Chapter

32 Resolving Conflict Between Farmers and Wild Boar in Europe and Northern Asia

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Introduction

High population densities of wild boar result in many conflicts between this species and humans (Massei et al. 2011; Barrios-Garcia & Ballari 2012). In forests, high wild boar population densities may adversely affect the composition of flora and fauna (Bratton 1975; Storch 1994; Groot Bruinderink & Hazebroek 1996; Saniga 2002; Economov & Domsky 2014; Suter 2014) and might even inhibit the growth of forest plantations (Gomez et al. 2003). There are a high proportion of road accidents involving wild boar (Primini et al. 2009; Langbein et al. 2011) as well as invasions of overcrowded populations of these animals into urbanized areas (Cahill et al. 2009). As wild boar are vectors of many diseases and parasites, including African swine fever (ASF) (Blome et al. 2013), the high densities of their populations are also a threat to the health of livestock (Lipowski 2003). Conflict arising between these animals and farmers due to crop damage caused by wild boar is a major problem with social and economic dimensions. It appears in most countries in Europe (Mackin 1970; Kristiansson 1985; Herrero et al. 2006; Schley et al. 2008; Amici et al. 2012; Frąckowiak et al. 2013), as well as within northern, central, and eastern Asia (Saulich 2008; Chauhan et al. 2009; Saito et al. 2011; Li et al. 2013). At present, there are only a few synthetic publications on the conflict between agricultural and wild boar management on a global scale because, in the publications available, the conflict is presented separately for particular countries (e.g. Apollonio et al. 2010). For these reasons, this work aims to presents the current state of knowledge on the characteristics and reasons of conflict between farmers and wild boar game management practices within Europe and northern Asia, as well as proposals on how to solve it.

In addition, the effect of the occurrence of African swine fever in wild boar on changes in game management of this species in the European Union is also discussed.

Research Methodology

The material for the presented study was gathered on the basis of published data on the occurrence and distribution of wild boar-related damage in farmlands, levels of compensation paid to farmers for crops damaged by wild boar, and the application of methods to reduce the level of damage. Biologists involved in research on this issue within the native range of this species, e.g. the European Union, Serbia, the Russian Federation, Japan, China, and the Republic of Korea, were also asked for data. No replies were received from Denmark, Greece, or Luxembourg. Assistance in obtaining the necessary data was received from the embassies of Japan, Korea, Kazakhstan, and Uzbekistan. The detailed list of persons and institutions which assisted the authors in obtaining the necessary information is given in the 'Acknowledgements' section.

Results

The Geographical Distribution of Wild Boar-related Damage

Within Europe, there are no published data in Norway, Great Britain, Ireland, or Cyprus on the occurrence of wild boar damage as the populations of this species there are small (Wilson 2004; Hadjisterkotis & Heise-Pavlov 2006; Rosvold & Andersen 2008; McDevitt et al. 2013). In the remaining countries of Europe, damage caused by wild boar occurs everywhere within farmlands (Genov 1981; Goryńska 1981; Drozd 1988; Briedermann 1990; Lemel 1999; Ladbudzki et al. 2009; Bleier et al. 2012; Novosel et al. 2012; Hearn et al. 2014). In the European part of Russia, the damage caused to farmland does not occur as a continuum (Ovsukowa 1996; Danilkin 2002; Saulich 2008). Damage to crops has been noted in the River Don valley, the Kuban lowlands (Cherenkov 2004), the Stavropol upland region, the Volga lowlands, the Volga River delta, the interfluves between the Volga and Akhuba rivers (Litvinov 2004), as well as in the central and eastern part of the Caucasus. In the Asian part of the Russian Federation, wild boar damage occurs in the area along the Amur river (Serebiennikov & Kirichenko 2004).

In Japan, wild boar damage occurs throughout the country (Honda 2007). Wild boar also exert crop damage in Turkmenistan around the Kara-Kum irrigation canal, as well as around the Amu Darya river which runs along the Turkmenistan and Uzbekistan borders (Saulich 2008). In Kazakhstan, wild boar damage is concentrated to the south of Lake Balkhash and in the valleys of the Tien-Shan mountain range (Figure 32.1). In China, damage is noted in most provinces situated in the eastern part of the country (Li et al. 2010a,b,c; Zhang & Liu 2012), and it is particularly severe in Jiangxi, Hubei, and Fujian provinces (Chen 2006).

Characteristics of Damage Caused by Wild Boar

The data on the number of damage cases indicates that in Luxembourg, Poland, and Italy cereal crops were overall most heavily damaged in comparison to other types of crops

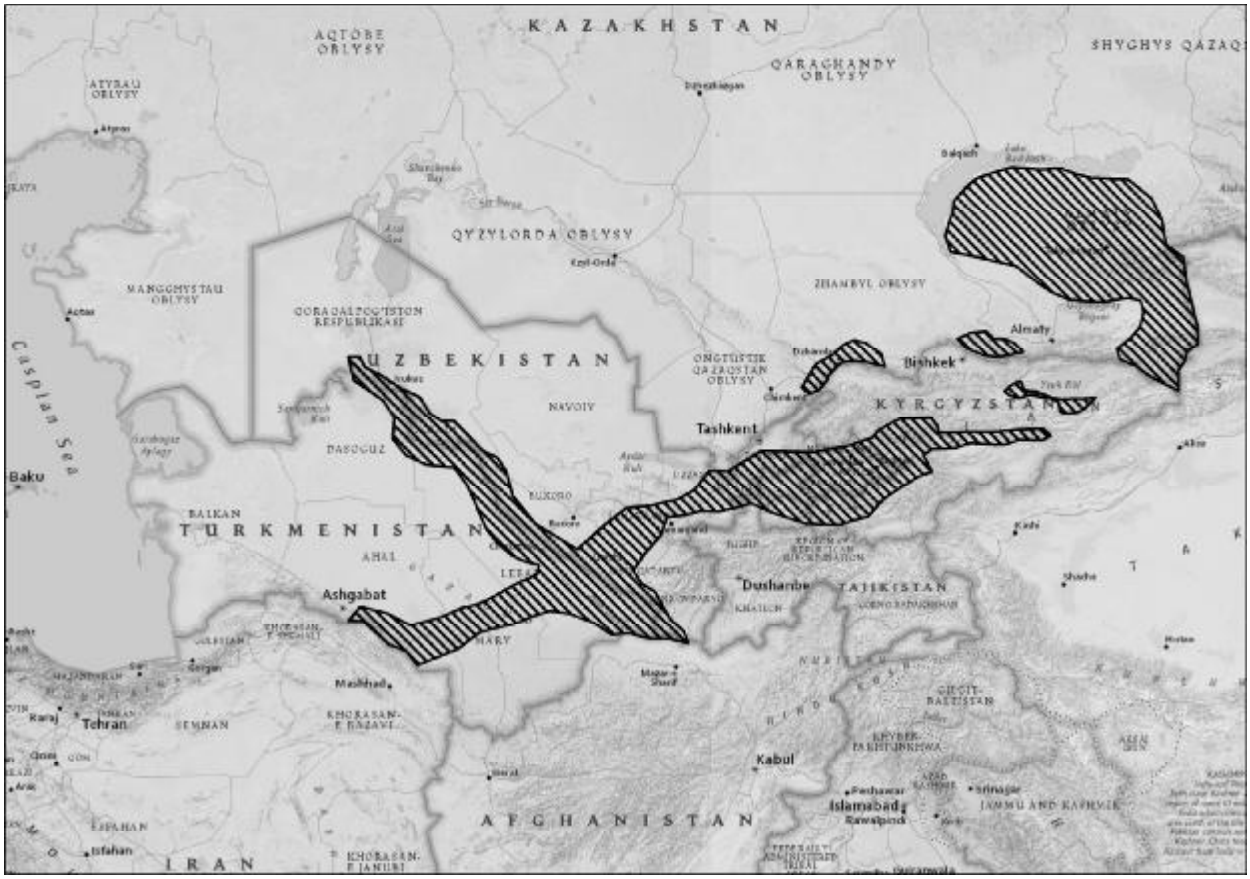

Figure 32.1 Distribution of agricultural crops damaged by wild boar in Central Asia (modified from Saulich 2008).

Table 32.1 Percent of cases for each type of crop damage during 1997–2006 in Luxembourg (Schley et al. 2008), in 2006–2008 in Italy (Amici et al. 2012), and during 2011–2013 in Poland (Bobek 2016). Number of damage cases in parentheses.

Crop type	Luxembourg (n = 13,276)	Italy (n = 766)	Poland (n = 1365)
Grassland	50.1	11.6	28.5
Maize	30.2	23.0	9.2
Wheat	11.7	15.8	12.6
Oats	1.4	4.2	13.0
Barley	1.2	3.5	–
Other cereals	2.0	–	13.6
Potatoes	1.2	–	14.3
Rape	0.8	–	7.2
Vineyards	–	13.7	–
Hazelnuts	–	12.9	–
Sunflowers	–	8.6	–
Chestnuts	–	3.3	–
Others	1.4	3.4	1.6
Total	100.0	100.0	100.0

(Table 32.1). Most of the damaged crops in Luxembourg and Italy was maize, whereas in Poland this proportion was 2–3 times lower. Damage caused to grasslands and pastures were highest in Luxembourg and lowest in Italy. In Italy, wild boar damaged sunflowers, vineyards, hazelnuts and chestnuts, i.e. the crops not cultivated by farmers in Poland and Luxembourg (Schley et al. 2008; Frąckowiak et al. 2011; Amici et al. 2012). These differences were connected with the availability of various crops.

The proportions of area damaged occurring in different crop species can be very different in subsequent years. In north-eastern Poland, the total area of farmland destroyed by wild boar in 2011 amounted to 270.5 ha from which all damaged cereal species reached 58.3 per cent and that of grassland 37.8 per cent. In the following year wild boar damage amounted to 310.4 ha. In this year, the area of damaged grasslands decreased by half, to 17.3 per cent, whereas the percentage of cereals increased to 61.7 per cent. During the two years of research, the percentage of damaged area in rape fluctuated from 13.3 to 14.5 per cent. In 2013 wild boar destroyed 419 ha of farmlands. The proportion of damages in grassland attained to 24.0 per cent and 41.0 per cent in cereals. Compared to the two earlier years the percentage of rape fields in area of damaged croplands increased markedly to 31.6 per cent (Bobek et al. 2017). In this study

Figure 32.2 Meadows destroyed by wild boar (photo by W. Frąckowiak).

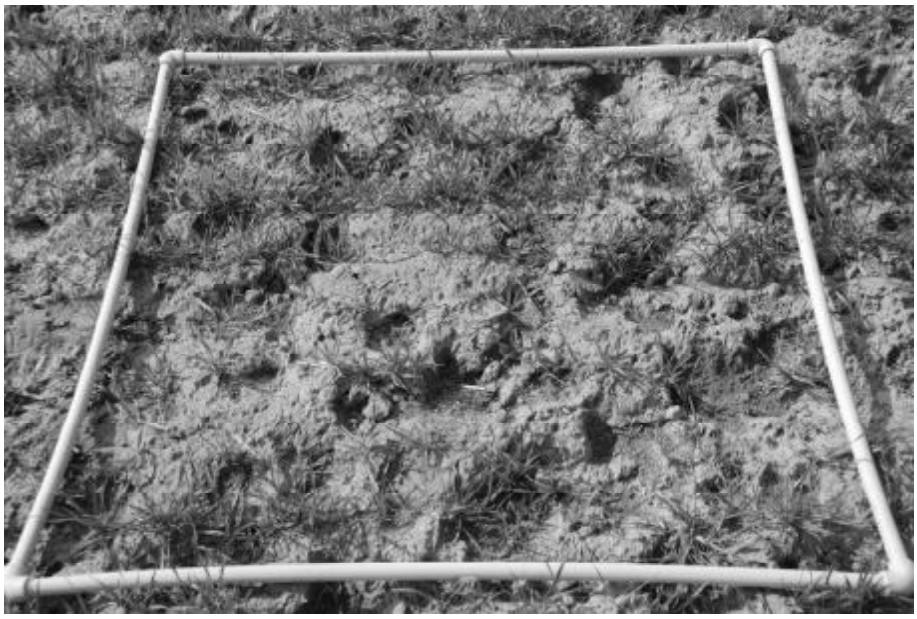

Figure 32.3 Grazing and trampling of winter wheat field by wild boars (photo by Michał Wójcik).

area the population of wild boar inhabited 65,600 ha of farmlands, meaning that damage caused by this species constituted 0.41–0.63 per cent of the total crops area.

In a year, wild boar damage is cumulated in early spring summer and late autumn (Schley et al. 2008; Labudzki et al. 2009; Frąckowiak et al. 2012; Kniżewska & Rekal 2015). Results obtained in north-eastern Poland (Bobek et al. 2017) showed that in March and April, most of the wild boar damage occurred in rape fields, as well as in grasslands and pastures (Figure 32.2) and cereal crops (Figure 32.3); in May, damage occurred in fields of young maize, grasslands and pastures. In July and August, the prevailing damage occurred in cereals, primarily wheat; in September and October, maize was most heavily affected (Figure 32.4, Figure 32.5). In Italy, a somewhat different pattern of annual dynamics of wild boar damage was reported by Amici et al. (2012). A cluster analysis for the area indicated two periods when levels of wild boar damage were at their highest. In August, the damage caused by wild boar occurred chiefly in the fields of sunflowers, maize, hazelnuts, chestnuts, and in vineyards. In September, cereals and potatoes are damaged. In Croatia, the highest intensity of wild boar damage was noted from August to October. Grasslands in both of these countries were damaged throughout the year, and the amount in crop losses was highest in winter or autumn (Amici et al. 2012; Novosel et al. 2012), similarly in the UK (Wilson 2004).

Figure 32.4 Wild boar damage in maize field (photo by Michał Wójcik).

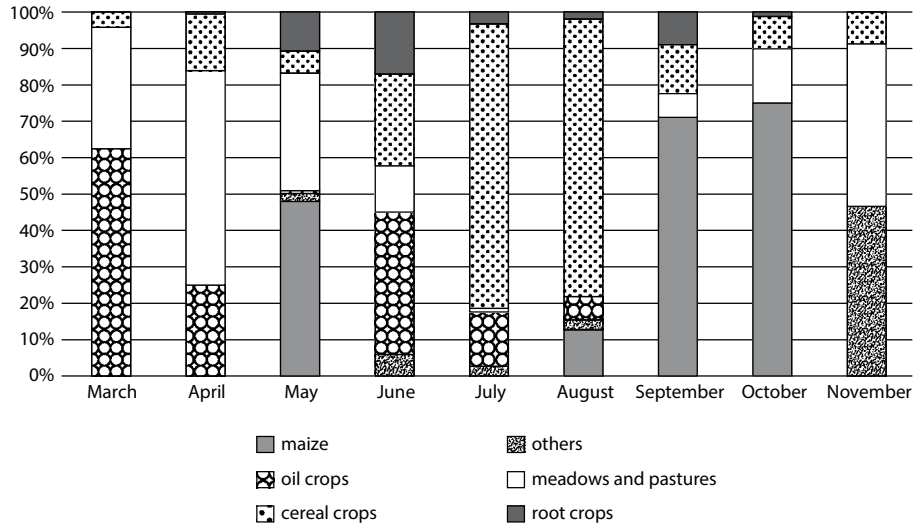

Figure 32.5 Agricultural crops damaged by wild boar over three years (2011–2013) in north-eastern Poland. Percentage of various crops damaged during every month is given in bars (Bobek et al. 2017).

Damage Compensation

In the European Union and Switzerland, compensation for wild boar damage is paid to farmers in all Member States where this problem occurs except Portugal, Finland, and Sweden. The expenses related to compensations are borne by the leases and owners of hunting districts. The amount of compensation is calculated on the basis of the area of damaged cultivation and the market value of the crop. As regards grasslands and pastures, the value of destroyed grass production is augmented by the cost of restoring the soil uprooted by wild boar (Figure 32.6). Very often, in order to receive compensation the affected farmer is obliged to undertake actions to reduce the level of damage, e.g. in Switzerland it involves fencing maize fields (Geisser & Reyer 2004).

Farmers in Japan are also covered by a compensation system for wild boar damage, but there the payments are made by the local state administration. In China, compensation is only paid in some provinces (Zhang et al. 2009). Compensation is paid by the local state administration. Farmers in the Russian Federation are not entitled to compensation for wild boar damage.

The amount paid to farmers as compensation for wild boar damage is very diversified in particular countries of the European Union. In Luxembourg, the average compensation per case of damage amounts to €397.0, whereas it is €477.0 in Croatia, and €2132 in Italy (Schley et al. 2008; Amici et al. 2012; Novosel et al. 2012). In Poland it is only €317 (Bobek et al. 2017). In Luxembourg, compensation for one hectare of damaged maize amounted to €1252, whereas for one hectare of damaged

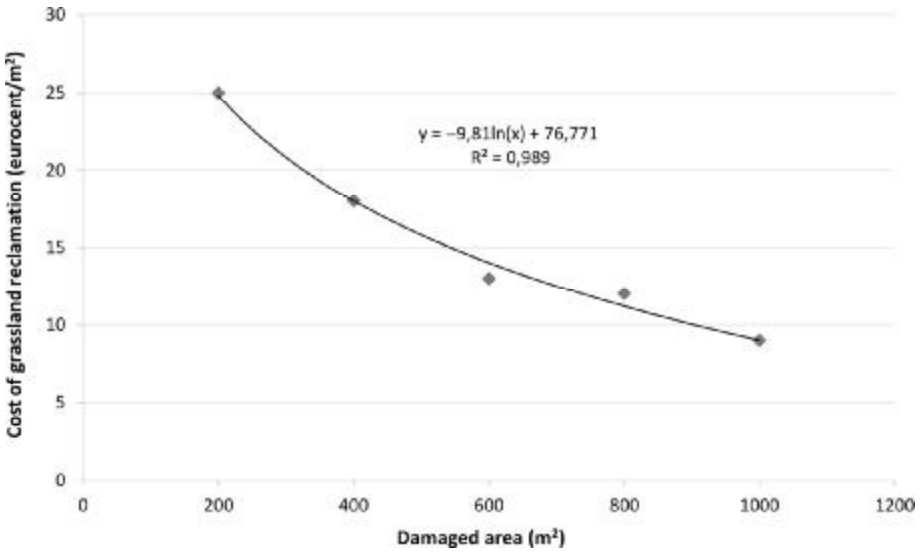

Figure 32.6 Cost of grassland reclamation (eurocent/m²) in relation to size of damage by wild boar (G. Lissmann, unpublished data).

grasslands it reached up to €1559. In Poland the amounts were markedly lower at €250 and €700, respectively (Bobek et al. 2017). The differences most likely stem from the lack of standardization of the methods for damage assessment, as well as from the differences in prices of crops and in the costs of labour in the reclamation of grasslands.

The statistical data on compensation for damage caused by wildlife in particular countries does not provide for the proportion of damage caused by wild boar, although it is known that it is the species that causes most damage to crops. In France, annual compensation for damage in fields ranges from between €45 million and €50 million (Guilbert 2011), in Germany €30–40 million (Lissmann 2011), whereas in Poland €12–18 million (Budna et al. 2007; Grzybowska et al. 2014). According to Guldemond (2015), the damage compensation in the Netherlands ranged between €160,000 and €250,000. In Japan, where the total population of wild boar is estimated at around 900,000, the sum of compensation per annum is around €80 million. In accordance with data from the Ministry of Environment, in 2012, wild boar damaged a total of 37,500 tonnes of crops, of which root crops constituted 34.6 per cent, rice 29.1 per cent, and vegetables 17.6 per cent. Damage caused by wild boar constitutes a severe problem in China where the population of this species is estimated at around 10 million animals (Jianbin Shi, Beijing Normal University, China, personal communication). Statistical data reports that in 2003 in Fujian province wild boar damaged 302,000 ha of farmland and orchards, i.e. 14.1 per cent of all areas involved in the production of plant crops. Losses in rice production were calculated to be 139,600 tonnes, and the total value of damaged crops was €27.2 million (Chen 2006).

The level of compensation paid to farmers in the European Union for wild boar damage is not known because the statistical data pertaining to damage caused by wildlife in farmland in particular countries do not separate the damage exerted by wild boar. The data are usually given as a combined figure for all species (deer, wild boar, badgers). Nevertheless, it is known that in Poland the amount of compensation paid out per one wild boar bagged amounts to €124.2 (Bobek et al. 2017); in Luxembourg, €133.3 (Schley et al. 2008); and €58.3 in Germany (Hohmann, unpublished data). The number of bagged wild boar in EU countries is around 3 million animals per year (Massei et al. 2015). If it is assumed that the average value of compensation (€105.3) per one wild boar bagged is representative for all EU countries, it means that the level of compensation for the crops damaged by these animals can reach some €315.9 million.

Conflicts between farmers and hunters during the process of assessing wild boar damage occur primarily on the issue of area of damage. The lack of competence of the damage assessor is often an additional element to these arguments. When combined with incorrectly prepared documentation, it results in the increased number of cases submitted to courts. For the above reasons, there is an urgent need to introduce unified methods of damage assessment by standardizing the process of settling claims. The experience of Germany and France provide an example of satisfactory solutions. In France, there are some 700 experts whose responsibility is to measure the area of damage, whereas the establishing of crop price indexes is the task for a local commission comprised of farmers and hunters. In both the aforementioned countries, there is a procedure for the training of assessors and awarding the rights to assess cases of damage. The procedure guarantees the reliability and professionalism of measuring the damaged area, as well as possible mediation between the affected farmers and the hunters and it is common in most European countries. The analysis of claim assessment procedures for game-related damage results in only a low number of court cases, which are the last resort for settling disputes (Wójcik & Hołoś-Krajewska 2008).

Factors Affecting the Level of Crop Damage

Publications dealing with the features of wild boar damage unambiguously indicate that the prime factor affecting the level of damage to farmlands caused by wild boar is the population density of the species. This relationship has been sufficiently proven using statistical methods (Amici et al. 2012; Bleier et al. 2012; Frąckowiak et al. 2013).

Another important factor that determines the amount of wild boar damage is the distance of the damaged site from the farmland–forest border. Both the area of damaged crops and the frequency of their occurrence decreases dramatically with increased distance from the border with the forest (Genov et al. 1995; Calenge et al. 2004; Cai et al. 2008; Amici et al. 2012). In Sweden, wild boar use grasslands and pastures for foraging within a belt that is several tens of metres adjacent to the forest (Thurfjell et al. 2009). According to Morelle and Lejeune (2015), the probability of wild boar damage to farmland is high within several tens of metres, and the highest distances of sites with damaged crops do not exceed 900 m. However, beyond this distance there is a remarkable decrease in the amount of damage caused by wild boar. The above-described pattern of the spatial distribution of crops damaged by wild boar results from the foraging of part of the wild boar population living in the farmland–forest environment as well as those animals not living in forested areas during the vegetation season, and those which use maize fields as hiding cover (Keuling et al. 2009).

The analysis of factors affecting the level of wild boar damage, conducted on 2.2 million ha of forests and farmland in north-eastern Poland demonstrates that the level of damage in farmland increases with increases in the wild boar population density index, the length of farmland–forest border, and Simpson's biodiversity index calculated for the proportions of predominant tree species. The model explained 55.6 per cent of the diversity in the levels of studied damage. Of this, the proportion of population density explained was 44.6 per cent while the length of the farmland–forest border was 4.7 per cent and the biodiversity coefficient 6.5 per cent (Frąckowiak et al. 2013). Drozd (1988) also showed a positive correlation between the index of farmland–forest border length expressed in km/ha and the level of wild boar damage in central-eastern Poland.

In the farmland–forest mosaic of north-eastern Poland, the number of crops damaged by wild boar decreased dramatically in line with the increased distance from the farmland–forest border. The average distance amounted to 332 m, whereas the maximum distance was up to 1700 m. In 20 analysed hunting districts, the home range of the local wild boar population, determined on the basis of locations of damaged crops and the length of farmland–forest border, covered an area of 65,600 ha, of which nearly 60 per cent were farmlands. The width of the belt in fields where wild boar foraged, determined by the equation of linear regression ranged from 200 to 600 m from the farmland–forest border, and increased with the lowered proportion of forest in the home range of wild boar (Bobek et al. 2017). The increase in the proportion of forested area in the home range of wild boar significantly reduced the level of damage as the fertile deciduous and mixed forests are intensively uprooted by boar because of the high density of rodents, invertebrates and herbs (Plisko 1965; Tumidajowicz 1971; Bobek 1973; Faliński 1986). The damage caused to farmlands was positively correlated with the wild boar population density. The multiple regression model covering the effects of wild boar population density and the proportion of forested areas in the home ranges explains 57.3 per cent of the variation in level of damage caused by wild boar in the analysed hunting districts, with population density explaining 41.9 per cent, and the proportion of forested areas in home ranges 15.4 per cent (Bobek et al. 2017).

The level of wild boar damage also depends on the species composition of crops. On the one hand, there are higher proportions of maize, wheat, and potatoes that appear to be damaged than would be suggested by their availability in the fields (Bleir & Szemethy 2003; Herrero et al. 2006; Cai et al. 2008). On the other hand, trichomatous crops such as barley, oat, and rye are foraged by wild boar in lower proportions than that resulting from their availabilities (Schley et al. 2008). It seems, however, that some varieties of wheat and potatoes can only be foraged by wild boar to a low extent (Kubacki 1972). Environmental factors also play a significant role in wild boar feeding on farmlands. The level of damage rises when farmlands are situated close to water sources whereas they drop near roads and human settlements (Honda 2007; Cai et al. 2008). Crops cultivated on wet soils are more exposed to foraging by wild boar than these growing on medium and dry soils (Jelenko et al. 2013; Li et al. 2013). Level of damage caused by wild boar increases in low-yield years resulting from the lack of sufficient precipitation (Cai et al. 2008).

Impact of African Swine Fever

The occurrence of African swine fever (ASF) in wild boar can have an enormous impact on the change in game management of this species across the countries of the European Union. In 2007–2008, the first foci of ASF epidemics emerged within the European part of the Russian Federation. However, it was only from 2012 onwards that ASF epidemics have started to spread more widely into countries bordering the Russian Federation (Makarov et al. 2014). At present, ASF has been found in wild boar populations in Belarus, Estonia, Lithuania, and Latvia (Pagani & Rijks 2015). The ASF epidemics occurring among wild boar in Lithuania (Pileviciene et al. 2016) have initiated the spread into wild boar populations living in eastern Poland (Pejsak et al. 2014; Podgórski 2016). This has resulted in enormous economic losses in farms as the ASF virus is transmitted on to domestic pigs via various routes. Under the binding regulations, the piggeries where the ASF virus has been detected had to be liquidated and their owners received appropriate compensation from the state budget. There are no precise data pertaining to this compensation, but it is likely to exceed the level of compensation paid to farmers for damage caused by wild boar on farmland.

Methods to Reduce Damage Caused by Wild Boar

Regulation of Population Density

The theoretical foundations for resolving human–wildlife conflicts indicate that one of the significant factors affecting the intensity of the conflicts is the population density of wildlife

species (Conover 2002). This view is shared by a great number of game biologists involved in studying wild boar damage in cultivated fields (Goryńska 1981; Schley et al. 2008; Amici et al. 2012; Bleier et al. 2012; Frąckowiak et al. 2013). It can thus be calculated what the effect of reducing the wild boar population number will be on the level of harm exerted on crops. For example, such calculations made for north-eastern Poland indicate that reducing the population density from 79 to 50 individuals/1000 ha of forest should lead to a decrease in the area of damaged farmland by some 38 per cent (Bobek 2016). Unfortunately, there are no published data showing the actual reduction in wild boar damage following the reduction in population density. Serious doubts can be raised as such data have never been published. The only fact is that an uncontrolled by hunters increase in the numbers of wild boar has been observed across Europe.

One of the methods used to combat the spread of the ASF virus is to reduce the number of individuals of wild boar. In accordance with the European Union directive, in areas where ASF occurs the wild boar population density should not be higher than 0.5 individuals/km^2 of hunting district. In connection with the above, the Polish Ministry of Agriculture and Rural Development issued a regulation imposing the obligation on hunters to reduce the population density of wild boar in the whole country to the level of 0.5 individuals per 100 ha of hunting district (Journal of Laws of 24 February 2016, item 229, clause 1). In Poland, a national inventory has begun in more than 8000 sampling plots each with an area of about 100 ha.

The results of this exercise will be used to determine the size of the hunting bag which, in 2–3 years, will bring the densities of wild boar populations down to the level provided in the European Union directive. It is estimated that the target number of wild boar in Poland after 2–3 years will thus be around 120,000, i.e. it over a threefold reduction from the current number of this species. The relevant law adopted a change in the hunting laws and envisages imposing financial penalties on hunters for not meeting the quotas of wild boar hunting bags contained in the plans given by the state administration.

In the opinion of Massei et al. (2015), the increase in the number of wild boar in Europe has stemmed from the reduced number of hunters. The high population densities of wild boar were not only the simple result of a reduced number of hunters, as there are regions where maintaining high population densities brings major profits to hunters (sales of wild boar meat, organizing collective hunts, renting single hunting opportunities), exceeding the compensation paid to farmers for wild boar damage. In Poland, the calculations of fiscal balance in wild boar game management in 26 hunting districts covering an area 1872 km^2 indicate that if the costs of winter feeding aimed at developing a network of baiting stations are disregarded in the calculations, then the compensation payments to farmers for damage caused by wild boar on farmland will consist of 75.8 per cent of the net income from wild boar meat sales and organizing collective hunts (Table 32.2). The existing conflict between farmers and hunters is fuelled by farmers' lack of participation in the profits from wild boar hunts conducted on their private land. In some regions in Western Europe an even greater discrepancy occurs between the payments associated with renting the wild boar hunting right and the level of compensation for damage caused by wild boar on farmland (Hohmann 2014). The compensation for wild boar-related damage on farmland only amounts to 10.0–45.0 per cent of the payments connected with wild boar hunts in Baden-Württemberg, Luxembourg, Alsace, and North Switzerland (Table 32.3). Thus, in times with high population levels, comparing the average income provided by landowners to the average damage compensation costs, the presence of wild boar might be more beneficial than harmful. The above-mentioned figures indicate that, especially for hunters in Western Europe, wild boar could have a market value that exceeds costs by far.

Barrier Feeding Site Strips

The supplemental feeding of wild boar during the vegetation season is a frequently used method to presumably limit the level of damage caused by these animals in cultivated fields. It is mostly done on long strips delineated in forests where fodder attractive to wild boar is provided. It is assumed that wild boar spend a certain portion of their foraging activity there and thus this decreases the pressure of foraging on crops. However, the results of relevant studies have been rather ambiguous. Some studies indicate that using the barrier feeding strips reduces damage to fields caused by wild boar (Andrzejewski & Jezierski 1978; Vassant et al. 1992; Calenge et al. 2004), whereas other publications show the lack of correlation between supplemental feeding in summer and the amount of wild boar damage (Hahn & Eisfeld 1998; Geisser & Reyer 2004; Frąckowiak et al. 2013). The barrier strips can likely limit the damage when population density is low and stays below 50 individuals/1000 ha of forest (Andrzejewski & Jezierski 1978). The area of the barrier strips is large and the fodder is offered at a large distance from the farmland–forest border and continues for a long time. The costs of such operations can, however, be equal or even outweigh the financial advantage from the reduction in wild boar damage (Calenge et al. 2004).

Table 32.2 Fiscal balance of wild boar management in north-eastern Poland (€ × 10^3/1000 ha of forest) – mean for three hunting seasons (2011–2013). The data represent 26 hunting districts and include net income from carcass sales and collective hunt fees, as well as expenditures associated with damage compensation and winter feeding. The table covers the hunting districts where the fiscal balance of wild boar management is positive, as well as those districts where the fiscal balance is negative (reproduced with permission from Bobek et al. 2017).

Number of hunting districts	Carcass sale	Collective hunts	Total income	Winter feeding	Damage compensation	Fiscal balance
11	2.93	1.61	4.54	0.65	2.35	+1.54
15	1.88	0.74	2.62	1.79	2.45	-1.62

Table 32.3 Comparison between hunting revenues from wild boar in hunting districts and the amounts of compensation paid for wild boar damage on farmland in various regions of Europe. Data are given in € per ha × year^{-1}. Based upon Elliger et al. (2001); Linderoth and Elliger (2002); Schley et al. (2008); Cellina (2008); Hohmann (2014); Schley (unpublished data).

Region	Hunting revenues (HR)	Damage compensation (DC)	DC/HR × 100
Alsace	35	5.6	16.0
Baden-Württemberg	20	2.0	10.0
Luxembourg	18	2.0	11.1
North Switzerland	6	2.7	45.0
Mean	19.7	3.1	20.5

Spatial Distribution of Crops

Depending on the proportion between farmland and forest in the daily home range of wild boar, the width of the foraging zone adjacent to the forested areas usually range from 300 to 400 m (Drozd 1988; Honda & Sugita 2007; Cai et al. 2008; Thurfjell et al. 2009). Thus, the cultivation of crops with high market values should occur outside the wild boar foraging zone in the fields. However, if the foraging zone is situated at fairly large distances from the farmland–forest border and includes agricultural fields, bushy bogs and small tree clumps providing wild boar with hiding cover, then the valuable crops will also be destroyed by wild boar there (Morelle & Lejeune 2015).

Fencing

Fencing should be limited to small areas of crops of high market value that are attractive to wild boar. It primarily pertains to maize, wheat, plantations of decorative plants, or strawberries (Herrero et al. 2006; Schley et al. 2008; Bobek et al. 2017). Fencing with a robust metal wire net, with a mesh size of no more than 10 × 10 cm, should be dug into the ground to a depth of about 20 cm (Hone & Adkinson 1983). Additionally, the fence should be equipped with at least two electrified wires, the first of which should be placed at 20 cm and the second at 45 cm distance from the ground (Figure 32.7).

Fencing is an expensive investment; therefore, the value of damage to a given crop and the cost of fencing must be carefully balanced (Conover 2002). The wide-scale use of fencing in Switzerland has not produced the expected results in terms of reducing wild boar damage (Schley et al. 2008). In Slovenia, however, the use of combined polywire-polytape electric fencing eliminated all damage to fenced maize fields, but brought about increased damage to unfenced farmland crops (Vidrih & Trdan 2008).

In summary, the design of fencing should assume the complete halting of wild boar access to the protected crop. Metal wire net fencing without additional security provided by electrified wires, or using sole electric fencing, does not meet the requirements for effective protection of crops against wild boar.

Odour and Gustatory Repellents

At present, there are many repellents that are supposed to reduce crop damage caused by wild boar. However, the majority do not possess credible certificates proving their efficiency and effectiveness in crop protection. In Switzerland, Schlageter and Haag-Wackernagel (2012a, b) verified the lack of suitability of gustatory and odour repellents for the protection of crops from wild boar. An experiment carried out in China with repellents based on tiger faeces and urine also failed to give positive results (Zhang & Liu 2012). The effect of repellent is usually limited to several days. After this time, the animals get used to the chemical substances used in repellents and forage in the fields 'protected by' odour or gustatory repellents.

Acoustic and Optical Deterrents

Various kinds of acoustic scarers, such as cannon firing, electronic sound generators, and wild boar alarm calls are used to repel wild boar (Massei et al. 2011). All such devices are effective for several days only. The same holds true for optical deterrents (Schlageter & Haag-Wackernagel 2011). Only night foot patrols organized by local farmers are effective in protecting crops against wild boar (Cai et al. 2008; Thapa 2010), but this measure greatly increases the costs of crops, and cannot be applied in countries where the cost of labour is high.

Concluding Remarks

Throughout Europe, northern, central, and east Asia, an increase in the number of wild boar uncontrolled by hunters has been observed (Markov 1997; Ohtsuka-Ito & Kanzaki 1998; Danilkin 2002; Danilov 2009; Apollonio et al. 2010; Massei et al. 2015). Therefore, the conflict between humans and wild boar has intensified year by year. This conflict has both financial and psychological dimensions (Galhano-Alves 2004), as some farmers are deeply frustrated when they observe the destruction to their crops caused by wild boar. Public opinion, particularly in farming communities, is negative towards wild boar, which is regarded as a pest species. In areas where wild boar damage levels are high, there are frequent demands for the total extermination of wild boar (Ma 2008; Li et al. 2010c). The cost of the total extermination of wild boar can be, however, markedly higher than the value of damage caused by this species on farmlands (Saito et al. 2012).

The review of research material published on the conflicts between farmers and wild boar clearly indicates that the reduction in the level of damage caused by these animals on farmlands must be coupled with the reduction of population density. Thus, it is an urgent task for both wildlife biologists and public administrations aimed at developing methods of estimating the wild boar population density as well as of empirical studies on the annual net increase. These methods should be both credible and easily applied in practice.

The lack of effective solutions to the issue of controlling wild boar population density stems from the actions of hunter lobbies in all EU Member States. These lobbies are stronger and better organized than the groups of farmers who suffer losses

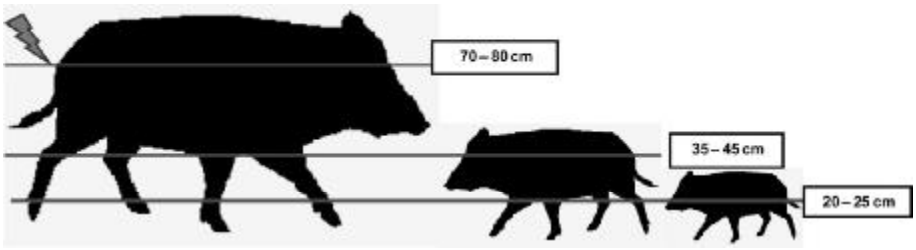

Figure 32.7 Recommended distances between electrified wires that are used to prevent the access of wild boar to agricultural fields (reproduced with permission from Wójcik & Hołoś-Krajewska 2008).

and demand the limitation of damage caused by wild boar to farmlands.

The implementation of balanced game management for wild boar is possible and most probable in European Union countries by enacting a relevant Directive. The Directive should obligate Member States to maintain a suitable wild boar population density at which the level of damage is tolerable to local farming communities (Hearn et al. 2014), and also to apply credible methods for estimating the population numbers, as well as to arrive at an empirically established annual net increase in population. Therefore, in particular EU Member States, significant changes must be made to laws regulating wild boar game management issues. In all places where the population numbers of wild boar are on the increase or stay at high densities due to the insufficient commitment of hunters, it will be necessary to involve professional hunters paid for by users or owners of local hunting districts. In areas where hunters are not interested in reducing overcrowded populations because of the high income generated from organizing wild boar hunts, it will be advisable to trigger restrictive legislative mechanisms forcing the owners and users of hunting districts to attain population densities determined by the state administration. The regulation of numbers in overcrowded populations of wild boar will also solve other problems associated with the impact of these animals on the natural and urbanized environment.

The current wild boar population management practices within the EU are chaotic, ambiguous (Cellina 2014; Cavagnuolo et al. 2015; Settimio et al. 2015), and generate conflict in a number of different areas important to humans. They are not in accordance with the provisions of the European Charter on Hunting and Biodiversity which was formulated in 2007 upon the initiative of the Council of Europe. The Charter presents obligations on hunters as the hunts have been considered an effective method for using natural resources. The concept of sustainable game management was defined there as 'the use of game animal species in a way which should not lead to a reduction of the biodiversity of species and their habitats'.

The official sources within the state administration report that the ASF virus now occurs in wild boar living in central Poland and is spreading to the west. It is probably only a matter of time before the ASF invasion spreads to the wild boar populations living in the countries of Western Europe (Germany, France, and neighbouring countries). This development will thus force the state administration to undertake drastic legislative changes leading to a reduction in the number of wild boar. This may mean that the past relationship between wild boar hunting revenues and the amount of damage produced by wild boar on farmland will be modified by new principles in wild boar game management.

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