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## **Wild boar interaction with human activities: three years of investigations in Central Italy**

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### **Summary**

*The recent record of the number of wild ungulates in Italy shows that in some areas there is a deleterious animal density. Among the ungulates, the number of wild boars has been increasing considerably, during past decades in Italy as well as in many European countries; somewhere the number has reached the overabundance level, causing conflict between wild fauna and human activities.*

*The implications of wild game overpopulation are manifold and mainly related to the sanitary risk and to the intensification of conflicts between agricultural practices and humans activities. As a consequence an increased compensation budget has to be allocated by local public authorities. Damages to agriculture, livestock and other economic activities catch the farmers' attention and that of the local communities. Management authorities, however lack of an integrated approach, and often tend to adopt ex post reimbursement schemes without appropriate management plans.*

*The wild boar population growth is likely to increase the number of requests for reimbursement that would make heavier the financial burden of public administrations up to a critical point. The present paper aims for a first definition of the potential damage. The value is assessed on the basis of a GIS definition of area where wild boars rest and on the potential damage to cultivations*

*Outcomes will be of help for those actors involved in wild board management plans as well as for public authorities responsible for compensating wild fauna damages to human activities. Conclusions shall drive public actions in order to minimize wild boar negative effects on areas potentially affected by the highest rate of damage.*

**Keywords:** wild boar, damage, risk, prediction

JEL Classification codes: Q18, Q28, Q57

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# Wild boar interaction with human activities: three years of investigations in Central Italy

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## 1. INTRODUCTION

The recent record of the number of wild ungulates in Italy shows that in some areas there is a deleterious animal density (Carnevali *et al.*, 2009). Among the ungulates, the number of wild boars has been increasing considerably, during past decades in Italy as well as in many European countries (Feichtner 1998, Klein *et al.* 2007, Milner *et al.* 2006; Saez-Royuela and Telleria 1986; Toigo *et al.* 2008; Carnevali *et al.* 2009); somewhere the number has reached the overabundance level, causing conflict between wild fauna and human activities.

Specialisation and intensification of agricultural activities implies the abandonment of marginal areas mostly in hilly and mountain regions (Ewert *et al.*, 2005). As a consequence, ecological equilibrium is pushed to shift to new states, and wild species may find additional fields to spread.

Concerns regards the increased number of damages to cultivations as well as the presence of the ungulate in urban areas where car accident (Primi *et al.*, 2009), and unwanted contacts between humans and wild boar are more and more frequent. Overpopulation is often indicated as the main reason for an alarming dynamics showing severe implications at different levels: costs for damage reimbursement; threat to biological diversity; damage to relevant natural ecosystems where important species are present (e.g. SCI and SPA according to Directive 92/43/EEC); sanitary risk.

Damages to agriculture, livestock and other economic activities catch the farmers' attention and that of the local communities (Schon, 2013; Thurfjell *et al.*, 2009; Morelle and Lejeune, 2015; Schley and Roper, 2003; Schley *et al.*, 2008). It is worthwhile to mention the case of protected areas where management rules do not allow hunting activities, letting wild species to grow uncontrolled (Tomei, 2014): field crops, orchards as well as livestock fodder are an excellent food source easily available to wild fauna whilst farmers have poor chances of an effective defensive strategy.

Agricultural crops subject to wild fauna risk is an important variable to be considered when management plans are designed. Species population, however, is often unknown and proxy variables based on reimbursement requests don't seem to have been effective in describing the phenomenon, in recent years. This is due to the following factors: 1. administrative procedures that take long to be completed; 2. public reimbursement funds that allow to deliver only a low damage reimbursement rate; 3. conflict between farmers and hunters' groups; 4. Common agricultural policy that gives incentives in case of non cultivated areas or non-harvested crops devoted to wild fauna feeding.

At present public bodies responsible for damage compensation don't have an integrated approach to wild boar, however they face an increasing economic burden able to hinder their financial capacity.

The present paper, which is part of a wider project focused on Lazio region, aims to quantify potential damage to crops in Viterbo province. The work benefits from previous studies that defined spatial location of wild boar and provided a GIS representation of resting places where the game may hide and reproduce; those results are presented in the second chapter along with the methodology used to assess the potential damage.

Concluding remarks will be of help for those actors involved in wild boar management plans, and public bodies responsible for compensating wild fauna damages to human activities. Conclusions shall drive public actions in order to minimize wild boar negative effects on areas potentially affected by the highest rate of damage

## **2. WILD BOAR POTENTIAL DAMAGE**

In this paper, the risk of damage to a cultivated field is intended as a consequence of two phenomena: 1. Probability of presence of wild boar on the field; 2. Value of the vegetable specie cultivated onto the field. Following this approach, the risk is intended as a potential damage due to the presence of the ungulate combined with the value of the agricultural products cultivated.

The first aspect is mainly correlated to the presence of resting places and ecological corridors in the surroundings of the fields. The latter is a consequence of the farmers' choices. Both, however, are influenced by the general legal ? CAP? Regulative? framework that may give incentives to specific cultivations (direct payments, set aside payments, etc.), may provide contributes to take care of environmental goods (hedges, protected areas, ecological focus areas, greening activities in general, etc.), and hunting practices like the artificial feeding of ungulates for allowing them to be less erratic and have an habitual presence for longer periods in limited areas (usually those areas pertinent to specific hunters' groups, or area where the hunting harvest may be easier).

Resting places are identified and identified and classified with respect to:

- Forest type
- Isolation
- Height
- Hunting intensity
- Water bodies distribution

The above characteristics vary according to the hunting activities and, accordingly, distinction between hunting season (mid September – January) and the rest of the year has been considered. This is a phenomenon well known in literature that investigates wild boars' spatial patterns and home range (Abaigar et al., 1994, Virgos, 2002, Acevedo et al, 2006, Pelorosso et al. 2007, Amici et al., 2012) referring to habits of seeking for a refuge during hunting seasons (hunting interference).

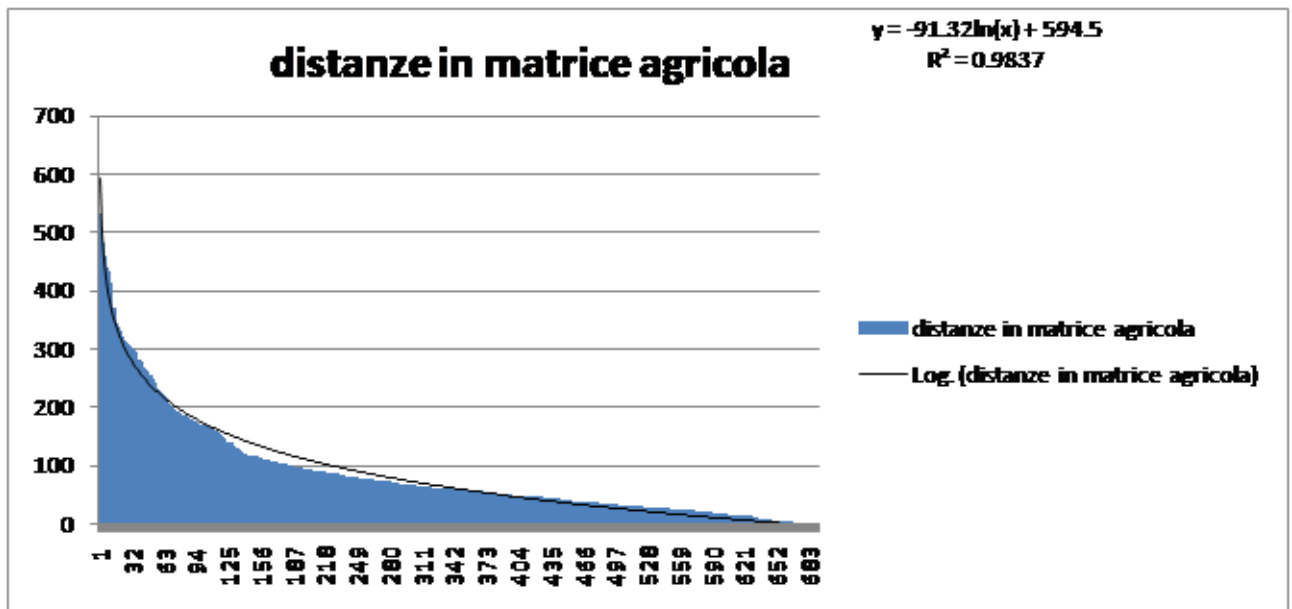
### 2.1. Wild boar resting places

Resting places are identified according to the work carried out by Amici et al (2017) by using specific weighting coefficients characterizing environmental factors (land use, altitude, water bodies buffers, natural and anthropic barriers, etc.) both in hunting and non-hunting seasons.

Season distinction is made because of the habit of wild boars of grazing in agricultural plots mainly during those months when the risk to be shot is low, while they prefer to hide themselves in resting places and protected areas during hunting season.

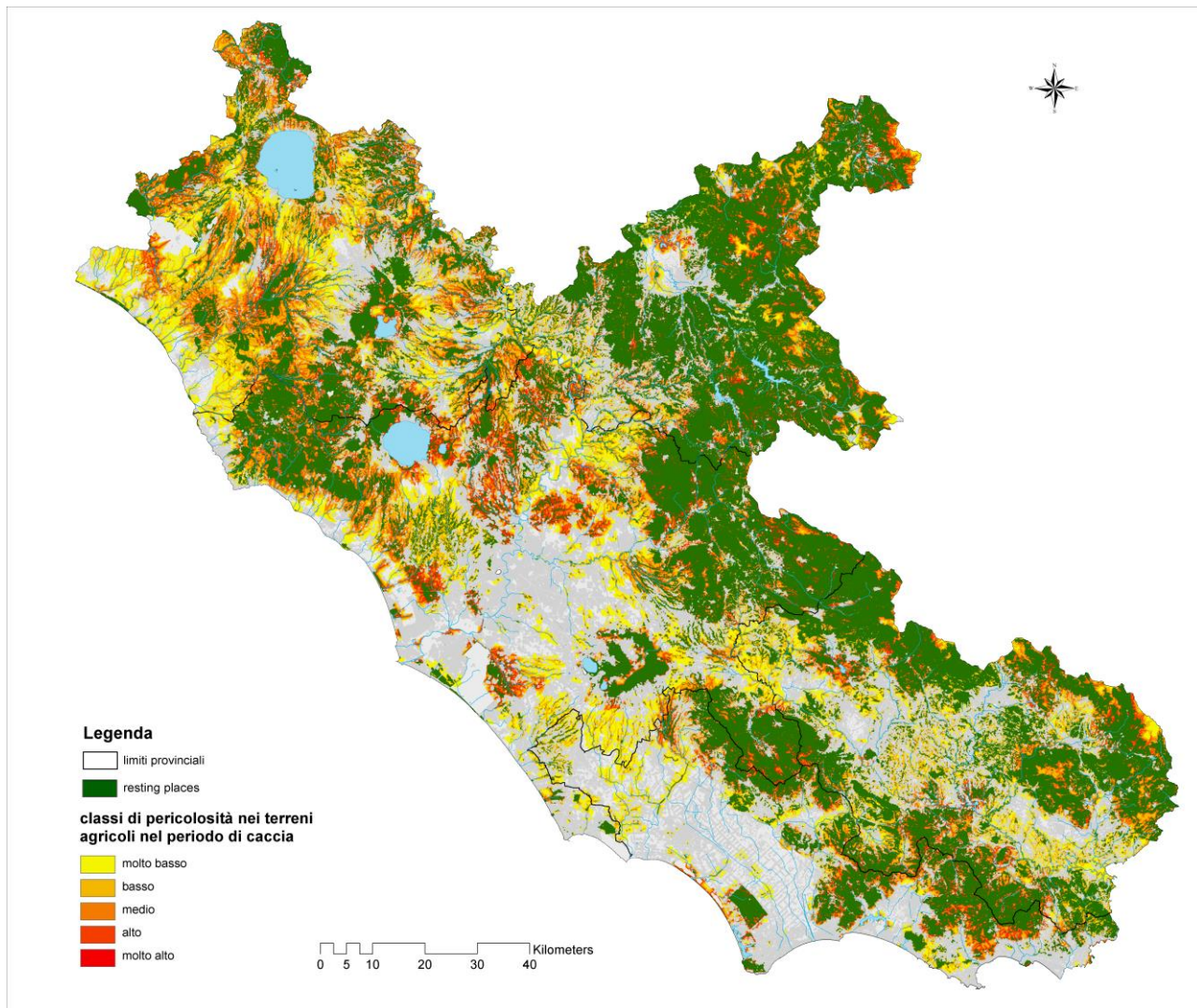
Level of potential danger due to wild boar presence in cultivate plots is then obtained following Amici et al. (2012), who found a suitable spatial damage distribution regressing past damage (based on historical reimbursement requests) as a function of resting places (RP) distance from agricultural plots. Distribution of distances and regression function are shown in Fig 1

Fig. 1: Damage distance from resting places (Amici et al, 2012)

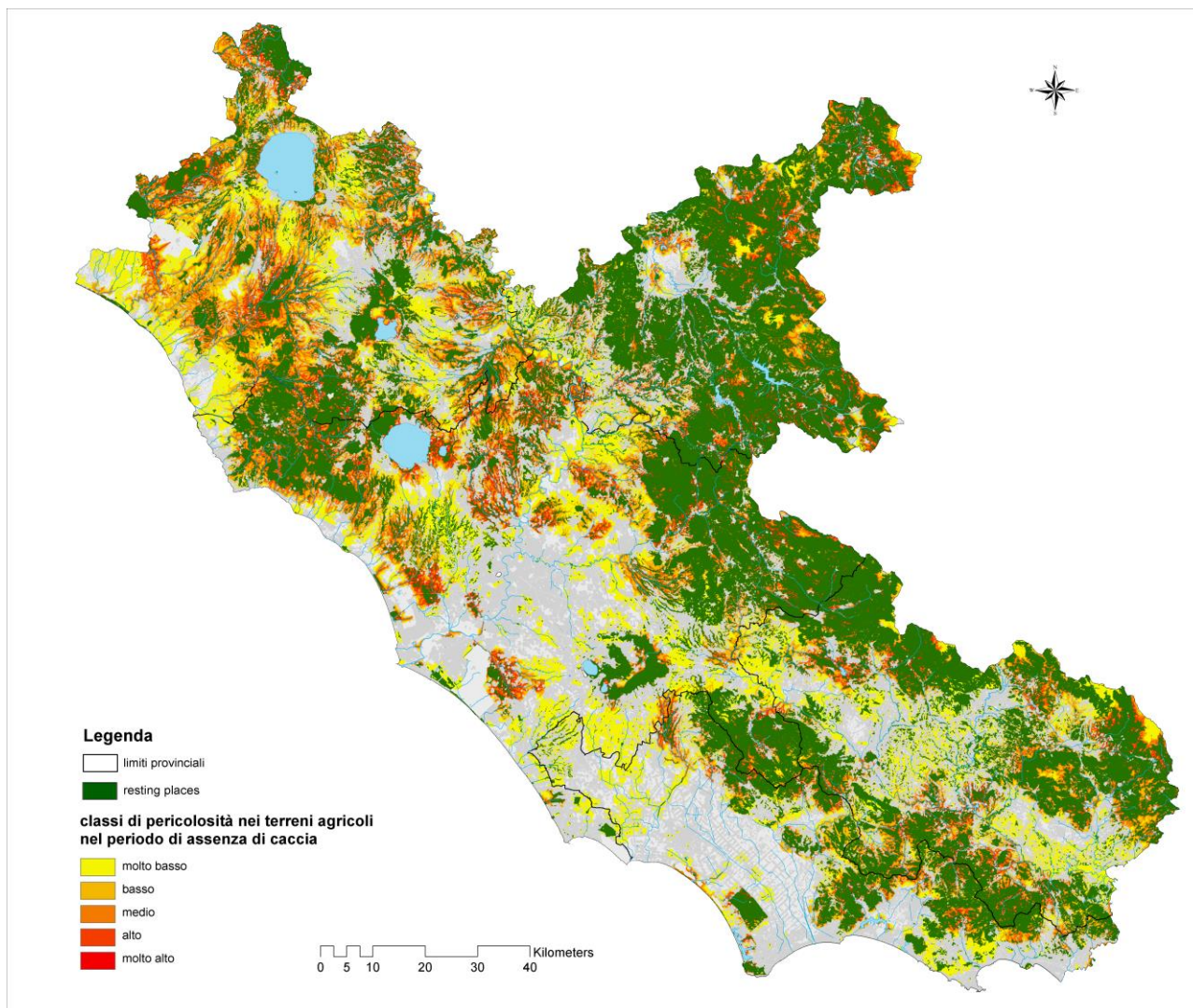


The product obtained by multiplying resting places classes (ordered according to territorial parameters) with distance from agricultural plots gives a risk map. Its distribution in Lazio region is shown in fig. 2 and 3 referring to hunting season and non-hunting season.

**Fig. 2:** risk map of Lazio Region during hunting season (Amici et al. 2012). Yellow = low risk Red = High risk



**Fig. 3:** risk map of Lazio Region during non-hunting season (Amici et al. 2012). Yellow = low risk Red = High risk



## 2.2. Crop Damage assessment

Historical data of damages reimbursements are reported in Fig. XXX

Figura 14 numero eventi

Figura 15 distribuzione dei danni

Figures refer to reimbursement procedure consequent to wild board mace to crops in Lazio region during the period 2011-2013, according to Amici et al (2017). Damage amounts, however, are generally underestimated for several reasons. Among other the most important seem to be 1. limited amounts are often neglected due to transaction costs to access the reimbursement procedure; 2. and long administrative procedures that may take several months up to years to be completed; 3. given the limited financial liquidity made available by public bodies responsible for compensations, usually reimbursement cover only a small

percentage of the assessed damage since the overall money amount available must be shared between all the farmers asking for compensation.

Present contribution aims at estimating a potential global damage caused by wild boar. The area under analysis is restricted in one of the fifth Lazio provinces: Viterbo. There the total annual reimbursement amount (in the period 2011-2013) reaches 0.437 mil of euro, for a total damaged surface of 1.929 hectares, on average.

The highest ratio of damages to agriculture occurs during the non hunting season, when wild boars move and graze with less fear of being shot. Thus, the most damaged cultivation are: irrigated field crops (corn, sunflower), hazelnuts and chestnuts.

The area of the province was classified following a field use map (CUS ver. ARP Lazio 2010), grouping original classes (total 76 classes) pertinent to the cultivated species relevant for the study, in three categories as below specified in tab. 1. By using the damage frequency obtained on the basis of farmers' reimbursement requests (area damaged divided by the total farm area cultivated with a specific crop), in each single crop category and danger classes (1 lowest to 5 highest), total damage area was calculated as shown in tab. 1.

**Table 1.** area (ha) of danger classes per crop group – Viterbo province. (source: own elaboration)

	Non-hunting season			Hunting season	
	Danger class	Overall Area (ha)	Potential Yearly Damaged area (ha)	Overall Area (ha)	Potential Yearly Damaged area (ha)
<b>Irrigated field crops</b>	1	34 115	1 711	35 099	2
	2	280	7	246	10
	3	4.408	215	4 132	7
	4	285	18	530	10
	5	3 943	162	4 900	9
<b>Chestnuts</b>	1	14 846	54	14 740	0
	2	59	9	48	11
	3	1 621	-	1 513	0
	4	220	15	485	2
	5	1 884	63	2 259	1
<b>Hazelnuts</b>	1	2 141	174	1 527	1
	2	2	0	1	4
	3	243	8	220	2
	4	37	1	90	2
	5	425	14	438	10
<b>Tot (ha)</b>		64 508	2 450	66 230	71

The damage amount on a constant area, however, depends on the crop stage which is unknown. This is why, in order to define a suitable damage interval, a minimum damage was calculated under the hypothesis of a damage close to seeding time (usually compensated with a sum equal to the value of tillage and seed operations + products used), while a maximum damage value corresponds to a total product loss. Values are reported in tab. 2



**Table 2.** potential damage (000 eur) of danger classes per crop group – Viterbo province. (source: own elaboration)

	Danger class	Non-hunting season				Hunting season			
		Total yearly damage (000 euro)		Yearly damage (euro/ha)		Total yearly damage (000 euro)		Yearly damage (euro/ha)	
		Min	Max	Min	Max	Min	Max	Min	Max
<b>Irrigated field crops</b>	1	855.35	3 421.42	25.07	100.29	0.76	3.03	0.02	0.09
	2	3.32	13.29	11.87	47.47	5.09	20.37	20.68	82.70
	3	107.28	429.13	24.34	97.34	3.39	13.55	0.82	3.28
	4	8.93	35.71	31.32	125.26	4.82	19.27	9.08	36.32
	5	81.14	324.58	20.58	82.32	4.28	17.13	0.87	3.50
<b>Chestnuts</b>	1	-	174.20	-	11.73	-	0.16	-	0.01
	2	-	29.26	-	494.12	-	36.18	-	760.43
	3	-	-	-	0	-	0.01	-	0.01
	4	-	46.87	-	213.33	-	5.76	-	11.87
	5	-	201.50	-	106.97	-	3.80	-	1.68
<b>Hazelnuts</b>	1	-	938.85	-	438.59	-	7.87	-	5.15
	2	-	0.54	-	232.87	-	23.29	-	-
	3	-	42.77	-	176.21	-	13.16	-	59.82
	4	-	4.48	-	122.01	-	12.10	-	134.24
	5	-	78.18	-	183.93	-	53.78	-	122.88
<b>Damage (000 eur)</b>		1 056.03	5 740.78			18.34	229.45		

### 3. CONCLUDING REMARKS

In Lazio region, as well as in all other Italian regions, wild boar increased its presence and impact in recent years. Damages to crops increased in last years, as shown by reimbursement requests that, however, seem to underestimate the total monetary impact amount on agricultural activities.

Different actors involved in planning management plans often don't put much efforts devoted to an effective coordination activity, being wild boar population control carried out mainly by means of gaming.

This study aims for assessing at a regional level how wild boars species may vary its presence depending on territorial characteristics. Resting places and agricultural activities were both identified according to land use classification and ecological variables.

Abandonment of agricultural activities implies an increase of uncultivated fields, mostly in marginal areas, which results in an increase of resting places where wild boar may refuge and settle. Furthermore, abandonment may enhance the mobility of wild boars that may tend to relocate expanding their resting and feeding habitat and damaging more cultivated plots.

The relation between resting places and damages clearly shows a negative logarithmic functional form of the distance between predated plots and resting places. More than the 95% of damages are encountered in a range of 300 m from resting places.

The analysis focussed on the most damaged crops: irrigated crops, chestnut and hazelnut; the economic losses were assessed with reference to reported damages in Viterbo province.

Potential damage has been quantified in a range between 18 000 and 229 000 euro during hunting season, and a range between 1,056 and 5,74 million of euro during non-hunting season. The result is in line with expectations being spring-summer cultivations preferred for feeding and due to the dissuasive effects of hunting activities that push ungulates to refuge in ban hunting areas.

Irrigated annual crops, which are cultivated on the largest area, show high total damage amount. Hazelnuts, however, show the highest damage per ha due to the higher product value and the high damage probability because traditional production districts are located close to forest and protected areas.

Damage per ha show results somehow instable and not completely correlated with the defined danger risk class. This is probably to ascribe to uncertain land use classification (mainly with respect to irrigated vegetal crops) in lower damage classes that tend to be “residual classes” summing several fuzzy situations. Another reason for those unexpected results may be the tolerance effect of farmers with respect to low damage amounts (given the low compensation rate, the procedures’ administrative burden joined with reimbursement time delay), while those severely affected tend to adopt preventive actions - such as specific fences – for high margin cultivations (e.g. hazelnuts).

Chestnuts values s somehow have to be discussed considering that in recent years the presence of chestnut gall wasp considerably reduced chestnut production. Orchards are often located in the middle (or beside) of forest areas and therefore chestnut is one of the first cultivation interested by wild fauna. Furthermore, little product amount are often not harvested and left in the orchards. This feeding source is appreciated by wild boars present in the surroundings.

From a management perspective it has to be noted that the potential damage amount is referred to the overall province area, and accordingly several actors are responsible for reimbursement. The total assessed damage, however, may be very high with respect to past amounts delivered to farmers, and potentially unaffordable to be reimbursed, causing increasing conflicts (among whom?).

At present hunting activities have shown to be unable to control ungulates’ population, while areas where hunting is not permitted, offer a wide basin for wild boar to take shelter during hunting season. A re-thinking of management plans in those areas gains an increasing priority for population control and damage reduction.

Widespread presence of the specie in the region suggests the need for a co-ordination of harvesting and control plans, and an agreement between management institutions to define an effective strategy (public administrations at province level, hunters’ groups, Private hunting farms, protected areas management bodies, Nature 2000 sites management bodies), adopting all the hunting techniques allowed in Italy i.e dog drive hunting, still hunting and standing hunting.

Since damages during hunting season are negligible, hunting season extension, even for limited periods (1 months before and after actual season) may contribute in lowering damages to crops’ first/final stages. Those are the most vulnerable because products (or seeds) stand on the plant or lay on the soil.

Wild boar management plans appear to be more and more important in reservoir areas (areas without hunting allowed throughout large part of the year ) where ungulates may find refuge during hunting season escaping from gaming. When game is suspended then wild boars move again to feeding areas with the result that control plans by means of hunting are ineffective.

Policy measures may take place as well. Abandonment of cultivated areas, because of the adoption of CAP measures tending to lower farmers’ income support, may be limited introducing specific actions or introducing soil management requirements tending to make non-cultivated fields less inviting for wild fauna.

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