WHERE AND WHEN: THE ECOLOGICAL PARAMETERS AFFECTING WILD BOARS CHOICE WHILE ROOTING IN GRASSLANDS IN AN ALPINE VALLEY

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Abstract: Rooting is the most obvious sign of presence of the species in a given area and it has been used to study habitat and space use. The study was carried out in Susa Valley at altitude from 700 to 1,410 m u.s.l. 58 plots of grassland or pastureland have been studied by visiting them every fortnight looking for rooting. Each plot was characterized by measuring some physical parameters and on each visit the soil hardness, vegetation or snow height, sign of deer use, human activity and amount of rooting were recorded. Climatic condition in the period before each visit was measured by two meteorological stations.

Keywords: Wild boar, *Sus scrofa,* Suidae, Plot, Rooting, Feeding, Italy, Europe.

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1. Introduction

Rooting is the most obvious sign of Wild boar presence in a given area and it has been used to evaluate the space and habitat use of the species (Dardaillon, 1985; Lescourret & Génard, 1985; Coblentz & Baber, 1987; Abaigar, 1992) or to try to estimate Wild boar (or feral hog) density (Mackin, 1970; Hone, 1988). Extensive rooting can modify the chemistry of the soil mixing the 0, A and B horizons, it accelerates decomposition, it causes loss of nutrients in the forest floor (Singer *et al.*, 1984), it modifies the local flora (Bratton, 1974; Welander, this volume), it affects beech sprouting (Lacki & Lancia, 1986), it changes small mammals distribution (Singer *et al.*, *op. cit.*) and possibly it causes soil erosion (Bratton, 1975).

Rooting has a seasonal pattern possibly related to food availability and geophytes distribution (Falinsky, 1986).

On the other hand it is commonly known that wild boars often perform rooting activity many times in the same place in the course of the year or year after year *i.e.* they seem to prefer some restricted areas in apparently uniform habitat.

The aim of this study was to examine the seasonal pattern of rooting on grassland in an Alpine valley and to identify the environmental parameters that may justify the choice of some field. We have focused on grasslands that are rooted throughout the year even if a seasonal pattern may be present (Macchi *et al.*, 1992).

2. Study area

The upper Susa Valley (Piedmont, NW Italy) is a typical piedmontese alpine valley running SW-NE. The climate might be considered as continental with low rainfall (1,000 mm annual) and strong temperature changes from winter to summer. At the bottom (700 m u.s.l.) the broadleaves are widespread and are replaced at higher altitudes by Larch (*Larix decidua*), *Picea abies, Abies alba* and *Pinus cembra* on the north-facing slope, and by *Pinus sylvatica* on the warmer, south-facing slope. Timberline is at ca. 2,400 m u.s.l..

Cereals and grapes on less steep and warmer slopes were cultivated until some thirty years ago, now most of these areas are only mowed or abandoned. Shrubs are invading many fields and woods are enlarging their surfaces.

3. Methods

Open areas are mainly represented by grasslands, pasture lands and meadows. 58 plots were chosen on both slopes of the valley in order to represent a range of elevation, aspect, management (mowed or abandoned), etc., irrespectively to previous rooting activity. Altitude ranges from 700 to 1,450 m u.s.l..

For each plot 20 characteristics were recorded and those were defined as "geographical" parameters. They were: Altitude, Side of the valley (left or right hydrographic), Aspect, Slope, Area, Perimeter, Management (mowed or abandoned), Visibility index (average distance from the centre of the field to the next sight obstacle in accord to the direction of the four

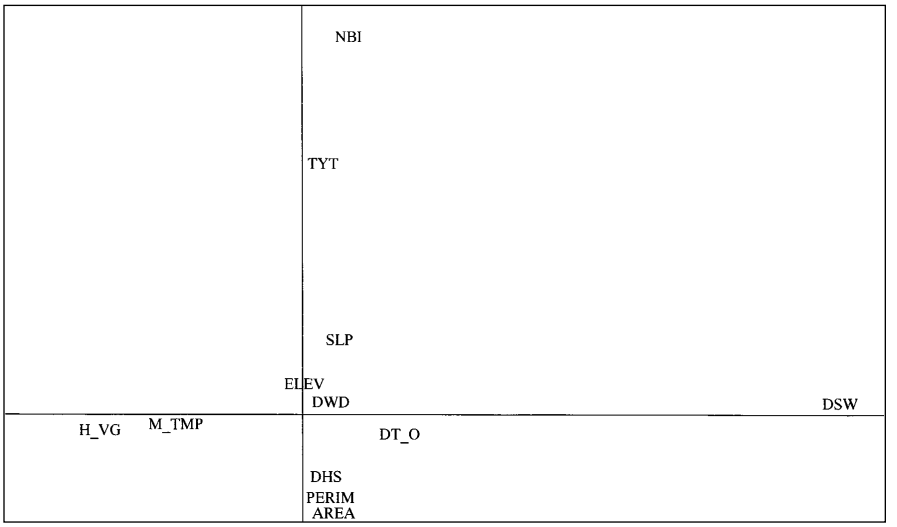

Figure 1a - Variables distribution - Never or once visited fields.

List of the "geographic" parameters measured on each plot. For the analysis all data were transformed in classes.
NBI = Number of bushes in the plot - TYT = Typology of the trees on the edge (single, row, group) - SLP = Slope - ELEV = Elevation - DWD = Distance from wood borduary - DHS = Distance from human settlements - PERIM = Perimeter - AREA = Area
List of the "ecological" parameters recorder in each time a plot was visited. All were transformed in classes.
H_VG = Grass height
List of "climatic" parameters recorded in each visit. All values were transformed in classes.
M_TMP = Mean temperature - DT_0 = Number of days with mean temperature below 0° C - DSW = Number of days with snow cover

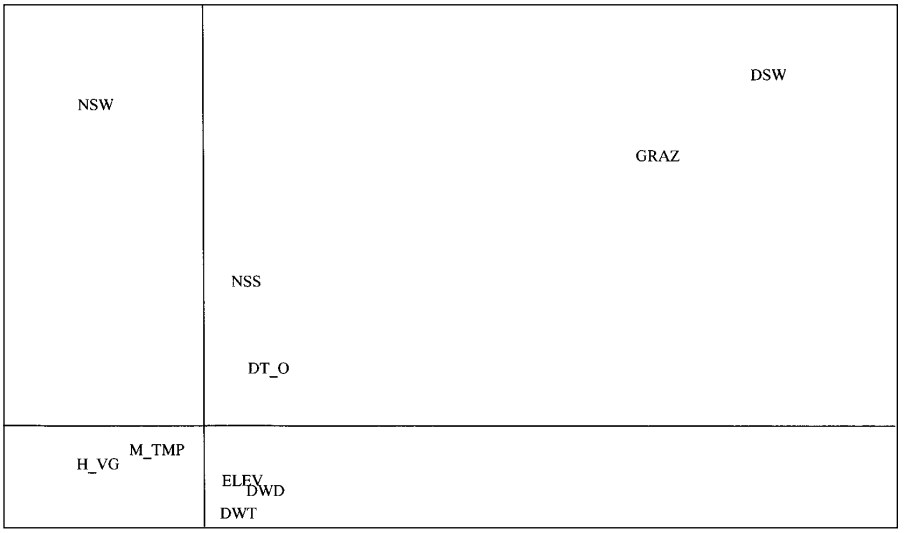

Figure 1b - Variables distribution - Often visited fields.

List of the "geographic" parameters measured on each plot. For the analysis all data were transformed in classes.
NSW = Number of sides in contact with wood - NSS = Number of sides in contact with shrubs - ELEV = Elevation - DWT = Distance from water bodies - DWD = Distance from wood borduary
List of the "ecological" parameters recorder in each time a plot was visited. All were transformed in classes.
GRAZ = Sign of grazing by Domestic/Wild/None - H_VG = Grass height
List of "climatic" parameters recorded in each visit. All values were transformed in classes.
DSW = Number of days with snow cover - DT_0 = Number of days with mean temperature below 0° C - M_TMP = Mean temperature

cardinal points), Presence of small mammals, Distance from human settlements, Distance from roads, Distance from water bodies, Distance from wood borduary, Number of sides in contact with woods, Number of sides with shrubs, Percentage of the perimeter in contact with woods, Percentage of the perimeter with shrubs, Typology of trees in the edge (single, in a row, in group), Number of trees in the field and Number of bushes in the field.
Each plot was visited two times per month from the second half of December 1992 to the end of October 1993 resulting a total of 18 visits and 935 visit charts. On each visit 7 "ecological" parameters were recorded: Soil condition (dry, wet, frozen, etc.), Snow height, Grass height, Sign of cattle or wild Ungulates presence, Sign of human activities, (mowing and hay collection, disturbance) and Wild boar rooting signs.
In order to estimate the amount of rooting and express it in percentage, a 10-metres wide line transect was performed.
Besides, data collected by two meteorological stations allowed us to include 5 "climatic" parameters: Mean temperature, Total rainfall, Number of rainy days, Number of days with mean temperature below zero degrees and Number of days with snow cover. All these data referred to the period between two consecutive visits.
In order to point out which parameter(s) influenced the extent of rooting and to create a predictive model a Stepwise Multiple Regression Analysis was performed with all parameters having set as dependent variable the amount of rooting (SAS/STAT, 1988).
Since some plots were rooted several times during the study period (up to 8 times), we tried to understand which parameter(s) could affect the Wild boar choice.
Thus a Correspondence Analysis was done both on fields that suffered no rooting or that were rooted only once and on fields that were rooted two or more times (Snedecor & Cochran, 1982).
It was not possible to use the Regression Analysis since the dependent variable should have been a continuous number and not a count as in this case.
In the Correspondence Analysis only the variable that showed higher squared cosin values (>0.45) were plotted.
This allowed to show which were the parameters that better represent the fields of each group.

4. Results

On the whole study period 33 (57%) of the plots were never rooted, 15% were rooted only once and two plots were rooted 7 and 8 times respectively. This may indicate that some plots were preferred to others and some were avoided.
The sequence of rooting shows that in most occasions after Wild boar has rooted on a plot this resulted not rooted in the following visit. Very rarely the plots were recorded as rooted more than two following visits.

The Correspondence Analysis was used to see which were the parameters that better represent the two plot types (Not Rooted and Often Rooted). The analysis of the parameters representing the plots that were rooted only once or never (Fig. 1a) shows a clear difference between "geographic" and "ecological" parameters. All "geographic" parameters lay on the second axis while "ecological" ones are found on the first axis. The first axis represents the weather conditions (Number of days with snow cover, Number of days with average temperature below zero degrees, Average temperature) and the second the plots' characteristics (Number of bushes, Typology of the trees on the edge of the plot, Slope, Elevation, etc.). In Fig. 1b (often visited plots) a strong difference between "geographic" and "ecological" parameters still exists, but the climatic parameters are moved toward the second axis. Thus in this case the two axis do not represent so well the two groups of parameters.
In both the analyses the parameters that better indicate the Wild boar choice are the same: Number of day with snow cover, Number of days with temperatures below zero degrees, Presence of shrubs, Altitude and Distance from woods.

The number of rooted plots varied throughout the study period. Highest percentages were recorded in December, late September, January and February; no rooting was found in March and mid April but the zero score was reported between two high scores. From June to early September the average percentage is below 10% (Fig. 2): the extent of rooting shows a different pattern: high in April and May, moderate in winter and summer, low in autumn.

As a first step a Multiple Regression Analysis was performed with all data for the whole study period. This analysis created a model statisti-

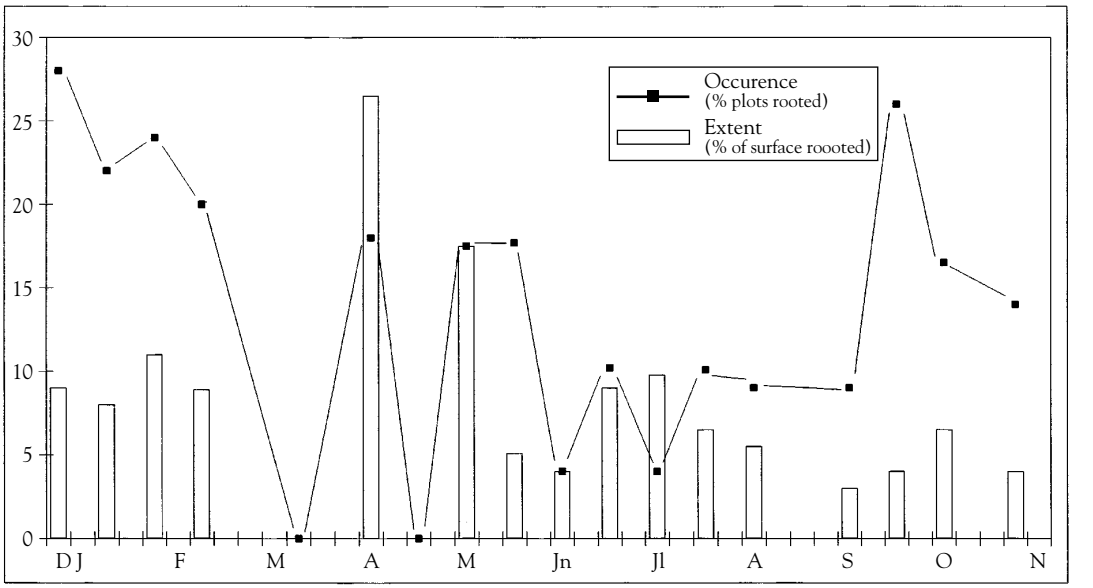

Figure 2 - Variations in occurence and extent of fields rooting during the study.

cally highly significant, thus the measured parameters described well the phenomenon. The obtained equation includes both "geographical" and "ecological" parameters: the amount of rooting increases with the Visibility Index and with the presence of groups of trees at the edge of the plot, and decreases when other wild Ungulates use the plot and when the temperature is high; it also increases with the number of days with snow cover.
It can be said that Wild boar seeks for food on larger areas (extensive rooting) in those fields that allow to detect any approaching predator (high Visibility Index) and that give the opportunity to gain cover quickly (presence of a group of trees or of a wood nearby).
In plots used by other Ungulates (Red Deer, *Cervus elaphus*, and Roe Deer, *Capreolus capreolus*) rooting intensity is low, but from the results of the Correspondence Analysis, they seem to be rooted more often.

Three different periods were identified: winter (late September - February) when many fields are rooted but not on large surfaces; spring (March - May) when rooting is not performed continuously, but rarely and on large areas; summer (late May-August) when rooting is less performed both in terms of number of plots and extension.
Therefore Multiple Regression Analysis was done on these three periods. All the analyses were statistically highly significant for all three identified periods.
During the winter period rooting increases with the number of days with average temperature below 0°C and is more common in the less cold south-facing slopes and in plots closer to woods. The only parameter included in the general model as in the winter one is the distance from wood borduary.
In Spring, the same difference between the two sides of the valley was enlighted. The rooting is moreover more intense in plots located at lower altitudes, with less shrubs, with a low Visibility Index and abandoned. Rooting is less performed during rainy periods.
Although the model resulting from the analysis carried on the summer period is statistically highly significant, it may be considered as a descriptive model rather than predictive: during this period the rooting is performed rarely and the temperatures are high.

5. Discussion and conclusion

Both in spring and winter the more rooted side of the valley is the south-facing one. Since the damage caused by the species has been found not to be related to the number of animals the reason for this should be searched in the fact that this was the side that was more intensively cultivated until few decades ago and the bushes and cover is more available if compared to the north-facing side covered mostly by coniferous woods.

Radio-tracking data collected nearby also indicate that Wild boar tend to move to lower altitudes during spring and summer probably looking for fresh and cover since most females give birth in this period.

The comparison between the outcomes from the Correspondence Analysis for Often-Rooted and Not-Rooted plots indicate that Wild boar uses more frequently the fields whose characteristics change more along the year.

Analyzing the extent of rooting and how it changes along the year it may be concluded that its has been possible to depict a general model to predict when and where the rooting happens.

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