

AN ANALYSIS OF THE HUNTING PRESSURE ON WILD BOAR (*Sus scrofa*) IN THE TRÁS-OS-MONTES REGION OF NORTHERN PORTUGAL

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ABSTRACT

During the hunting seasons of 1999/2000 (November to February) and 2000/2001 (October to February), wild boar shooting drives were studied in the Trás-os-Montes region of northern Portugal. All of the females were weighed and assigned to an age class based on tooth examinations. Uteri was extracted to confirm the presence of embryos or foetuses. Preliminary results show that female body weight, and the number of animals captured decreased between the first and second hunting seasons. Those findings might be due to the natural variability of the species under certain environmental conditions, particularly those related to food resources. Increased hunting effort might be another reason for the pattern observed. Therefore, the shooting of animals drives evolution, and the animals captured were analysed in these last years. Additionally, a comparative between hunting areas and the home range of wild boars was performed using the Arcview GIS software program.

Key words: Females, Hunting, Portugal, *Sus scrofa*, Wild boar.

INTRODUCTION

Several studies have shown that the wild boar (*Sus scrofa* L., 1758) is a species whose inter-annual population dynamics can vary dramatically and are influenced by multiple environmental factors (Leaper et al. 1999). Unfavourable climatic conditions, such as severe winters or heavy snowfall, can cause high mortality among piglets. Wolf predation is also considered an important factor in the regulation of some wild boar populations (Okarma et al. 1995, Kanzaki et al. 1998). Spatial-temporal variation in food abundance and availability (Singer et al. 1981, cit. Leaper et al. 1999, Groot Bruinderink et al. 1994, Massei et al. 1996) can have a strong influence on population dynamics. According to Pepin et al. (1987), the wild boar reproductive cycle is strongly influenced by the abundance of food resources in autumn and winter. Supplementary feeding influences fecundity, affects the reproductive period, and

average litter size. Years of high forest fruit production can lead to a population increase, followed by high mortality in the following year (Massei et al. 1997). Hunting bags might be influenced by those inter-annual variations in abundance, which makes difficult to estimate the impact of hunting on the population dynamics of the species.

In Portugal, as elsewhere in Europe, wild boar populations have increased in recent decades (Bugalho et al. 1984, Telleria and Saez-Royuela 1985, Nores et al. 1995). Several factors might be involved in those increases, such as socio-economical changes that lead to the abandonment of agriculture, and forest replacement by shrubland, which improves the environmental conditions for the wild boar. The increase in wild boar populations has caused increases in the damage to agriculture and forests, and consequently, has increased hunting of the species, even in areas where there was no previous hunting tradition.

Until 1986, in Portugal, free hunting was allowed throughout the country, and the State was the sole manager. Law no. 30/86 of 1986 was mandatory for the establishment of hunting zones to be managed by several agencies, and where the hunting for wild boar provides the best conditions. In the region of Trás-os-Montes in northern Portugal, where this study was conducted, the wild boar hunt had not attracted much interest prior to 1996. Nevertheless, it was after that date, with a greater adherence to form hunting areas, that wild boar shooting drives increased from 39 to 56 in the 1999/2000 hunting season. According to data from the Agricultural Department of the Trás-os-Montes Region (DRATM), the harvest has increased 79% (from 57 to 102 animals), which reflects the increase in population size. Nevertheless, we observed a decreased harvest in the 1999/2000 and 2000/2001 hunting seasons, which might be a result of intensive hunting pressure. The purpose of our research was to test that hypothesis. To that end, we examined the development of the shooting drive and the number of animals captured in recent years. Additionally, we used the GIS software program Arcview to compared the distribution of hunting areas and the home range of the wild boars in Trás-os-Montes.

MATERIALS AND METHODS

The region of Trás-os-Montes, Portugal (40°55' - 42°00'N and 6°12' - 7°55'W) has an area of 12864 km² and is in the *Carpetano-Ibérico Leonesa* Province of the Mediterranean biogeographic region (Figure 1). The mean annual temperature is 13.1° C. The average minimum and maximum annual temperatures are 38° C and 21.4° C, respectively. Average annual rainfall ranges from 361 to 2012 mm. The landscape is very heterogeneous with sharp contrasts in geomorphology, climate, and vegetation. The traditional land use is diversified, and includes forestry and

agriculture in a common exploitation regime, and rangeland. The amount of arable land is about 463,500 ha (INE 2002).

Forests occupy 26% of the area. The predominant tree species is maritime pine (*Pinus pinaster*), which represents about 36%. The remaining area is covered by other species, such as oak (*Quercus pyrenaica*-14.7%), chestnut (*Castanea sativa*- 10.3%) and, to a lesser extent, evergreen oak (*Quercus rotundifolia*) and cork oak (*Quercus suber*). Forest galleries are dominated by alder (*Alnus glutinosa*) and other species, such as *Fraxinus* sp. and *Salix* sp. The most common shrubs associations are *Genistello tridentatae-Ericetum aragonesis*, *Genisto falcatae-Ericetum arborea*, *Cytiso scoparii-Genistetum polygaliphyllae*, *Cytiso striati-Genistetum polygaliphylla*, *Lavandulo sampaionae-Cytisetum multiflori*, and *Erico scopariae-Arbutetum unedonis*.

The first step in our the study was to examine the results of the wild boar shooting drive, which occurs from October to February, and is the most popular method of hunting wild boars in Portugal. Such an analysis was performed on hunting data from five years (1996/97 to 2000/2001) relative to the number and sex of animals captured. Those data were provided by DRATM. Additionally, we had the opportunity to examine the results of the harvest from several shooting drives between 1999/2000 and 2000/2001 from the project "Evaluation of the hunting seasons impact on reproductive cycle of wild boar," the results of which are presented here. All female wild boars were weighed and assigned to one of three age classes based on tooth examination (Dardaillon 1986, O.N.C. 1995, Fernández-Llario et al. 1996): class 1 = 0-12 months, class 2 = 13-24 months, and class 3 >24 months. The uterus of each female was extracted to determine presence of embryos/foetuses, as well as the number and sex of these embryos/foetuses.

To analyse hunting pressure from a spatial perspective, a thematic map was created using the Arcview GIS software programme, which displayed all of sites where shooting drives were allowed by DRATM in the 1999/2000 and 2000/2001

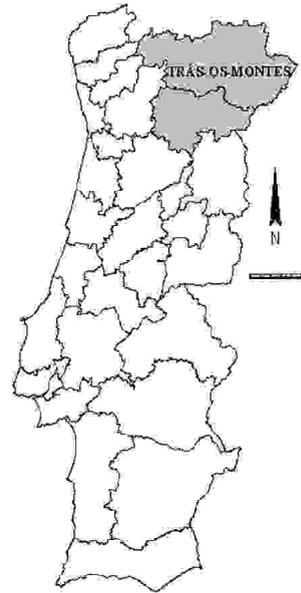


Figure 1. Location of the Trás-os-Montes region in Portugal.

hunting season. We assumed that each hunting drive affects the core of a family group, whose average home range was assumed to be about 400 ha (Spitz and Janeau 1990), and displaces wild boars some kilometres from their territories, (up to 15 km in a single night; Leaper et al. 1999). By using the CAD programme (Arcview) that area and distance were overlain on each shooting drive site, so as to identify the areas with the heaviest hunting pressure. Data from each weekend were grouped and treated as a separate level of information in the GIS analysis.

RESULTS

Figure 2 summarises the hunting areas results, but these data have been treated cautiously because only the hunting areas with successful hunting drives submitted results, and these represent all of wild boar harvests, independent of the number of hunting drives.

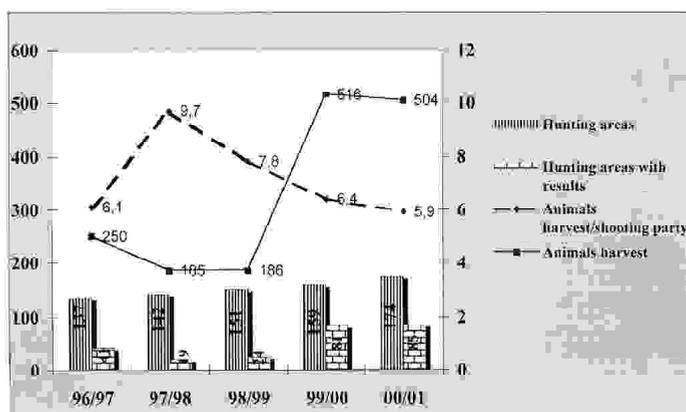


Figure 2. Cinegetic activity evolution of the wild boar in the Trás-os-Montes region of Portugal.

The number of hunting areas has increased (Figure 2) between 1996 (137) to 2001 (174), but the mean number of harvested animals did not change significantly. The hunting seasons of 1997/1998 and 1998/1999 are exceptions, but the true reasons for these results are difficult to ascertain because shooting parties without captures or those that were not carried out are not reported to DRATM, and the true number of shooting parties remains unknown. To explore the possible causes, comparisons were made between harvests and the agricultural production (kg/ha) of several products.

The Spearman correlation coefficient was significantly associated with total cereal production and, individually, with rye and maize ($r = 0.9$, $p < 0.05$).

After analysing the agrarian production data published by INE (2002), we verified that the 1997 season and, particularly, the 1998 season, had production below the average of 1990/2000 production for several crops (rye, almond, other dry fruits). That might have contributed to the decrease in harvest during the two hunting seasons, in which only a few hunting areas (Figure 2) had successful shooting drives (19 and 24 captures).

We did not observe any significant differences between the sexes, either in the period analysed ($\chi^2 = 7.5$, $p < 0.05$) or in the animals analysed during the shooting drives monitored in 1999/2000 and 2000/2001 ($\chi^2 = 2.1$, $p < 0.05$). A total of 48 shooting drives were sampled (Table 1), of which 38 provided results (18 in the first season and 20 in the second). Two hundred and two animals were killed, 56% were from the first age class, 10% from the second class, and 34% from the third age class (Table 2).

TABLE 1
Results of the shooting drives in the Trás-os-Montes region of Portugal.

Shooting drives			
Hunting Season	With Results	Without Results	Total
1999/2000	18	6	24
2000/2001	20	4	24
Total	38	10	48

TABLE 2
Age class and sex of wild boars harvested in two years in the Trás-os-Montes region of Portugal.

Sample year	Male				Females				Total
	Class 1	Class 2	Class 3	Total	Class 1	Class 2	Class 3	Total	
1999/2000	36	1	19	56	20	4	27	51	107
2000/2001	22	6	14	42	34	10	9	53	95
Total	58	7	33	98	54	14	36	104	202

Of 104 harvested females, 54 were pregnant (33 from the first year and 21 from the second year). Comparing the females weight between years, significant differences were found ($F = 2.62$, $df = 32.20$, $p < 0.05$). The mean weight of pregnant females in the first year (67.5 kg) was higher than in the second year (59.8 kg).

We verified that between the hunting seasons of 1999/2000 and 2000/2001, the harvest decreased from 109 to 76 animals, and the mean number of foetuses per pregnant female was lower in the second year. Foetal litter size differed significantly between hunting seasons ($F = 0.72$, $df = 32.20$, $p < 0.05$), and mean productivity was

higher in the first year (4.1 ± 1.0 foetus) than in the second year (3.8 ± 1.2). Hunting pressure on the class 3 females, the most productive group (Table 3), was very high in the first hunting season, amounting to 53% of the total number of captured females, which might have contributed to the results observed in the following hunting season. The analysis of the sex of fetuses did not reveal significant differences in the first year ($\chi^2 = 0.216$, $p < 0.05$), but males were slightly favoured ($\chi^2 = 3.78$, $0.1 < p < 0.05$) in the second year.

TABLE 3
Mean weight and mean number of embryos of captured pregnant female wild boars from the Trás-os-Montes region of Portugal.

Sample year	Class 1			Class 2			Class 3		
	Weigh Mean (kg)	Mean embryos/ foetuses	n	Weigh Mean (kg)	Mean embryos/ foetuses	n	Weigh Mean (kg)	Mean embryos/ foetuses	n
1999/2000	40	2.7	3	52.3	2.3	3	72.2	4.4	27
2000/2001	51.3	3.5	4	55.6	3.4	7	66.2	4.1	10

In the second year, fewer shooting drives were requested to DRATM than in the first year (from 179 to 141), and this might explain the smaller number of animals killed. However, other reasons for that result might exist, such as an increase in hunting pressure.

Figures 3 and 4 show the locations where hunt drives were authorised by DRATM in each of the two hunting seasons. The spatial distribution of the hunt drives in 1999/2000 (Figure 3) reveals that 18 were authorised in the same hunting areas and took place on consecutive weekends. In the 2000/2001 season that circumstance was verified in one hunting area only (Figure 4). Taking into consideration all of the sites having authorised shooting parties on a given weekend, no overlap was detected between the home ranges. Consequently, the wild boar family groups were affected solely by the activity of each shooting drive. The situation is different when we analyse the spatial distribution of all of the hunt sites across consecutive weekends. In that case, we counted seven overlaps between home ranges in 1999/2000 and three in 2000/2001. Consequently, a home range area might be partly affected by each shooting drive performed in neighbouring hunting areas.

In the Trás-os-Montes region of Portugal, we found an irregular distribution among the hunt drive sites. Of a total of 31 councils analysed, seven of these requested 68% of the permits. Those councils are mainly in the north and northeast, near the border with Spain.

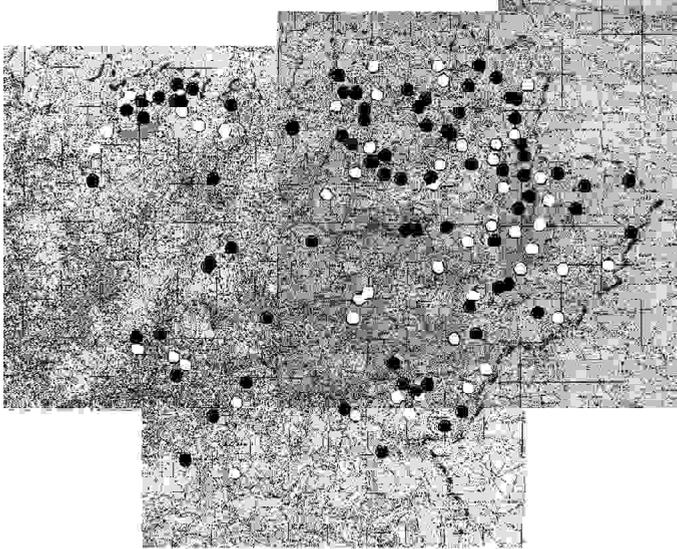


Figure 3. Wild boar home ranges and displacement overlaps for all shooting parties carried in the hunting season of 1999/2000 in the Trás-os-Montes region of Portugal. White- January; Black-February.

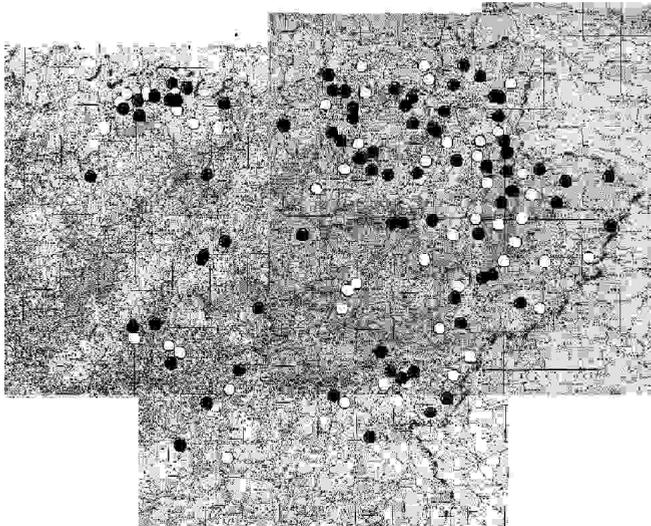


Figure 4. The wild boar home range and displacement overlaps for all shooting parties carried in the hunting season of 2000/2001 in the Trás-os-Montes region of Portugal. White- January; Black-February.

DISCUSSION

Our study provides data and conclusions about various aspects of wild boar hunting activities in the period 1996 to 2001 in the Trás-os-Montes region of Portugal. We found that corn productions, such as rye and maize, which can limit growth in wild boar populations, might explain the decrease in hunting bags between 1997/1998 and 1998/1999. Neet (1995) suggested that maize has a positive influence on the fitness and reproductive success of wild boars, which translates into population increases and, consequently, an increase in the number of captures. Krüger (1998) also suggested that an increase in corn production was the main factor involved in the increase of wild boar hunting bags.

Our analysis of the number of animals killed in the last two hunting seasons revealed a decrease in the numbers of captures. Pregnant females were lighter and foetal litter sizes were smaller in 2000/2001 than in 1999/2000. Corn yields and the availability of forest fruit (which is not extensive in the region) cannot be the explanation because the years were very similar in those respects. In the second year, we found a slight bias toward males among fetuses. Trivers and Willard (1973) and Clutton-Brock et al. (1988) argued that females invest more in males offspring when resources are limited.

Based on our results, we suggest that the wild boar population in the region is recovering from the adverse conditions that occurred in previous years (1997-98) but, at the same time, is the subject of higher hunting pressure, which has increased 177% in the last two years.

Given that almost all of the requests for permits are made for the months of January and February, and knowing that capture effort is spatially concentrated, hunting pressure is higher than what is expected based on the analysis of permits. The temporal proximity of some of the hunting activities that affect the same home range area, exacerbates the pressure placed on some of the wild boar family groups in the region we studied, and influences their spatial behaviour and population dynamics. Those subjects are outside of the scope of this paper, but deserve further attention. Hunting pressure is not homogeneous across the region, and is higher in the councils near the Spanish border, where a larger number of permits is issued. Many hunting zones of those councils request several shooting drives in the same hunting season, even if they do not occur on consecutive weekends.

Several authors have reported hunting-induced changes in the spatial stability of wild boar populations. Maillard and Fournier (1995) found a substantial increase in the size of home ranges in response to increased hunting pressure, which might result in abandonment in response to successive disturbances. Given that the size of

the annual home range that we have selected is not excessively large (some studies report home ranges of 15 km² or more), we conclude that wild boar family groups would be affected by more than two shooting drives in the same month in some areas of this study, which potentially could lead wild boar to abandon the sites. That might explain reduction in the number of captures that occurred in the second year of the study. Nevertheless, it should be noted that Sodeikat and Pohlmeier (2002) reported that most wild boars did not relocate their home range. It was only when the dominant sow was killed that the family group increased its home range considerably, but they studied hunting zones that are surrounded by undisturbed areas.

Current trends suggest a higher level of land management and an increase in the interest of the species to hunters in the future. Joint management plans between contiguous hunting zones will be important in insuring the species' sustainability, and the need to conduct continuous monitoring studies to determine whether the true magnitude hunting pressure is real.

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