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Wild boar (*Sus scrofa*) damages to mountain grassland. A case study in the Belluno province, eastern Italian Alps

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ABSTRACT: Five alpine pastures (34±14ha) of the Belluno province, patchily damaged by wild boar, were chosen to investigate on main environmental parameters that might influence the rooting sites selection. Eighty damage sites were examined. For each damage surrounding type of grassland and distance from woodland were recorded and mapped using a G.I.S. software. Proportional availability (% of total pasture surface) of grassland types (rough grass, rich grass, degraded, shrubs and trees) and classes of distance from woodland (<30m, 30-60m, 60-120m, >120m), and the respective use (% of total damage events) were estimated and compared with Chi-square test. A selection index was calculated as use/availability and Bonferroni confidence intervals (95%) were used to test significance. Degraded pastures and areas closer to woodland blocks were preferred. A vegetational analysis inside and outside the damaged areas showed a reduction in frequency of species producing bulbs and rhizomes, and in Poaceae as respect to other families of lower forage value. Future studies should investigate the role of different root forms, and invertebrate richness, on rooting site selection. Longer term studies are also needed to better define the evolution of pasture botanical composition of damaged areas.

Key words: Wild boar, Crop damage, Mountain grassland, Alps.

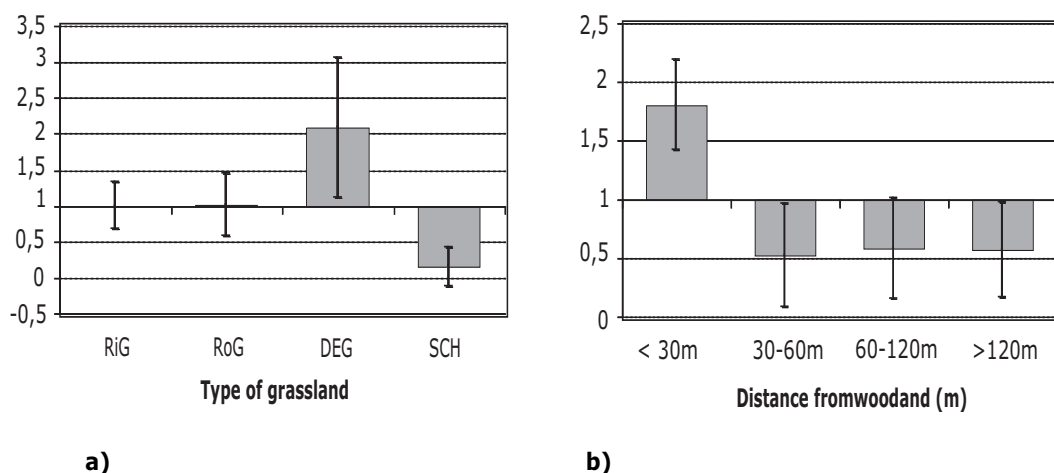
INTRODUCTION – Wild boar (*Sus scrofa*) is an opportunistic omnivorous (Schley and Roper, 2003). A conspicuous part of wild boar's diet consists of roots, bulbs, soil invertebrates and other below-ground material (Howe and Bratton, 1976; Genov, 1981). In addition, the alimentary habits of wild boar are influenced by the environmental characteristics and available resources of the area in which it lives (Herrero *et al.*, 2006). The recent colonisation by wild boar of the Belluno province (north-eastern Italy) has led to an increase in agricultural damages, with rapidly rising compensation costs, mainly due to rooting activity on pastures. The aims of this study were to explore the influence of environmental parameters on wild boar selection while rooting and to study the effects of rooting activity on floristic composition of different mountain pastures.

MATERIAL AND METHODS – The province of Belluno, in the northern part of the Veneto region, is a prevalently mountainous area (average altitude of 1276m a.s.l.); land use is mainly forestry (56.8%) and agriculture (12% meadows and crops, 7.5% pastures and grasslands) (ISTAT, 2002). The study was conducted in 5 alpine pastures representative of the different climatic districts of the province, patchily damaged by wild boar rooting and ranging in size from 16.9 to 48.6 ha (mean = 33.8ha; SD = 14.1ha) and in elevation from 1200 to 1700m a.s.l. (mean = 1497.2m a.s.l.; SD = 217.6m a.s.l.). During the summer 2006 each pasture ground, traditionally grazed during this period, was visited. Pasture types were classified according to the taxonomic key of Ziliotto *et al.* (2004) and, using a G.I.S. software (Arcview 3.1[®]) were mapped by digitizing polygon features on digital aerial photographs obtained from "Volo Italia IT 2000" (CGR, 2001). Location of rooting sites (a total of 80) was also mapped and characterised for type of grassland and distance from the nearest woodland. Since approximately 30 different grassland types were found, in order to perform subsequent analyses it was decided to assign each type to one of four categories, defined on the basis of forage productivity (rough grass, rich grass, degraded, shrubs and trees). Distance from woodland was divided into four classes (<30m; 30-60m; 60-120m; >120 m). Use of each resource (type of grassland and distance from woodland) category and class for rooting was expressed as the proportion of total rooting events occurring in each resource category and class (Manly *et al.*, 1993). The proportional availability of each resource cat-

egory and class was estimated from cartographical analysis as the proportion of total pasture surface included in each category and class. Selection (positive or negative) was estimated using a selection index (Manly *et al.*, 1993) as use/availability, using Bonferroni confidence intervals (95%) to assess probability of selection. In order to determine floristic composition and variation in species richness in damaged and undamaged areas, a vegetation survey was performed for each rooting site using two 10×10m sampling plots, placed respectively inside and immediately outside the damaged area. Plants species were classified and grouped according to their life form (Raunkiaer, 1934) and, with a systematic approach, into their botanical family (Poaceae, Fabaceae, Asteraceae, Other families). Species frequencies data inside and outside the damage were tested for statistical significance using the χ^2 -test and Bonferroni confidence intervals (95%).

RESULTS AND CONCLUSIONS – Proportional use of grassland types differed significantly from proportional availability (d.f.=3, $\chi^2=21.27$, $P<0.001$). Degraded pastures were clearly preferred, low and high productive pastures were used proportionally to availability, and shrubs and trees were avoided (Figure 1a). The preference observed for the degraded category could be explained with the low grazing intensity of this areas, which should favour a greater availability of invertebrate prey and softness of the soil (Schley and Roper, 2003).

Figure 1. Selection indexes for type of grassland (a) and distance from woodland (b). Bars indicate confidence intervals. Confidence intervals <1 indicate avoidance, while limits >1 indicate preference; if 1 is included in the confidence interval no selection is observed. RiG = Rich grass; RoG = Rough grass; DEG = Degraded pasture; SCH = Shrubs and trees.



Selection for distance from woodland was statistically significant (d.f.=3, $\chi^2=28.40$, $P<0.001$). A high preference for the distance class closest to woodland blocks (<30m) and an avoidance for the other classes were observed (Figure 1b). This selection can be related to a tendency to use open areas close to the woodland edge, that give the opportunity to gain cover quickly (Gallo Orsi *et al.*, 1995). Observed frequency of life forms within damaged areas differed from that expected from frequency observed outside (Table 1; d.f.=3, $\chi^2=21.32$, $P<0.001$). In particular, geophytes showed a significant reduction. These plants produce bulbs and rhizomes, and the reduction might indicate a selection by wild boar for these food resources. Significant differences were observed for botanical families between observed and expected (Table 1; d.f.=3, $\chi^2=45.04$, $P<0.001$). In particular it is possible to see a reduction for the species of Poaceae family and an increment of the Asteraceae and Other families. The Fabaceae family did not show any significant selection. The most probable explanation is that more sensitive species to wild boar disturbance (Poaceae) are replaced by others species which are probably more competitive in recolonizing rooted sites.

Table 1. Observed and expected frequency of life forms and botanical families. Confidence limits lower/higher than expected value indicate avoidance/preference.

Life form	Frequency Expected	Observed	Confidence Limits 95% CL lowest	95% CL highest
Camephyte	0.038	0.032	0.015	0.050
Geophyte	0.102	0.053	0.031	0.076
Hemicryptophyte	0.825	0.863	0.829	0.897
Terophyte	0.035	0.052	0.029	0.074
Botanical family	Expected	Observed	95% CL lowest	95% CL highest
Poaceae	0.239	0.143	0.107	0.179
Asteraceae	0.140	0.196	0.155	0.236
Fabaceae	0.101	0.080	0.052	0.108
Other families	0.520	0.582	0.531	0.633

In conclusion, our results suggest that rooting activity is concentrated in areas closest to woodland and that degraded types of mountain pasture are preferred. Rooting site selection by wild boar seems to be related with geophytes distribution. Future studies should further investigate the role of different root forms, and invertebrate richness, on this selection. Following the damage, families that have a low forage values tend to prevail in disturbed areas. However, a longer term study is needed to better define the evolution of pasture botanical composition of damaged areas.

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