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USE OF PHOTO TRAPS AND FAECAL PELLET GROUP COUNT FOR ESTIMATION OF WILD BOAR POPULATION DENSITY IN FOREST ENVIRONMENT

Plhal, R.[1], Kamler, J.[1], Homolka, M.[2]

Summary: Wild boar is an autochthonous animal species of the Czech Republic that has significantly increased its population density in recent years. Wild boar differs from the other free-living ungulates in its spatial activity and food selection, which limits applicability of the experiences and methods used for other species. Two methods of wild boar population census in a forest environment were tested in this study.
Wild boar abundance was estimated using traditional faecal pellet group (FPG) count and photo trapping data analysis in an area of 2,256 ha. Both field methods were used in the winter-spring season 2009 – 2010. Wild boar abundance as assessed by FPG count was 6.1 ind./km^2 and by photo trapping 6.8 ind./km^2. The results have revealed that if correctly performed, both of the tested methods are applicable to estimate wild boar abundance. Combination of several methods is advisable.
Key words: defecation rate, additional feeding, distribution

Introduction

Wild boar is a native species of the Czech Republic fauna, whose distribution and abundance is thought to have varied significantly throughout the last centuries. These fluctuations are believed to be linked to climatic conditions [10], and hunting; where this has been undertaken with the principal aim of agricultural crop protection [2, 13]. The only reliable source of data for either national or regional wild boar populations is from hunting records, and it is evident that despite the efforts to reduce numbers, the wild boar is increasing [13]. Anecdotal evidence suggests that the first real signs of wild boar overpopulation such as extensive damage to agricultural crops and an outbreak of classical swine fever appeared in the 1980's.
Today, the growing populations of wild boar present a serious economic, ecological and social threat not only in the Czech Republic but across central Europe [6, 18]. The most serious consequences of the increase is the associated damage to agricultural crops, road accidents, transmission of infectious diseases and the destruction of managed green space in populated areas [3, 9].
Various methods of wild boar population control have been tested, including poisons, sterilization of females and trapping [17, 33]. In spite of their partial successes, the most widespread and best proven technique to reduce the population would appear to be intensive hunting [8]. However, the required level of cull significantly varies in relation to the abundance of wild boar and their annual productivity. A relatively new approach to determining the control of wild boar population growth, based on observed reproductive rate, has been described in [7] and [30]. However, one crucial question in determining whether pest control is effective, is the need to ascertain whether the cause-specific mortalities are additive, dispensatory, or compensatory and it is our opinion that further work is required.
One of the considerable obstacles in the effort to stop the population growth of wild boar is the inaccuracy of current abundance estimations used to inform the decisions on the numbers of individuals that need to be removed [21]. For this reason, improved methods to determine wild boar abundance is a key pillar in the management of this species.
A general feature of most of the studies concerned with monitoring of wild boar populations is that the methods used are very time consuming and technically demanding, which limits their applicability in more widespread management of this species. One of the options to obtain accurate data and lower the demands on observers in the field is photo trapping. Analyses of photographs can greatly contribute to the study of population density [14, 23], distribution and spatial activity [15, 22] or feeding behavior [19] of wild boars. The objective of this study was to assess the applicability of winter phototrapping data analysis for estimation of wild boar populations.
Density of ruminant free living ungulates has often been estimated using counting of faecal pellet groups. This method originated in the late 1930´s [24] and is in several modifications widely used and considered as reliable and economic method. Besides ruminants was dung counting applied also for density estimation of snowshoe hare [27] and red fox [32]. In wild boar, this method has been neglected so far, mainly because of: 1. the lack of data on its defecation rate; 2. several-fold smaller production of faeces compared to ruminants and 3. uneven distribution of faeces in the environment.

[1] Radim Plhal, MSc., PhD student, Jiří Kamler, PhD, professor, Faculty of Forestry and Wood Technology, Mendel University in Brno, Czech Rep.;
[2] Dr. Miloslav Homolka, researcher, Institute of Vertebrate Biology, Academy of Sciences of the Czech Republic;
Corresponding author: Radim Plhal, Mendel University in Brno, Faculty of Forestry and Wood Technology, Zemedělská 3, 613 00 Brno, Czech Republic; E-mail: r.plhal@seznam.cz.

Material and Method

Study area

The study area of 22.56 km^2 is situated in the Drahanská vrchovina highlands in the south-eastern part of the Czech Republic at the average altitude of 450 m above sea level. The selected area is completely afforested and is enclosed within natural borders and man-made barriers that limit the migration of wild boar. From the south and the west it is surrounded with vast agricultural land and a water basin, and from the north and the east with a busy public road. Although the fields and the road do not prevent migration of wild boar, movement of wild boar from the study area during winter is believed to be extremely limited. During winter the wild boar were encouraged to remain in the study area by placing supplementary feeding on permanent sites whilst the surrounding areas remained covered with deep snow without any food and cover. For the detailed description of the study area, see [26].

Census with the use of phototraps on feeding sites

13 feeding sites were established to attract wild boar to specific areas within the study area. These feeding sites were regularly frequented by other additional ungulate species. The phototraps were installed at each of the feeding sites from the 16th to the 29th of January 2010 inclusive. The phototraps were attached to tree trunks approximately 40 cm above the ground or snow cover, at a distance of between three and ten meters from the feeding site centre, according to the individual manufacturer's recommendations. The phototraps were active for 24 h/day and were checked at two to three-day intervals. Their software was programmed to shoot with a time delay of 1 minute. During each inspection, the correct functioning of the camera was checked and the feed on the feeding site was replenished. Hunting was prohibited over the entire study area during the period of study and for two weeks prior, in order to minimize disturbance.

For each night, the number of males, females and piglets of wild boar that had visited a site was established by direct counting of animals on the pictures. Where individuals were repeatedly photographed on a feeding site in an evening these were only counted once. The final overall size of the wild boar population within the study area was established by assessing the total number of individuals recorded on each of the 13 sites. Duplicate records caused by the repeated presence of the same animal/s on a feeding site during one night were removed, as were visits to more than one site by the same individual/s if these occurred on the same night.

Estimation of the total wild boar abundance within the area was further improved by determining the number of animals that did not visit the feeding sites at all. This was determined by dietary analyses of their faeces. Of the places used by boars as daytime shelters, 14 localities were chosen, evenly distributed over the area at the distances of 100-1000 m from the feeding sites. From these, samples of 2-14 days old faeces were collected at the end of the study period after phototrapping had ceased. Before and during the study period, all feeding sites had been replenished with barley. Microscopic analysis of the food remains was performed to assess the percentage of food from the feeding sites; based on this information, the number of individuals that did not visit the sites at all was estimated.

For the detailed description of the methodology, see [26].

Population density estimation by FPG count

The study area was divided into seven basic types of habitat (clearing. young broadleaved growth. young coniferous growth. broadleaved pole stand. coniferous pole stand. mature broadleaved stand. mature coniferous stand). Ten localities, evenly distributed over the area of interest, were chosen for FPG counting. Data were collected in all seven types of habitat at each locality in the surroundings of its centre, for six days immediately after snowmelt in spring (18. – 23. 3. 2010). At each locality, we counted FPG on eight single-sampling uncleared strip transects of 100 × 2 m (200 m^2). Hence, we sampled 56 transects at each locality; per the whole study area it makes 560 transects of 1.12 ha in total. The period of faeces exposition, chosen with respect to the local climatic and natural conditions, lasted from the 1st November 2009 till the day of counting, i.e. 137 – 143 days (140 days on average).

For each type of habitat we calculated the mean number of pellet groups per the whole area it represented. Further, the absolute number of wild boar was estimated separately per each habitat according to the equation [25]:

$$PDi = \frac{\bar{xi}}{AP * DR * TA} * Pi * 10^6$$

PDi – population size for each habitat
xi – average density of FPG per transect
AP – accumulation period
DR – daily defecation rate (4.95 FPG/ind./day [25])
TA – transect area (200 m^2)
Pi – habitat area (km^2)

As the period of faeces accumulation fell within the intensive hunting season, the result is biased by the fact that the calculation includes FPG produced by the animals hunted down during the winter. To achieve more accurate

estimation of wild boar abundance at the time of the census, we subtracted the number of FPG equivalent to the number of the shot individuals from the total number of the recorded FPG. The number of pellet groups produced by the shot individuals was determined from the defecation rate and the date of shooting of the individual animals according to the equation [25]:

$$x = \left[\sum_{k=1}^{n} k \cdot (DR_1 \cdot a_k + DR_2 \cdot b_k)\right]$$

x – number of FPG produced by the shot animals within the study area
n – number of events (140 days)
DR_1 – defecation rate of piglets
DR_2 – defecation rate of adults
a_k – number of shot piglets on a specific day
b_k – number of shot adults on a specific day
Subsequently, the estimated total number of pellet groups produced by the shot individuals was divided proportionally between the individual habitats and subtracted from the number of FPG found in each habitat. This corrected number of FPG was used in the calculation of the final population density of wild boar in the area of interest at the time of the census.

Results and Discussion

Wild boar counting with phototraps

During a fortnights monitoring on the 13 feeding sites, using 13 phototraps, 10092 photographs were exposed; 4864 (48 %) of them capturing wild boar. Between 32 and 1024 pictures of wild boar were taken on individual feeding sites. Each feeding site attracted from 0 to 23 wild boar individuals. The total number of wild boar in the study area was estimated on the basis of the obtained photographs to be 139 ± 2 ind., confidence level 95 %. This number was determined as the mean of the 14 values; each of these values was calculated as the total of wild boar captured at all 13 feeding sites for individual days of investigation. Wild boars frequented the feeding sites on a regular basis during the monitored period and there is no significant difference between the mean values of the wild boar numbers observed during the 14 days (ANOVA: F: 0.0165, df = 13, p = 1.0).
Further correction of the total number of wild boar was established by estimating the percentage of animals that did not visit the feeding sites at all. Out of the 174 samples of faeces collected from 14 localities within the study area, 16 samples (9.2 %) did not contain any remains of the feed from the feeding sites. The percentage of feed from the feeding sites in the faeces samples ranged from 10 to 100 % of their volume. The 9 % of the present wild boars that did not frequent the feeding sites were added to the final estimation. The final wild boar population size estimated by the photo trapping in the study area is 153 ± 3 individuals (6.8 ind./km^2).

Population density estimation by FPG count

Distribution of FPG on the transects of 200 m^2 was uneven and the share of the places with zero value was high. Therefore, we pooled together the data from every 4 adjacent plots (in each habitat at each locality there were two transects of 800 m^2). The resulting set of data showed normal distribution within the individual types of habitat (one-sample Kolmogorov-Smirnov test; $p>0.05$. N=20. for all cases), except for the habitat 1 ($p=0.042$). Density of faeces was uneven in the individual types of habitat (ANOVA; F6. 133=16.07; $p<0.000$). The highest density was in young coniferous and broadleaved growths (habitat 2 and 3) as there were more FPG than in other types of habitat (post hoc test Games-Howell; $p<0.05$). The lowest density of faeces was found in older stands, both and coniferous ($p<0.05$; Fig. 1). According to the index of preference, wild boar preferred for defecation young growth the most during winter (Px>+0.5).
Based on the all FPG collected, the number of wild boar in the study area was estimated 171 individuals (±59; 95 % CI; Table 2). During the period of faeces accumulation, 71 wild boars were shot in the study area in total, of which 62 were piglets and 9 adults. From the 1st November 2009 until being shot, these animals produced 23640 FPG, which make approx. 20 % of the total number of wild boar pellet groups found in the area of interest. After subtraction of the pellet groups left in the area by the shot boars, the number of individuals present at the time of the FPG count decreased to 137 (±36; 95 % CI). The corrected average density of wild boar in the whole area at the time of the census was 6.1 ind./km^2 (±1.59; 95 % CI).

Discussion

One of the principle causes of failing to undertake appropriate wild boar population management is the difficulty in determining their abundance in any given area. It is possible to use similar methods for wild boar census as for other large ungulate species; however, it is necessary to consider the characteristics that are markedly different in this species. Assessment of wild boar population size and structure is complicated by their secretive lifestyle [5], nocturnal activity [20], no marked sexual dimorphism and the difficulty in estimating the age of living animals. As well as these factors, appropriate wild boar management is hampered by inappropriate interventions: the social structure is often disturbed due to hunting and the animals are given high rations of supplementary feeding.

Therefore the hunters' information on population structure and abundance often differs from reality. This study has confirmed that even in a free-living wild boar population it is possible to obtain sufficiently accurate data on their abundance to facilitate informed population management decisions using two relatively simple methods.

A significant prerequisite for obtaining high quality results is the selection of a suitable environment and time. The area chosen for this study was sufficiently large and well bordered to restrict the migration of wild boar both to and from the study population. We believe the size of wild boar population was stable during the study period and this allowed repeated collection of data. The census was undertaken in mid winter during extreme climatic conditions that markedly affected the spatial activity of boars as well as their feeding behavior. Very low temperatures (average daily minimum temperature –18 °C) and high snow cover (45 cm on average) lasted throughout the whole data collection period. Wild boar reacted to these conditions with reduced activity which was limited to regular short-distance movements between the feeding sites and the resting places.

Conditions were ideal for both methods of assessment as the feed available at the feeding sites was the most easily accessible source of food for wild boar in this period. In case of lower snow cover, movements would be higher and attendance to the feeding sites lower, which would require prolonging the monitoring period to obtain an accurate result. Use of phototraps is very convenient as it allows obtaining a great amount of information over a short period of time [31]. Use of this new technology saves a lot of time compared to direct observation requiring presence of a researcher in the field [29]. This equipment provides records of high quality that can be archived and repeatedly studied from many aspects, which enables us to acquire valuable data on population of the studied species [28]. Within this research, quality of the pictures from the phototraps was mostly influenced by shortened life of batteries in the phototraps due to low air temperatures and high air moisture. Sometimes the objective lens or the flash was covered with freshly fallen snow or with frost deposit, which led to poor quality photographs. Occasionally, analysis of the photographs was compromised when there were by too many animals in one shot -as the bodies were overlapping each other- and also, by heavy snowfall reducing the visibility. However, the number of shots from individual days and from each feeding site was sufficient to allow an accurate estimation of the number of animals.

FPG count is one of the most common [12, 24] and the most accurate [1, 4] methods of abundance estimation in free-living animals; however, in case of wild boar it is often left out, mainly due to lack of data on defecation rate, seasonal migrations over long distances, until recently low population density and uneven distribution of faeces in the environment [11]. Generally speaking, FPG count can be employed to estimate abundance of wild boar similarly like abundance of ruminants, bearing in mind its limiting conditions. In our study area, we determined the defecation rate experimentally, the animals did not migrate outside the area during winter, their density was relatively high and their faeces showed normal distribution thanks to the suitably chosen size and number of the transects. The winter climatic conditions ensured persistence of faeces throughout the whole period and the exposition could have been sufficiently long.

The density of wild boar population that we have estimated by FPG count in the area of interest was 6.08 ind./km^2. This value corresponds to the abundances of wild boar found in other works. i.e. in the Bialowieza National Park. (3.5-5.9 ind./km^2; [16]) or in forests of other European countries (1.5-12 ind./km^2; [11]). At the same time, the obtained data are very similar to the values from the same area and the same period determined by snow track count (6.3 ind./km^2; [26]). The fact that FPG count produced results on the same level as the other methods indicates that its application in optimum conditions (stable non-migrating population, sufficient population density of wild boar, sufficiently large area and persistence of faeces in the environment) is possible.

Other available sources of information on the abundance of wild boar are the estimates based on direct observations at feeding sites undertaken by the local hunters or game managers. In recent years, the population of wild boar in the area in question had been estimated to be around 60 individuals (2.7 ind./km^2; [unpubl. data]).

Conclusion

The estimates of wild boar abundance assessed by the two methods used in our study, notably photo trapping and FPG counting, gave comparable results. It is evident that a combination of several complimentary methods will improve the accuracy of annual population assessment and that actual abundance is often underestimated by hunters using traditional techniques. We can recommend the application of photo trapping during periods of heavy snow cover to accurately establish wild boar populations. Whilst photo trapping involves a significant initial capital investment, the technology provides a significant amount of information and is less labour intensive than other methods.

We have confirmed that FPG count conducted in winter is well applicable for estimation of wild boar abundance on a larger area. Moreover, FPG counting involves no equipment and its work difficulty is comparable to other methods. To prove useful, however, FPG count requires the size of the monitored area and the method of data collection to minimize the errors due to uneven distribution of faeces. After verification of the share of faeces found in the places without undergrowth, it is possible to count FPG on approximately half area of the studied region only. Further research is needed mainly to determine the distribution of faeces in different environments to verify the defecation rate of wild boar in relation to the type of diet and to test the accuracy of the wild boar abundance estimation by FPG count as compared to other methods.

In the presented case, we believe the most accurate population estimate is that obtained using phototrapping when complemented by faecal analysis; that is, 153 ± 3 wild boar individuals (6.8 ind./km^2).

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