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TEMPOROSPATIAL CHARACTERISTICS OF WILD BOAR ROOTING DAMAGE IN MAIZE FIELDS

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ABSTRACT
Damage caused by game species in agricultural areas has increased in recent decades in Hungary. This trend is causing significant conflicts between wildlife managers and farmers. In maize fields, rooting damage by wild boar after sowing is a major concern. We aimed to study which factors can influence the occurrences of the damage The study was carried out in Győr-Moson-Sopron county, north-western Hungary, on a 6000 ha hunting area for two years. The forest cover is approximately 20%, and the wild boar harvesting averaged 118 individuals in the two years of the study. We visited the maize fields periodically after sowing. We measured the maximum distance of the rooting damage from the field edges to the inner parts of the field in every 20 m, and we measured the length of the damaged edges as well. We also surveyed the crop in adjacent fields. We recorded the number of hunting occasions and hours spent hunting. These were used to determine the spatial and temporal patterns of rooting damage, as well as the effects of hunting pressure and the impact of adjacent areas. It was found that the distance of rooting damage from the field edge was 23 meter on average and the maximum observed was 150 meter. It can be observed that 90% of the rooting damage remained within 50 m of the edge. The survey of the edges showed that of the total 8272 meters of available edges, 3205 metres were damaged, representing 38.7%. The most preferred edge for damage was rape, followed by forest. During the study, the hunting pressure applied to control game damage kept damage low (first year: 5.5 hours/night, second year: 3.7 hours/night). In the first year, the average area which affected by damage was 1.3 ha, represents an area ratio of 3.5% of the total area. In contrast, in the second year, the average was 0.03 ha, representing 0.18% of the total area. The negligible damage in the second year was due to the start of hunting immediately after sowing. In contrast, in the first year, hunting started after the first damage had occurred.

Keywords: human-wildlife conflict, hunting, mitigation method, edge effect,

INTRODUCTION

The wild boar (*Sus scrofa*) is one of Europe's most widely distributed large mammalian game species. Populations have been increasing across Europe in recent decades (MASSEI ET AL. 2015). This trend has also been observed in Hungary. The population increase also caused a change in spatial distribution, resulting in wild boar occurrence also in low forest cover lowland habitats. Following the emergence of African Swine Fever (ASF) in 2018, the estimated number of animals decreased significantly due to mortalities, diagnostic shooting and increased harvesting numbers (CSÁNYI ET AL. 2021). However, even at low densities, problems caused by wild boar should be expected. These problems include: damage caused by acorn consumption in forest habitats (GRÓF ET AL. 2012), damage caused by rooting in grasslands (COCCA ET AL. 2007), presence in urban areas (TARI ET AL. 2016) or wildlife-vehicle collisions (KRUUSE ET AL. 2016). Furthermore, wild boar damage in agricultural areas is very significant (BLEIER ET AL. 2012). Even at low population densities the damage to be paid can be significant, due to increased cereal prices. The crop most exposed to damage is maize, which is damaged by wild boar from sowing (BOYCE ET AL. 2020). Several methods are used by farmers to mitigate damage, such as wire fences and electric fences (LAGUNA ET AL. 2022), chemical repellents (SCHLAGETER AND HAAG-WECKERNAGEL 2012), visual disturbance (SCHLAGETER AND HAAG-WECKERNAGEL 2011) or acoustic devices (SUTER 2013). The most common mitigation method against wildlife damage is hunting during periods of damage risk (GEISSER AND REYER 2004). The aim of this research was to determine the spatial and temporal characteristics of wild boar damage in maize fields, including the influence of hunting and habitat structure.

MATHERIALS AND METHODS

Study area

The study was carried out over two years (2019, 2020) in north-western Hungary, in Győr-Moson-Sopron County (N47°33'36"; E17°36'12"), in a 6000 ha hunting area. 10% of the area is not part of the hunting area (inhabited area, road, etc.). Approximately 65% is under agricultural cultivation, the crops are maize (*Zea mays*), rape (*Brassica napus*) and cereals (*Triticum aestivum*), with no significant proportion of grassland. The forest cover is approximately 20%, with black locust (*Robinia pseudoacacia*), sessile oak (*Quercus petraea*) and turkey oak (*Quercus cerris*) being the typical tree species. The area is typically a hunting ground for big game. Red deer *(Cervus elaphus)*, roe deer *(Capreolus capreolus)* and wild boar can be found. Wild boar harvesting averaged 118 individuals in the two years of the study.

Study design

Three maize fields per year were included in the study. The size of the fields varied between 31 ha and 64 ha. After sowing, the fields were visited 3 times until emergence. The interval between visitations was 5-9 days, depending on the germination rate of the seeds. During each control visitations, the entire perimeter of the fields has been checked. Stopping every 20 meters along the perimeter of the field, the maximum distance of the rooting damage from the field edge to the inner parts of the field was recorded, using a handheld GPS device. The length of the damaged field edges were recorded as well. During data processing, the extent of the damaged edges and the maximum distance of the rooting damage from the edges were determined by use of QGIS software (QGIS.ORG, 2022). Using this two parameter, the area affected by damage (ha) was calculated. In addition, hunting activities and their duration were recorded. Hunting pressure was calculated using the hours spent with hunting, and the number of the night between two control visitation. The habitat type of the areas adjacent to the surveyed maize fields (*forest, maize, cereals, rape, grassland*) was recorded. The Jacobs-index (D) (JACOBS, 1974) was used to analyse the edge effect on rooting damage and to identify the preferred habitat edges. It's formula is D=(utilization-availability)/(utilization+availability-2*utilization*availability). Where availability was the proportion of different habitat edges length in relation to the total perimeter of field. Utilization was the ratio of different damaged habitat edges length to the total damaged perimeter of field. is the ratio of each habitat type based on the total length of the edge and is the length of the damaged edge. The index can take a value between 1 and -1, where one represents preference and -1 represents avoidance. For statistical analysis, Past4 (HAMMER, 2001) software was used.

RESULTS

Different results were observed for the extent of the damage in the two years of the study. In the first year, the average area which affected by damage (ha) was 1.3 ha (±SD 0.6 ha), represents an area ratio of 3.5% (SD±1.3%) of the total area. In contrast, in the second year, the average was 0.03 ha, representing 0.18% of the total area. The average hunting pressure (hours hunted/night) was 5.5 in the first year and 3.7 in the second, with no difference between the two years (Mann-Whitney U test, p=0.596). However, a difference in hunting dynamics was found. In the first year, hunting pressure increased as the value of damage per night increased between control periods, but this was not found to be significant (Spearman Rank correlation, r=0.589, p=0.096). In the second year this trend was not observed (Spearman Rank correlation, r=0.173, p=0.656). For the spatial characteristics of rooting damage, results were based on data from the first study year as damage was negligible in the second year. It was found that the distance of rooting damage from the field edge was 23 meter on average and the maximum observed was 150 meter. There was no significant difference between the three control visitations (Kruskal-Wallis test, H=4.896; p=0.086). The frequency of rooting damages as a function of distance from the edge is shown in *Figure 1.* It can be observed that 90% of the rooting damage remained within 50 meter of the edge.

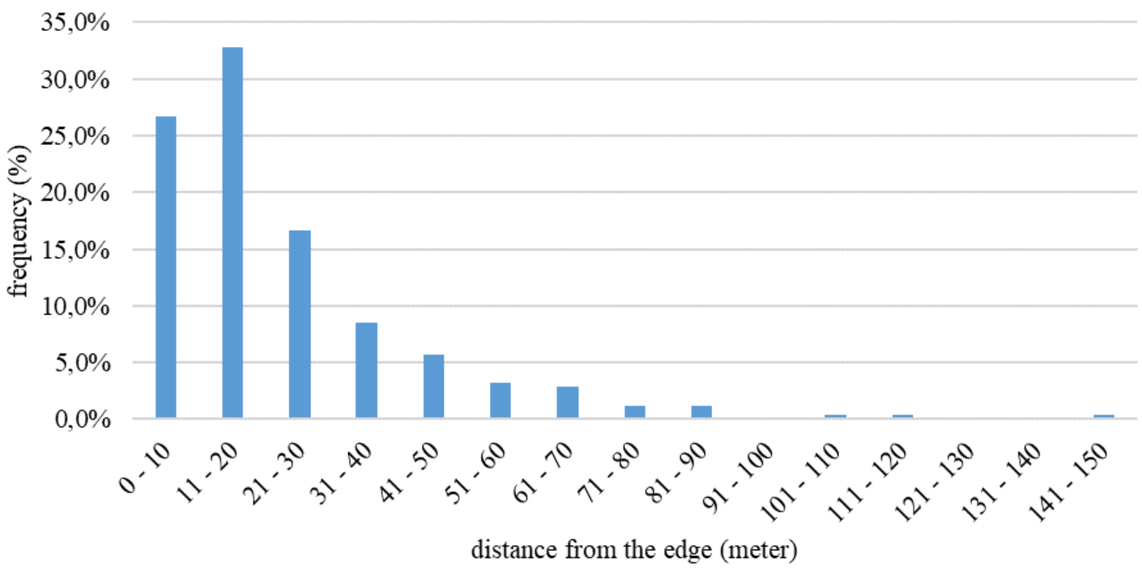

Figure 1: The frequency of rooting damages as a function of distance from the field edge

The survey of the edges showed that of the total 8272 meters of available edges, 3205 metres were damaged, representing 38.7%. *Table 1.* shows the proportion of availability of edge types, the distribution of rooting damage by edge type and the preference for each type.

Table. 1: Results of analysis of damaged edges

	Forest	Maize	Cereals	Rape	Grassland
edge availability (%)	35.84%	19.73%	22.75%	16.88%	4.80%
distribution of damage (%)	48.80%	4.59%	10.45%	36.16%	<0.01%
preference (Jacobs-index)	0.2608	-0.6728	-0.4323	0.4723	-1

It can be seen that the highest proportion of wild boar damage occurred in the edges bordering the forest. The second highest proportion of damage occurred at the edges bordering the rape; then cereals, maize and at last grassland. For preference, the former order has changed. The most preferred edge for damage was rape, followed by forest. For grassland, avoidance was observed with low availability

DISCUSSION

Based on the results of the study, it can be concluded that several factors influence the occurrence of wild boar damage in maize fields. During the study, the hunting pressure applied to control game damage (first year: 5.5 hours/night, second year: 3.7 hours/night) kept damage low. However, it can be concluded that the hunting which started at an early stage, further increased the success rate of rooting damage control. In the first year of the study, hunting pressure followed the increased occurrence of damage. Hunters began hunting as damage appeared and increased hunting pressure as damage increased. In contrast, in the second year of the study, hunting was started on the day of sowing (damage appeared not yet). The change in damage control strategy caused a reduction in damage in the second year. In terms of the spatial pattern of damage, 90% of the damage occurred within 50 m of the field edge. Several wildlife damage studies in Hungary have shown that agricultural fields bordering forests are more affected by damage (Barna et al., 2007; Bleier et al., 2006). The incidence of damage decreased away from the forest edge (Bleier, 2014). Making it particularly important that the hunting high seats used for protection are primarily placed in the field edges and only placed inside the field when justified by the topography. Regarding the placement of the hunting high seats, the results of edge preference analysis suggest that it is not sufficient to place hunting high seats only and exclusively in the edges bordering the forest. The edges of the fields bordering other habitat types should also be included in the protection. The Jacobs index results show that the most preferred edges were those bordering rape, followed by the forest borders. Wild boars moving from resting areas in the forest have chosen alternative routes due to hunting pressure (disturbance) which concentrated at the forest edge. Rape is able to provide adequate cover, however, low crops with less cover (grassland, maize, cereals) were avoided. Based on these findings, it is necessary to review the position of hunting high seats used for wild boar control depending on the changes in the crop structure over the years. Where necessary, mobile hunting high seats should be installed. Overall, it can be concluded that the damage caused by wild boar in maize fields can be reduced by intensive hunting pressure, started at the same time as sowing, and with an appropriate network of hunting high seats.

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