Institute of Animal Health, National Institute of Agriculture, Food and Technology in Madrid presented a paper pointing out the cartographic definition of endemic ASF zones in wild boars, including cases of asymptomatic carrier of the virus. As suggested by the authors such map would support identification of ASF vulnerable zones as the part of the ASFV reservoir. The map of ASF spread prepared for the period of 2007 to 2016 for the whole Eurasian area may help in the development of various risk scenarios and the control of ASF. The durability of the unfavorable situation - even for many years - is indicated by the endemic areas of ASF, which have been maintained since 2007, and concerns in particular the Russian Federation while the permanent reservoirs of ASFV are present in wild boar population.

EFSA opinions on ASF epidemiological situation

To summarize the future perspectives, in the absence of an effective vaccine and drugs, specific strategies for surveillance of ASF situation focused on limitation of wild boar population are the only measures of combat and eradication of ASF. However, they require harmonized legislation that takes into account differences in the distribution, number and density of wild boar population, as claimed by European Food Safety Authority (EFSA) guidelines (EFSA 2014). It should be emphasized that such data are often not precise and do not exhaust the issue of the current epidemiological situation. For example, the EFSA' opinion issued on March14th, 2014, claimed that „it is not possible to drastically reduce wild boar population in the way of hunting" because there will be an inflow of animals from new areas. Similarly, in the opinion issued on July 14th, 2015, the EFSA reported that „intensive depopulation of wild boars with intensive removal of dead boars is recommended". Importantly, EFSA experts do not recommend hunting at the epicenter of ASF infection. They suggest that there should be a ban on entering to this area by people who may transfer the ASFV to areas previously free of this disease. It is also recommended to use electric fence and/or repellents, which should prevent migration of wild boars from the infected area (EFSA 2015). It is also suggested to feed the wild boars in order to discourage them from going outside the infected area. In parallel, an intensive search and utilization of dead pigs is extremely important. The recent paper by Lang and Thulke (2017) is an example of the lack of unambiguous views on the importance of wild boar carcasses in spread of ASF. Finally, the paper by Depner et al. (2016) continuously emphasized the great importance of wild boar carcasses and infected living wild boars in ASF epidemiology.

Summary and perspectives

Being consistent with these theses, four years of our national experience indicate that dead wild boars, then much less frequently living infected animals were the primary reason for the spread of ASF in wild boar population. The future situation in terms of biosecurity of pig holdings is directly related to efforts which should be taken to limit the contact with wild boars or wild boars habitat as the main ASFV reservoir in Poland, Baltic States, Czech Republic, Romania or recently - Hungary and future ASF-affected countries.

Further perspectives of vaccine development is still far away from final application but in the National Veterinary Research Institute (NVRI) in Pulawy the attempts to investigate the molecular function and mechanisms of genes related to host immune defense are still being conducted (Frączyk et al. 2016). The most recent efforts of NVRI in Pulawy are taken towards the construction of recombinant ASFV virus lacking A238L, EP402R and 9GL genes taking part in these mechanisms. However, the final results of this project may only sketch some new ideas for future vaccine development and application.

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