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ORIGINAL PAPER

The winter preferences for different forest habitats by wild boar *Sus scrofa* estimated using the track counting method

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ABSTRACT

Wild boar *Sus scrofa* L. winter selection among (1) different types of forest sites, (2) dominant tree species, and (3) age of stands was examined using the line transect method. The research was conducted over 125 km^2 of managed forest in the Myślibórz Forest District in northwestern Poland. The habitat preferences of wild boar were determined by the non-invasive method of counting tracks on line transects. Transects with a length of ~77,000 m were surveyed in January or February 2002, 2003, 2005, and 2006. Tracks of wild boar were recorded by GPS, with an automobile odometer and recorded for 6 types of forest sites, 4 classes of stand ages, and 3 dominant canopy species. The research included only those fragments of transects that had the same type of forest on both sides. Finally, wild boar tracks were counted on transects with a total length of ~24,000 m. During the winter, wild boar more often penetrated both young forest stands (up to 20 years old) and the oldest (60 years and older) stands, in association with resting sites and the availability of food in the upper layers of the soil. Middle-aged forest stands (20-60 years old), due to their structure, provide neither optimal protection nor maximum food resources, so they were the least penetrated by wild boar. In terms of canopy species, wild boar penetrated old stands dominated by oaks and beeches, where there are acorns and beech nuts in the upper layers of the litter. The greatest numbers of tracks were found in alder forests, perhaps because these provide trophic and protective conditions for wild boars during mild winters. The importance of different types of forest sites in the winter ecology of wild boar requires further research.

KEY WORDS

commercial forestry, forest structure, line transects, snow tracks, wildlife management

Introduction

Wild boar *Sus scrofa* L. are among the most numerous wild omnivores in Poland. Their numbers in the post-war period increased more than tenfold (Fruziński and Łabudzki, 2002). Their range and the diversity of environments colonized by this species also increased. Initially, they were typically forest animals preferring old oak stands (Haber, 1966). However, in Poland as well as in other regions of Europe, wild boar have gradually settled in agricultural landscapes and in recent

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decades also in urban environments (Cahill *et al*., 2012; Rutten *et al*., 2020). The expansion of wild boar territory is probably related to two basic phenomena. Firstly, wild boars are highly adaptable to changing landscape conditions (Castillo-Contreras *et al*., 2018). Secondly, as omnivorous food opportunists, wild boar are very effective at using a food base that is diverse in quantity and quality and is very often of anthropogenic origin (Genov, 1981; Wlazełko *et al*., 2009; Nasiadka, 2019). Agricultural landscapes feature some of the largest seasonal changes and this significantly affects wild boar activity patterns. Meadows in spring and arable fields in the second half of summer are very attractive feeding places for wild boar during the growing season (Nasiadka and Janiszewski, 2015; Nasiadka, 2018). In winter, wild boar concentrate in forests.

In Poland, 98% of all forests are commercial forests. Their management is subject to the principle of sustainable management of natural resources (Forest Act, 1991; Forestry, 2021), but the impact of human activity on the living conditions of wild boar remains little known (Fonseca, 2008). Systems of timber harvesting and then forest renewal significantly affect the quantitative and qualitative distribution of food resources and cover for wild boar. Forestry work, such as the restoration of clearcuts, clearing plantations, thinning in older stands or logging, as well as the removal of diseased and thickened trees, determines the species composition of stands, depending on the forest habitat type. These actions result in a mosaic of forest types and age classes of tree stands that are composed of various species. Forest management in Poland is conducted based on forest types, the classification of which makes use of soil fertility and moisture content (Bańkowski *et al*., 2004).

In commercially managed forests, the age classes of tree stands affect the spatial-temporal variation of quantity and quality of potential food resources for large herbivores (Dzięciołowski, 1969, 1970; Bobek *et al*., 1994; Siuta, 2006). The species and age structure of a forest also affect local climatic conditions such as temperature, wind speed, and interception of atmospheric precipitation (Tomanek, 1972; Geiger *et al*., 2003; Renaud *et al*., 2011). In winter, the aforementioned environmental variables, the costs of energy expenditures associated with thermoregulation (Grace and Easterbee, 1979; Parker, 1988), and the impacts of human disturbance caused by forest management, hunting, and tourism (Mason, 1998; Sunde *et al*., 2009; Jarnemo and Wikenros, 2014; Thurfjell *et al*., 2014), exert a very significant impact on the energy balance of wild boar.

Knowledge of the habitat and the preferences of wild boar for inhabiting commercial forests can, for example, enable effective planning of forest works (pro-ecological optimization of economic activities) to avoid conflict situations in a difficult winter season for wild boar. Therefore, the aim of this study was to find out the preferences of wild boar for different types of forest sites, age classes of stands, tree species that create the forest canopy, and forests that are potential winter refuges for these animals.

Study area

The research area was located in the Myślibórz Forest District (F.D.) in northwestern Poland (14°30'-15°07' E and 52°55'-53°08' N), ~40 km from the western border of Poland with the German state of Brandenburg (Fig. 1). Forests in the district cover an area of ~125 km^2. These are fragmented complexes scattered over an area of ~675 km^2. There is a total of 86 forest complexes in the Myślibórz F.D. The largest complex has an area of ~70 km^2 and contains 56.1% of all the district forests. Four smaller complexes, from 5 km^2 to 20 km^2, constitute a total of ~30.2% of the area, while the remaining 81 complexes do not exceed 5 km^2 each.

Deciduous tree stands dominate in the area of the Myślibórz F.D. and cover 87.3% of the forest area. Coniferous tree stands constitute 5.2%, and the share of wetland and marshy tree

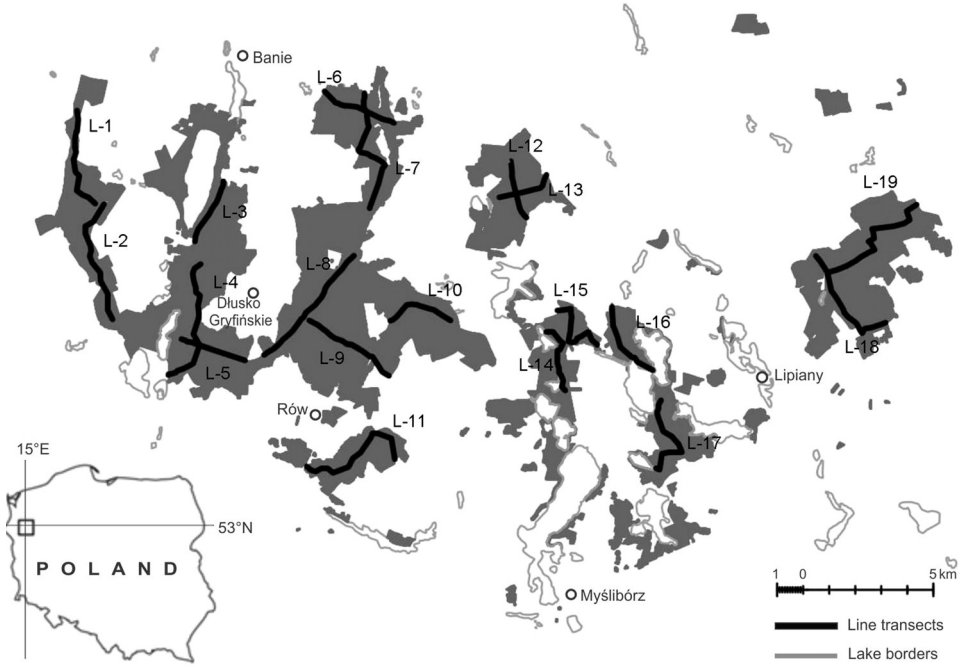

Fig. 1.
The spatial distribution of line transects in forest habitat administrated by the Myślibórz Forest District in northwestern Poland

stands is ~7.5%. The largest area is occupied by fresh broadleaved forest, in which the dominant plant community is *Tilio-Carpinetum typicum* and fresh mixed broadleaved forest with *Tilio-Carpinetum calamagrostietosum* (56.2% and 23.3%, respectively). A smaller area is occupied by moist broadleaved forest *Tilio-Carpinetum stachyetosum*, fresh mixed coniferous forest (*Peucedano-Pinetum* v. with *Oxalis acetosella* L., *Serratulo-Pinetum typicum*), alder forest *Ribo nigri-alnetum* and alder-ash forest *Circaeo-Alnetum typicum*, respectively, 7.6%, 5.1%, 4.0%, 3.4%. The total area of moist mixed broadleaved forest *Querco-Piceetum*, swamp mixed broadleaved forest *Sphagno squarrosi-Alnetum* and fresh coniferous forest *Peucedano-Pinetum typicum* do not exceed 0.5% of the forest area of the Myślibórz F.D.

The forest complexes are surrounded by large areas of relatively fertile arable land on which intensive farming takes place. This agricultural landscape is dominated by maize *Zea mays* L. and winter oilseed rape *Brassica napus* L.

The Myślibórz F.D. area is characterized by relatively warm summers and mild winters. Snowy winters are very rare there. Snow cover and temperatures below 0°C usually last from several days to several weeks at the most. The vegetation season lasts about 230 days, which is among the longest in Poland. The mean annual temperature is +8.4°C, and the mean annual precipitation total is 555 mm (Woś, 1996).

Game management in the Myślibórz F.D. is based on red deer *Cervus elaphus* L., roe deer *Capreolus capreolus* L., and wild boar. The annual average wild boar bag in the study area is 1,241 individuals, *i.e.*, 10.7 animals per km^2. Using the relationship between the population density and harvest rate, Bobek *et al.* (2015) calculated the population density of wild boar as 10.1 animals per km^2 of the study area.

Materials and methods

Studies of habitat selection by wild boar were conducted in 2002, 2003, 2005, and 2006 using snow tracking on line transects. Nineteen transects were placed evenly on the Myślibórz F.D. map (scale 1:25,000). The total length of transects was 76,750 m in 2002, 75,950 m in 2003, 79,500 m in 2005, and 76,400 m in 2006. Transects were located on forest roads and forest compartment lines that were passable for a car. Forest-habitat maps (scale 1:10,000) were used to calculate the lengths of transects that ran through homogeneous forest fragments (*i.e.*, both sides of the transect had the same environment). Three characteristics of the forest were taken into account: forest site categories, age classes, and types of dominant tree species that create the canopy of stands. Finally, wild boar tracks were counted on transects with a length of ~24,000 m: 24,775.0 m in 2002, 24,662.5 m in 2003, 23,962.5 m in 2005, and 23,575.0 m in 2006.

Taking into account the availability of cover and potential food for wild boar, the following age classes of forest stands were distinguished: young stands aged 1-20 years (Y), which provide dens and shelters; maturing stands aged 21-60 years (M) with already limited cover and before the fruiting period; fruiting stands aged 61-100 years (F), which were at the age of intense fruiting (providing seeds and winter food for wild boar), and ripe fruiting stands which were >100 years old (RF), which, in addition to fruiting, had a multi-layered structure providing some cover for wild boar. The dominant canopy tree species were divided into three groups: conifers (C) mainly Scots pine *Pinus sylvestris* L. and, more locally, spruce *Picea abies* (L.) H.Karst., over larch *Larix* sp.; so-called 'heavy seed deciduous' (HSD), *i.e.*, oaks *Quercus* sp. and beeches *Fagus sylvatica* L.; and other deciduous (OD) tree species.

Wild boar tracks were counted in 6 out of 9 types of forest stands in the Myślibórz F.D. because the transects there ran through homogeneous parts of the forest: alder forest (Al-f) – 512 m, alder-ash forest (Al-As-f) – 1,100 m, fresh mixed coniferous forest (FMC-f) – 4,337 m, fresh broadleaved forest (FB-f) – 65,275 m, fresh mixed broadleaved forest (FMB-f) – 20,750 m and moist broadleaved forest (MB-f) – 5,000 m. The transect lengths were proportional to the share of individual habitats in the study area (Spearman $r=0.98$, $p<0.05$).

Accounting for the total length of the transects, slight differences in their length between years, the minimum and maximum length of transect fragments in homogeneous forest patches, and the accuracy of GPS measurements, transects were divided into 12.5 m sections. In the following years, wild boar tracks were counted in 1,982 sections in 2002, 1,973 sections in 2003, 1,917 sections in 2005, and 1,886 sections in 2006.

Depending on snow cover, the tracking exercises lasted for five days in January or February of each year of the study. The location of tracks was recorded using an automobile odometer and GPS. Track-counting on each transect always started at the same permanently determined point. During the first day of the study, the transects were toured and all wild boar tracks were erased. In the five subsequent days, only new daily tracks crossing the given transect were counted and again erased. To avoid multiple counting of the same tracks, only one crossing of a single individual or groups of wild boar of different numbers were counted on each day of tracking for a given transect.

Non-parametric tests were used in statistical analyses. The median test was used to determine the existence of statistically significant differences within the group of examined variables. The Mann-Whitney U test was used for comparisons between the two variables. Differences were deemed significant at $p<0.05$ (*i.e.*, $\alpha=0.05$).

Results

A total of 3,022 wild boar tracks was recorded during the 4 years of studies (788, 826, 814, and 594, respectively). Tracks were found in 597 out of all 7,758 sections covered by the count throughout the 4-year study period (161 in 2002, 154 in 2003, 153 in 2005, and 129 in 2006). The number of tracks ranged from 1 to 35. In most cases, namely 393 (66%), the records represented passage by 1-5 wild boar. There were 133 sections where passages of 6-10 wild boar were identified. Larger groups, of 11-15 and 16+ individuals, made up only 8% and 4% of observations, respectively. The mean numbers of tracks that crossed 12.5 m sections of transects did not differ statistically between the study years: 0.39 (SD ±1.85); 0.41 (SD ±1.96); 0.42 (SD ±2.02) and 0.31 (SD ±1.44) (χ^2=2.80, df=3, p>0.05) in 2002, 2003, 2005, and 2006, respectively.

Transects differed significantly in terms of the mean number of tracks (χ^2=78.97, df=19, p<0.05). The fewest tracks, 0.15/section (SD ±0.81), were recorded in the L-14 transect, whereas the most, 0.86/section (SD ±2.84), were observed in L-13. The mean number of tracks varied from 0.15 to 0.29/section in the case of 8 transects (42%), 0.30-0.49 passages were detected in 5 transects (26%) and 0.50-0.69 passages in 4 transects (21%), with single cases (5%) featuring 0.70-0.85 tracks/section.

There were significant differences between the mean numbers of tracks in various habitats (χ^2=16.11, df=5, p<0.05). The most passages, 1.02/section (SD ±3.30) were recorded in Al-f and the fewest, 0.05/section (SD ±0.22), in Al-As-f. The mean numbers of tracks in the following habitats: FBM-f, 0.30/section (SD ±1.56), MB-f, 0.32/section (SD ±1.57), FB-f 0.41/section (SD ±1.92), and FMC-f, 0.43/section (SD ±2.13), did not differ statistically from one another (χ^2=11.63, df=3, p>0.05). In all these habitats, tracks were fewer (p<0.05) than in alder (Al-f) and more than in alder-ash forests (Al-As-f) (Fig. 2).

Significant differences in mean numbers of tracks were found among the 4 forest stand age classes: Y, M, F and RF (χ^2=10.29, df=3, p<0.05). The most numerous tracks were recorded in the youngest stands, Y=0.62/section (SD ±2.33), followed by the oldest, RF=0.48/section (SD ±2.26), and stands entering their intense-fruiting age, F=0.39/section (SD ±1.83). The differences between these three age classes were not significant (χ^2=3.26, df=2, p>0.05). The lowest mean number of tracks was observed in the sections running through middle-aged class forests. The mean number of tracks in the M tree stands was only 0.30/section (SD ±1.49) and was significantly less than in the Y (Mann-Whitney U=537857.50, p<0.05) and RF (Mann-Whitney U=352938.50, p<0.05) classes (Fig. 3).

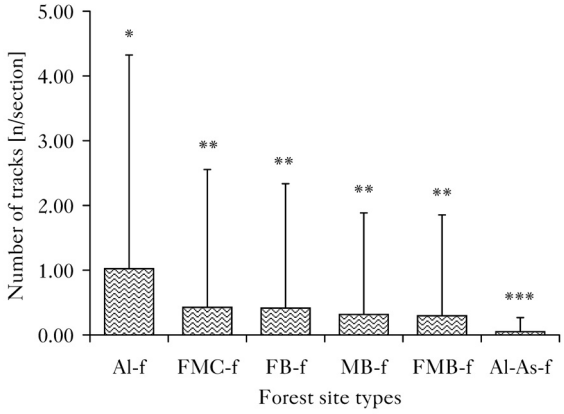

Fig. 2.

Comparison of the mean number of wild boar tracks in transect sections located in six forest habitat types (p<0.05 between forest types marked *, **, ***)

There were significant differences between mean numbers of wild boar tracks in transects that crossed forest stands containing three different groups of dominant tree species: coniferous (C), heavy seed deciduous (HSD) and other deciduous (OD) (χ^2=10.64, df=2, p<0.05). The largest number of tracks was observed in HSD forest stands, 0.43/section (SD ±2.01), significantly more than in C, 0.32/section (SD ±1.62) (Mann-Whitney U=5918488.00, p<0.05) or in OD forest stands, where a mean of 0.32 tracks/section (Mann-Whitney U=1371208.00, p<0.05) was recorded. However, no significant differences were found between the OD and C forest stands (Mann-Whitney U=882861.00, p>0.05) (Fig. 4).

A comparison of the mean numbers of tracks separately for the AGE and CANOPY groups demonstrated that statistically significant differences occurred. In the case of CANOPY, the mean numbers of tracks in transects did not differ between the youngest stands Y (χ^2=4.83, df=2, p>0.05) and maturing stands M (χ^2=0.83, df=2, p>0.05). Wild boar penetrated both coniferous (C) and deciduous (OD and HSD) stands with equal intensity. Differences appeared in older stands, where mean numbers of tracks in the stands with dominant heavy seed species (HSD) were significantly larger than in OD stands (Mann-Whitney U=275555.00, p<0.05). While comparing mean numbers of tracks in different age classes, it was discovered that C and OD tree stands featured similar levels of forest penetration by wild boar regardless of the age of these stands (χ^2=0.28, df=3, p>0.05 for C stands; χ^2=3.56, df=3, p>0.05 for OD stands). There were significant differences in the case of HSD forest stands (χ^2=13.21, df=3, p<0.05), where the most abundant tracks were found in stands at the youngest developmental stage (Y), followed by mature stands and the oldest stands (Table 1).

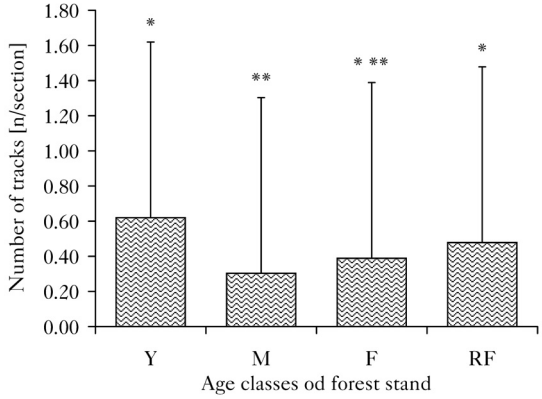

Fig. 3.

Comparison of the mean number of wild boar tracks in transect sections located in 4 age classes of forest stands (p<0.05 between forest types marked *, **, ***)

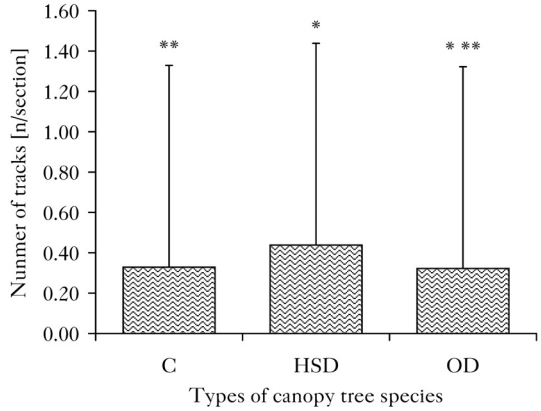

Fig. 4.

Comparison of the mean number of wild boar tracks in transect sections located in stands with three groups of dominant tree species (p<0.05 between forest types marked *, **, ***)

Table 1.

The mean number of wild boar tracks [n/section] in stands of 4 age classes and 3 types of groups of dominant tree species

Age classes of stands	Canopy tree species			
	C	OD	HSD	Differences inside the AGE group (p<0.05)
Y	mean: 0.66 SD: 2.95 n: 68	*lack of data*	mean: 0.65 SD: 2.24 n: 295	n.s.
M	mean: 0.29 SD: 1.41 n: 1568	mean: 0.40 SD: 1.90 n: 388	mean: 0.28 SD: 1.41 n: 990	n.s.
F	mean: 0.36 SD: 1.78 n: 1145	mean: 0.23 SD: 1.43 n: 200	mean: 0.44 SD: 1.94 n: 1183	HSD>C HSD>OD
R-F	*lack of data*	mean: 0.07 SD: 0.25 n: 30	mean: 0.48 SD: 2.27 n: 1873	HSD>OD
Differences inside the CANOPY group (p<0.05)	n.s.	n.s.	M<Y M<F Y>RF	

Discussion

In winter, the availability of food and cover for thermoregulation are key factors determining the distribution of animals and their patterns of activity in forest ecosystems (Mysterud and Østbye, 1995; Renaud *et al*., 2011). In the case of wild boar, the winter food spectrum is relatively wide and to a large extent, it includes food from the litter and the topsoil (Genov, 1981; Wlazełko *et al*., 2009; Nasiadka, 2019). In the case of winter cover, the forest fragments with dense vegetation are attractive to wild boar.

The differences found in this study between the number of tracks in different age classes of forest stand confirm the above statements. In the forests of Myślibórz F.D., wild boar similarly penetrated the youngest age classes (Y) and the oldest stands (F and RF), and the number of tracks in the maturing stands (M) was the lowest. In the case of the youngest stands (Y), the reason for their penetration by wild boar was probably the search for safe places for day shelters. Wild boars choose dry and dense places for their lairs, which additionally provide thermal protection (Jensen, 1989; Mayer *et al*., 2002; Fernandez-Ilario, 2004). Zhang *et al*., (2021) showed that the youngest age classes of coniferous stands are characterized by significantly higher temperatures in winter than the older stands. In the case of commercial forests, the number of saplings grown in the youngest age classes may be as high as several thousand per hectare (Szymański, 2001), and the high level of vertical cover markedly reduces the horizontal visibility (Collins and Becker, 2001).

In the case of the oldest age classes (F and RF), there may be at least two reasons for their intensive penetration by wild boars in winter. Due to the dilution of the canopy, old stands allow more light to reach the forest floor and therefore create favourable conditions for the development of the lowest layers of vegetation, *i.e*., undergrowth and shrubs in the summer (Connell and Slatyer, 1977; Bazzaz, 1979; Bartels and Chen, 2010). This factor is important because during the dormant season forest floor vegetation disappears from the ground surface and plants

store high-quality energy resources in their underground parts (Tumidajowicz, 1971). Increased undergrowth density, which results from greater sunlight on the forest floor, provides resting sites for wild boar, and the dense undergrowth increases the potential for good-quality food resources in the form of roots, rhizomes, or tubers. The least favourable light conditions are found in the maturing stands (M) where the tight tree crowns limit the access of light to the forest floor. The conditions there are neither favourable for the development of a dense undergrowth nor the development of undergrowth vegetation.

An additional feature of old stands (especially oak and beech) that is beneficial for wild boar is the periodic fruiting of trees, which provides acorns and beech nuts that are highly sought after by wild boar. Research carried out on the diet of wild boar in the forests of central Poland found that during the fruiting of oaks, acorns may be more attractive as food to wild boar than, for example, corn available in arable fields or hunting baits (Nasiadka, 2019). This fact is confirmed in our studies because the mean numbers of wild boar tracks were significantly higher in the older classes (F and RF) of oak and beech stands (HSD) compared to coniferous (C) or other deciduous (OD) stands.

Comparing the number of tracks depending on the type of forest sites, it was found that wild boar penetrated different forest sites to different extents. Most of the tracks were registered in alder forests. Wild boar penetrated the next four types of forest sites to a similar extent, and the least tracks were counted in alder-ash forests. The preference for alder forest in winter is probably due to several reasons, including (1) the inaccessibility of this environment to various intruders (natural and human) and therefore the possibility of finding a peaceful shelter by wild boar; (2) the possibility for wild boar to find fresh food, especially in a mild winter, because wetlands and swamps are active at a time when other habitats are dormant (Jurko, 1986; Eliáš and Mariničová, 2017); and (3) access to water, which is important for wild boar all year round (Fernandez-Ilario, 2004).

Interestingly, it turned out that wild boar, having at their disposal alder forests and alder-ash forests, more often penetrated the first of these. It is difficult to explain these differences unequivocally. Perhaps they result from alder forests having a lobed structure and a greater proportion of undergrowth plants (drier patches provide cover, and the underground layers of soil provide food). Alder-ash forests have a more developed layer of deciduous shrubs, which limit the development of the undergrowth, and do not provide dense cover in winter (Matuszkiewicz, 2007).

It should be clearly emphasized that the above statements are only assumptions, and the issues of differences in the use of various types of forest sites by wild boar should be the subject of further research on the winter ecology of this species in commercial forests.

Conclusions

- During the winter season in Myślibórz F.D., wild boar more often penetrated the young (up to 20 years old) and the oldest (60 years and older) forest stands, which is related to the location of resting sites and the availability of food in the upper layers of the soil. Middle-aged forest stands (20-60 years old), due to their structure, provide neither optimal protection nor maximum food resources, and therefore their penetration by wild boar was the least.
- In terms of canopy species, wild boar penetrated old stands dominated by oaks and beeches, clearly because of the presence of acorns and beech nuts in the upper layers of the litter, which are desirable food for wild boar during the winter.
- The greatest number of tracks (the highest penetration) was found in alder forests. Perhaps this fact can be explained by the specific physical and biological characteristics of this envi-

ronment, but the importance of different types of forest sites in the winter ecology of wild boar requires further research.

Authors' contributions

L.O. – conceptualization, methodology, writing – original draft preparation, review and editing; P.N. – methodology (supporting), formal analysis, writing – original draft preparation (supporting).

Conflicts of interest

The authors declare no conflict of interest.

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STRESZCZENIE

Zimowe preferencje wybranych drzewostanów przez dziki *Sus scrofa* określone metodą tropień na transektach

Zimowe tropienia na transektach pozwoliły na porównanie stopnia penetrowania lasu przez dziki w odniesieniu do siedlisk leśnych, wieku drzewostanów i gatunków panujących. Badania przeprowadzono na terenie położonego w północno-zachodniej Polsce Nadleśnictwa Myślibórz (powierzchnia ok. 125 km^2) (ryc. 1). Dane pochodziły z 19 liniowych transektów o średniej długości 77 000 m, na których były liczone tropy dzików w ciągu 5 kolejnych dni na przełomie stycznia i lutego przez 4 lata: 2002, 2003, 2005 i 2006. Lokalizację tropów rejestrowano za pomocą GPS i licznika samochodowego, co pozwoliło na odniesienie uzyskanych danych do siedlisk, gatunków panujących i wieku drzewostanu. W tym celu wykorzystano mapy glebowo-siedliskowe nadleśnictwa w skali 1:10 000. Transekty podzielono na odcinki o długości 12,5 m, uwzględniając dokładność wykorzystanych przyrządów. Aby uniknąć wpływu sąsiedztwa drzewostanów o różnych cechach, w obliczeniach uwzględniono tylko te odcinki, na których po obydwu stronach transektu znajdowały się takie same siedliska. Transekty przebiegały przez 6 typów lasu: ols, ols jesionowy, bór mieszany świeży, las świeży, las mieszany świeży oraz las wilgotny. Pod względem wieku drzewostany podzielono na 4 klasy: Y – drzewostany do 20 lat, M – drzewostany średniowiekowe: 21-60 lat, F – drzewostany 61-100-letnie oraz RF – drzewostany 100-letnie i starsze. Gatunki drzew dominujących podzielono na 3 grupy: C – gatunki iglaste, HSD – gatunki ciężkonasienne (dąb, buk) oraz OD – pozostałe liściaste.

W czasie 4 lat badań na transektach o średniej długości 24 000 m zarejestrowano 3022 tropy dzików (odpowiednio: 788, 826, 814 i 594). Średnie liczby tropów przecinających odcinki transektów o długości 12,5 m nie różniły się statystycznie istotnie pomiędzy latami badań i wynosiły w latach 2002, 2003, 2005 i 2006 odpowiednio: 0,39 (SD ±1,85), 0,41 (SD ±1,96), 0,42 (SD ±2,02) i 0,31 (SD ±1,44) (χ^2=2,796; df=3; p>0,05). Stwierdzono statystycznie istotne różnice pomiędzy średnimi liczbami tropów w różnych siedliskach (χ^2=16,11; df=5; p<0,05). Najwięcej przejść zarejestrowano w olsach – 1,02/odc. (SD ±3,30), najmniej w olsie jesionowym – 0,05/odc. (SD ±0,22) (ryc. 2). Istotne różnice pomiędzy średnimi liczebnościami tropów stwierdzono również w 4 klasach wiekowych drzewostanów (χ^2=10,29; df=3; p<0,05). Najwięcej tropów zarejestrowano w drzewostanach najmłodszych Y – 0,62/odc. (SD ±2,33), a najmniej na odcinkach przebiegających w lasach średniej klasy wiekowej M – 0,30/odc. (SD ±1,49) (ryc. 3). Stwierdzono istotne statystycznie różnice pomiędzy średnimi liczbami tropów dzików w zależności od gatunków drzew panujących (χ^2=10,639; df=2; p<0,05). Najwięcej tropów zarejestrowano w drzewostanach HSD – 0,43/odc. (SD ±2,01) i było ich istotnie więcej niż w drzewostanach C – 0,32/odc. (SD ±1,62) (Mann-Whitney U=5918488,00; p<0,05) oraz w drzewostanach OD, gdzie zarejestrowano średnio 0,32 tropu na 12,5-metrowych odcinkach transektów (Mann-Whitney U=1371208,00; p<0,05) (ryc. 4). Porównanie średnich liczebności tropów oddzielnie dla grup AGE i CANOPY także wykazało istnienie różnic istotnych statystycznie. W przypadku CANOPY różnice pojawiły się w drzewostanach starszych, gdzie średnie liczebności tropów w drzewostanach z dominu-

jącymi gatunkami ciężkonasiennymi (HSD) były istotnie większe niż w drzewostanach OD (Mann-Whitney U=275555; $p<0,05$) (tab. 1).

Porównując średnie liczebności tropów pomiędzy klasami wiekowymi, stwierdzono istotne statystycznie różnice w przypadku drzewostanów HSD ($\chi^2=13,209$; df=3; $p<0,05$), w których najwięcej tropów stwierdzono w najmłodszych stadiach rozwojowych (Y), a następnie w drzewostanach dojrzałych i najstarszych (tab. 1).

Na terenie Nadleśnictwa Myślibórz w sezonie zimowym dziki częściej penetrowały drzewostany młode (co wynika z dostępności miejsc odpoczynku) i drzewostany najstarsze, gdzie dno lasu, ze względu na owocowanie drzew (zwłaszcza ciężkonasiennych), zapewnia bazę pokarmową. Drzewostany średniowiekowe, ze względu na swoją strukturę, nie zapewniają już optymalnych osłon legowiskom, a ze względu na wiek drzew wystarczająco zasobnych żerowisk i dlatego były penetrowane przez dziki w najmniejszym stopniu. W odniesieniu do gatunków panujących dziki penetrowały stare drzewostany zdominowane przez dęby i buki. Wiąże się to z występowaniem w górnych warstwach ściółki nasion dębu i buka, które są dla dzików pożądanym pokarmem w okresie zimowym. Natomiast intensywna penetracja olsów w czasie łagodnych zim, charakterystycznych dla terenu badań, może wynikać z korzystnych dla dzików warunków: dostępności wody, świeżego żeru i gęstej osłony. Uzyskane wyniki wskazują na potrzebę dalszych badań nad wpływem zróżnicowania strukturalnego lasów zagospodarowanych dla dzików.