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Research Article

An integrated program to prevent, mitigate and compensate Wolf (*Canis lupus*) damage in the Piedmont region (northern Italy)

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Abstract

Wolves' natural recolonization in the Western Alps in the early 1990s resulted in increased in depredation events. The Piedmont Regional Administration has been running a program aimed at monitoring the wolf expansion process and mitigating the human-wolf conflict since 1999. Three key actions, i) compensation of canids (wolf and dog) damage; ii) a subsidy system to promote good livestock husbandry practices; iii) promotion of preventive measures, were used to prevent and compensate damage caused by wolves. Direct damage was verified by veterinarians and refunded according to an annually updated price list. In addition indirect losses were compensated on a lump-sum basis proportional to the herd size for each attack.

Since 2007 a subsidy system has rewarded shepherds who, pasturing within the home range of wolf packs and in neighbouring areas, have adopted good management practices and preventive measures.

Ad hoc damage prevention plans have mainly addressed chronic situations. Changes in animal husbandry (removal of dead livestock from pastures, confining sick animals, synchronizing births and using shed lambing), promotion of use of electric fences and introduction of livestock guarding dogs (LGDs) have been the most common interventions. A new model of electrified net has been developed and LGDs have been selected and diffused; LGDs behavioural research is in progress.

The Regional wolf Program integrates different measures to manage the human-wolf conflict: not only to compensate depredation damages, but also to stimulate the adoption of husbandry practices compatible with the presence of wolves. Actually, in order to promote wolf tolerance by livestock owners, the Program aimed to distribute wolf conservation costs more equitably and involve farmers in decisional processes.

Background

Wolf (*Canis lupus*) became extinct in the Western Alps at the beginning of the 20th century (Brunetti, 1984). In Italy, the wolf population declined to a minimum in the 1970s (Boitani, 1992); the wolf has been legally protected since 1971; it started recovering since the 1980s, des-

pite persistent illegal persecution and thanks to ecological changes such as the decline of extensive farming, increased forest cover and wild ungulates densities (Boitani, 1992).

Wolves natural recolonization of the Western Alps began in the 1990s, as a Northern Apennines wolf sub-population spread (Boitani, 2003; Fabbri et al., 2007). Since 1994, when the first pack was documented in the Alps, Piedmont population increased to 20 packs in 2009, including those with transboundary territories (Marucco et al., 2010).

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Farmers were intolerant to the presence of wolves since in the absence of predators livestock management in the alpine pastures evolved into non-guarded grazing. As a result human-wolf conflict has resurfaced in the areas occupied by the species.

In order to monitor the recolonization process and to manage the conflict, Piedmont regional administration started a Program called “Progetto Lupo Piemonte” in 1999. Funding came from the Interreg Program Italy France from 1999 to 2001 and afterwards from the budget of the same Administration. In 2005 the Regional Center for Conservation and Management of Large Carnivores was instituted at Alpi Marittime Natural Park in order to coordinate the research and management activities.

The “Progetto Lupo Piemonte” Program, besides monitoring wolf population, with the aim to mitigate the wolf / farmers conflict, implemented 3 key actions: i) compensation for livestock damages; ii) a subsidy system to promote the good livestock husbandry practices; iii) promotion of preventive measures.

Compensation for livestock losses

The Regional Administration, uses an *ex-post* compensation policy (Boitani et al., 2010; Schwerdtner and Gruber, 2007) as established by national Italian law n. 157/92. Farmers are compensated for all animals killed or injured due to predation. Veterinarians of the Program must be alerted within 48 hours from finding the damage. They inspect the scene of the alleged attack and carry out the necropsy of carcasses and/or examine the injured animals; the main aim is to check if canids depredation effectively occurred as well as verify whether or not wolf or dog attacked. In addition, the veterinarians provide free medical care to wounded animals.

An objective distinction between wolf- and dog-caused damages is not feasible in most situations (Cozza et al., 1996). For this reason damage caused by both predators are equally refunded, except when the dog’s owner is traced.

The amounts to be refunded take in account the species of the victims, breed, sex and genetic

value. The prices are annually updated on the basis of market prices and with the agreement of farmers associations.

The observed damages paid by such compensation scheme do not always correspond to the actual loss: lost animals and indirect damages such as abortion and loss of condition due to stress are difficult to assess, especially for sheep and goat herds (Engeman, 2000; Nyhus et al., 2003). Since 2006, in order to compensate such costs a lump-sum is also paid. The amount, applicable only to sheep and goat damage, is proportional to flock size and is allocated when the first attack of the season occurred; then, for each ensuing attack the sum is increased by 15%. The total amount is shared among owners of the animals in the flock in proportion to the number of animals owned. In 2009, in addition to the compensation for verified damages, for the first attack to a flock of up to 20 animals, €60 were paid to cover indirect damages, increasing to €260 for a flock composed by more than 1000 heads.

Given that the wolf population recolonized the region since more than one decade and the farmers have had time to adapt livestock management to wolf presence (Marucco et al., 2010), since 2006 eligibility for compensation depends on the adoption of at least one preventive measure between human presence in the pasture, LGDs use, corrals and night confinement (DGR 9-4153 of the 30th October 2006). This is meant as an incentive to avoid depredation damage to animals detained in wild state (Fourli, 1999). Damage is refunded yearly at the end of the grazing season.

Farmers are responsible for carcass disposal. According to EU Regulation 1069/2009 (European Parliament and Council, 2009), repealing EU Regulation 1774/2002 which had similar rules for carcass disposal, the carcass has to be destroyed by burning or, in remote areas, the mayor can allow the burial on site. Until 2009 the disposal costs were directly sustained by the farmers; for this reason some attacks might not have been reported in order to avoid such costs, but from 2010 farmers are compelled by regional law n. 11/2001 (Consiglio Regionale del Piemonte, 2001) to subscribe an insurance covering carcass disposal costs.

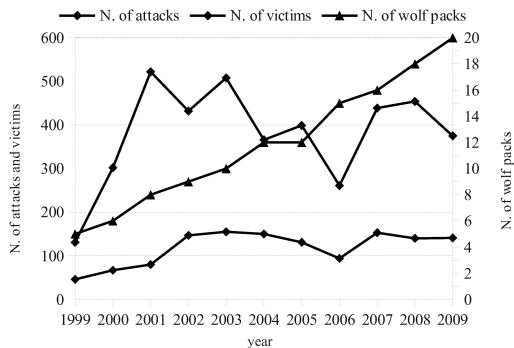


Figure 1 – The canids (wolf and dog) trend of damage on domestic animals and the trend of wolf packs in the Piedmont Region: number of attacks, number of victims (dead and injured) and number of wolf packs in the years 1999-2009.

Livestock grazing in Piedmont pastures during the summer seasons from 1999 to 2009 averaged 77198 sheep and goats (SD = 8830) and 89918 cattle (SD = 5998) (data from public veterinary service, Regione Piemonte 2009).

Livestock damage began in the Piedmont Region in the 1990s; the compensation system was launched on 1999; the certified canids attacks and victims increased according to wolf pack number (Fig. 1).

Between 1999 and 2009 the program recorded an average of 118.5 canids attacks/year (SD = 39.3, range 46–155) that caused an average of 380.8 victims (dead or injured)/year (SD = 114.5, range 131–508). Based on physical evidence or field findings, the wolf has been regarded as certain or probable responsible for 76.0% of attacks and for 61.8% of victims, dog has been regarded as certain or probable responsible for 9.8% attacks and for 20.1% of victims and finally 14.2% of attacks and 18.1% of victims were attributed to canids in general.

Most verified depredations occurred in the south-western parts of the Alps (Maritime Alps, Cuneo Province) and in the western part (Cottian Alps, Torino Province), reflecting the history of wolf recolonization from Apennines northward (Fig. 2). Some complaints were also filed in the northern part of the region close to the Swiss border (Ossola, Verbano-Cusio-Ossola Province), due to loners. The Program has been extended to the Apennines part of Piedmont (Alessandria Province) only since 2005,

so there is no data regarding wolf presence and damage before this date, though it is likely the area was recolonized before Alps.

The main prey were sheep (79.4%) and goats (16.8%), but repeated depredations on bovines (3.5%) occurred locally, mainly on calves. Equids (0.2%) and shepherd dogs (0.1%) were rarely prey.

There were some false claims. Herders complained wolf damage, but by the means of necropsy another cause of death was verified. On some occasions the carcass had even been altered (e.g. post-mortem wounds inflicted in the neck region) in order to simulate a carnivore attack. These facts stress the importance that damage verification be carried out by skilled veterinarians, in order to avoid fraud, hence, waste of public resources and distortion the real impact of depredation.

Between 1999 and 2009, the program paid an average of €40245.8/year (SD = 17745.9) to damaged herders (average 48/year), being almost stable in recent years (Fig. 3) although the number of packs grew from 5 to 20 calculating transboundary packs (Marucco et al., 2010). The maximum expense in one year was €69146.08 in 2009.

Data on the wolf pack sizes and distribution in the same period in Piedmont came from a monitoring study carried out in the same Program by the means of non-invasive genetic techniques (Marucco et al. 2010, 2012, this issue). We divided the annual amount paid for damage compensation for the annual number of packs: the annual cost per wolf pack ranged from €2272.4 to €4519 with an 11-year average of €3377 (SD = 735.3) (Fig. 3).

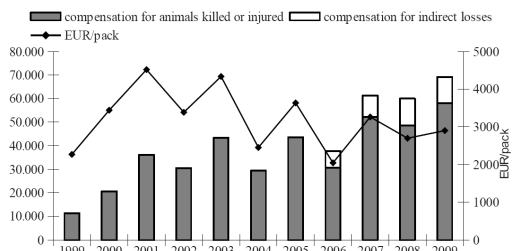


Figure 3 – The annual cost of damage compensation and compensation paid yearly per wolf pack in the Piedmont Region in the years 1999-2009.

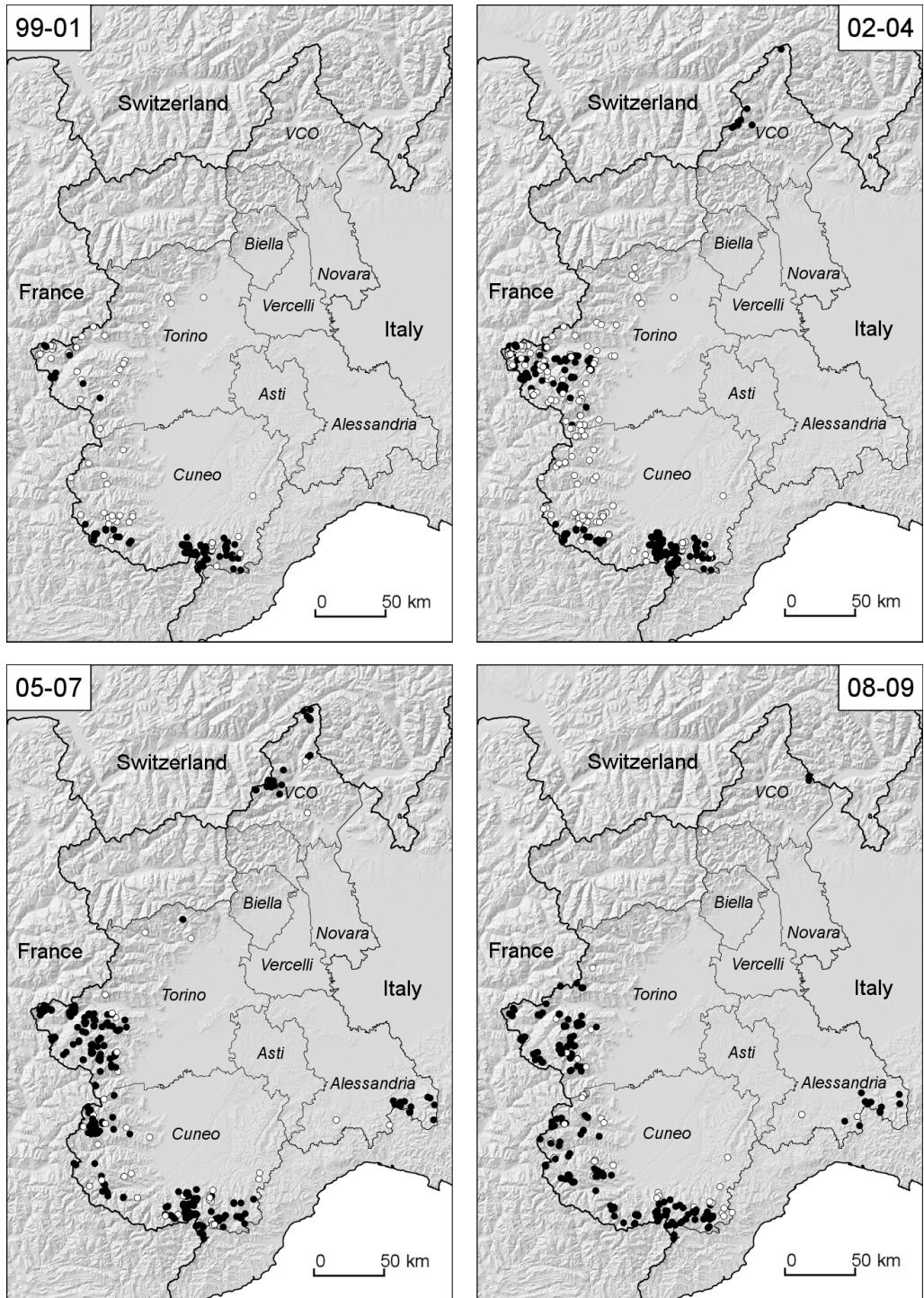


Figure 2 – Geographical distribution of livestock depredations recorded in the Piedmont Region, Italy, since 1999 (onset of the Program called “Progetto Lupo Piemonte”) to 2009. Full dots correspond to wolf depredations, open dots to unknown canid or dog depredations. The Piedmont Region area is outlined in the upper left map.

A subsidy system to promote good livestock husbandry practices

In the areas where livestock husbandry evolved in the absence of large carnivores, wolf recovery and acceptance imposes further costs and labour, such as attending livestock, using guarding dogs and herding livestock at night into enclosures. These costs fall on the shepherd and they are not covered by traditional *ex-post* damage compensation schemes (Boitani et al., 2010). Moreover the compensation system per se does not incentivate farmers to self-protection, on the contrary it serves as an insurance and may even foster a reduction of preventive actions (which causes costs) in order to simply receive compensation for damage (Bulte and Rondeau, 2005; Rondeau and Bulte, 2007).

In order to integrate the *ex-post* compensation scheme and to stimulate the farmers to enhance livestock protection, since 2007 the Program has been running a subsidy system (“Premio di Pascolo Gestito”) which rewards the sheep and goat herders who pasture in wolf presence areas and implement good management practices and preventive measures.

Farmers who file for the subsidy are visited on mountain pastures by an operator of the Program. During the visit they fill in a declaration form regarding flock management, that the operator can verify on the field. Finally a score is attributed to each farmer; 23.2% of the maximum score are related to general management (milk production, frequency at which pen is moved, flock size), 26.3% for shepherds attending the flock, 24.2% for the use of secure enclosures at night, 21.1% for the number and efficiency of livestock guarding dogs (measuring the satisfaction degree of the owner and biting complaints filed to veterinary services), and 5.3% for the number of attacks sustained during the pasture season. The sum of points scored is then multiplied by a coefficient based on wolf presence as monitored by the Program: in the zones of stable presence (core areas of wolf packs) is multiplied by 1, in zones of temporary presence by 0.8, while in areas of absence no subsidy is awarded. The budget made available by the administration

is shared among farmers who applied in proportion to such final score.

The multiplication by different coefficients according to wolf presence is aimed to concentrate the efforts to promote prevention measures in the intensest areas of wolf presence, where the depredation risk is supposedly higher. Being linked to the wolf presence (and to the packs core areas), the subsidy recalls compensation-in-advance schemes as defined by Schwerdtner and Gruber (2007) with the difference that 78% of the score depends on the adoption and effectiveness of preventive measures (human presence, night enclosures, guarding dogs). In 2009, 78 shepherds were awarded the subsidy (total € 81645.30, mean € 1046.73).

Promotion of preventive measures

From 1999-2009, in the Piedmont Region, 293 farms suffered depredation losses. As reported in several studies carried out in other areas, predation events on livestock were particularly concentrated in a few farms that reported a high level of conflict (Cozza et al., 1996; Ciucci and Boitani, 1998; Gazzola et al., 2008; Fritts et al., 1992; Robel et al., 1981); 91.9% of the affected farms suffered < 11 attacks, whereas 8.1% suffered 11-92 attacks per farm, accounting for 50% of canids victims (ranged from 36 to 160) and 49.3% of depredation events reported for the region. Frequent attacks consistently inflated compensation costs and were frustrating for the herders, stirred up the conflict and may have incentivated illegal revenge killings.

For these reasons the Program focuses on the chronic situations where technicians work in close collaboration with herders to implement preventive interventions.

The key aspect of an effective predation control plan is to integrate various techniques. Moreover, all protection methods have pros and cons and what is effective for one farmer, not be for another. For this reason a damage prevention plan is developed by the technicians of the Program according to the specific needs and concerns of each farmer.

The use of electric fences and use of livestock

guarding dogs are promoted along with changes in animal husbandry such as the presence of the shepherd in the pasture to attend livestock, the location and management of lambing season, culling of weak animals, carcass removal from pastures.

Proper livestock management can minimize the risk of predation. Human presence in the pasture is the key point to enable good animal husbandry and rational use of the pasture and it discourages predation. In case of small flocks, where human presence is not economic, the association between different livestock owners is encouraged to share the cost of management practices and of preventive measures.

Electric fencing was proven to be effective for preventing predation (Linnell et al., 1996; Wade, 1982); moreover it is quite easy to maintain and cheaper than conventional fencing. In the Alps mobile electric fences are mainly used for confining flocks at night. While conventional nets are 90 cm, a higher (145 cm), stronger electric net was developed according to farmers needs to improve the safety, but as it is heavier, it is less suitable for frequent replacing of the enclosure and for use in zones not served by roads. A total of 57 shepherds were provided with it or with a conventional one.

LGDs are very effective (Coppinger et al., 1988; Green and Woodruff, 1988; Green et al., 1994, 1984) to protect livestock from predators. In Piedmont the use of LGDs is not traditional, so shepherds did not know how to train these dogs. In 2004 Orsiera Rocciavrè Natural Park began a LGD promotion program. It provided some selected shepherds with puppies and a specialist taught them how to raise, train and socialize the dogs with the flock. Since 2005 LGD program was extended to the whole of Piedmont and it was integrated in the regional Program. The Regional Center for the selection and breeding of LGDs was instituted at the Orsiera Rocciavrè Natural Park in 2006.

The methods described by Coppinger et al. (1983) and Lorenz and Coppinger (1986) that have been updated by Green and Woodruff (1999) and Dawydiak and Sims (2004) have been adopted to introduce dogs in the flocks. Rearing techniques vary depending on the individual dog and owner personalities and the

sheep husbandry system in use. In general the most important factor is early bonding to the flock: the puppies during the period of social development have to socialize with the other species that they will protect. Puppy development has to be supervised in order to prevent and correct bad habits (excessive playfulness or aggressive behaviour towards livestock). The puppies must also be socialized with humans. An appropriate level of human contact with the guarding dog is paramount, which varies depending on the temperament of the dog. Too much human contact can cause a dog to be more bonded to humans than to livestock. Otherwise too little human contact can cause a dog to be extremely shy or fearful of people, sometimes aggressive. Such dogs are difficult to manage and are hard to control: they cannot be moved readily to other pastures and cannot be kennelled.


Behavioural studies are ongoing in order to evaluate the dog's temperament by means of developing a specific ethogram: the first adult dogs introduced worked successfully, showing all the three basic traits (trustworthy, attentive and protective) of LGDs (Coppinger et al., 1983; Coppinger and Coppinger, 1996).

During 2004-2009, 40 LGDs (mainly Maremma Sheepdog and some Great Pyrenees breed) have been introduced into 21 different flocks. They have seemed effective to protect livestock: in the 73.7% of these flocks the numbers of attacks and victims have been decreased in the 2 years after LGDs introduction. Further studies will be important to confirm this hypothesis.

Lessons learned

- Compensation is, as elsewhere, the main tool used to mitigate the costs of depredation, but it may be limited at improving tolerance for wolves as already pointed out by Muhly and Musiani (2009); in fact it has its most positive effects where livestock are depredated rarely and irregularly (Boitani et al., 2010), but it fails to reduce the animosity towards wolves of chronically affected herders. The costs of compensations, although not negligible, are still some 50 times less than the sums

paid annually to refund wild boar damage to crops in the Piedmont Region (Regione Piemonte, 2011).

- The procedure to verify alleged claims must provide that a skilled veterinarian carries out thorough necropsies and examination of wounded animals. Fraudulent claims are common and if not promptly recognized they tend to become chronic, causing waste of resources and distorting the extent of real wolf damage.
- As the compensation scheme alone is not able to promote the adoption of preventive measures, the subsidy system fills the gap and, being linked to wolf presence, to some extent acts as a form of performance payment / *ex-ante* compensation (Zabel and Roe, 2009) which is well accepted by the agricultural community.
- It's of paramount importance, both for economic and conservation aspects to address chronically affected flocks the effort to promote and implement preventive measures. In fact regularly repeated damages cause unacceptable losses to a minority of farmers, who can suffer most of the damage. Such cases can also fuel political debate, and media campaigns at the local level.
- In order to be accepted by the farmers, both compensation rules and prevention interventions need to be the result of an ongoing, participatory process. Farmers associations are constantly involved in setting the rules of compensation schemes and of the subsidy for good livestock husbandry practices. Moreover the involvement of farmers makes the efforts for mitigating wolf conflicts highly effective; for this reason the presence of mediators to help maintain dialogue between farmers and Institutions is beneficial. In particular they are deputed to listen to farmers needs in order to develop with them *ad hoc* prevention plans and to report their raised issues and proposals to the administration in a privileged channel. 

References

- Boitani L., 1992. Wolf research and conservation in Italy. *Biol. Conserv.* 61(2): 125–132.
- Boitani L., 2003. Wolf conservation and recovery. In: Mech L.D., Boitani L. (Eds.) *Wolves. Behaviour, Ecology and Conservation*. University of Chicago Press, pp. 317–340.
- Boitani L., Ciucci P., Raganella-Pelliccioni E., 2010. Ex-post compensation payments for wolf predation on livestock in Italy: a tool for conservation? *Wildl. Res.* 37(8): 722–730.
- Brunetti R., 1984. Distribuzione storica del lupo in Piemonte, Valle d'Aosta e Canton Ticino. *Riv. Piem. St.Nat.* 5: 7–22. [in Italian]
- Bulte E.H., Rondeau D., 2005. Why Compensating Wildlife Damages May Be Bad for Conservation. *J. Wildl. Manage.* 69(1): 14–19.
- Coppinger R., Coppinger L., Langeloh G., Gettler L., Lorenz J., 1988. A decade of use of livestock guarding dogs. *Proceedings of the Vertebrate Pest Conference*: 209–214.
- Coppinger R., Lorenz J., Glendinning J., Pinardi P., 1983. Attentiveness of guarding dogs for reducing predation on domestic sheep. *J. Range Manage.* 36(3): 275–279.
- Coppinger R., Coppinger L., 1996. Biologic Bases of Behavior of Domestic Dog Breeds. *Readings in Companion Animal Behavior*: 9–18.
- Cozza K., Fico R., Battistini M.L., Rogers E., 1996. The damage-conservation interface illustrated by predation on domestic livestock in central Italy. *Biol. Conserv.* 78(3): 329–336.
- Ciucci P., Boitani L., 1998. Wolf and dog depredation on livestock in central Italy. *Wildl. Soc. Bull.* 26: 504–514.
- Consiglio Regionale del Piemonte 2001. Legge regionale 25 maggio 2001, n. 11. (Testo coordinato) Available from: <http://arianna.consiglioregionale.piemonte.it/base/coord/c2001011.html>. [in Italian]
- Dawdyiak O., Sims D., 2004. *Livestock Protection Dogs Selection, Care and Training*. Second Ed., Alpine Publications, Loveland, Colorado.
- Engeman R.M., 2000. Economic considerations of damage assessment. *Proceedings of the Third National Wildlife Research Centre Special Symposium, Fort Collins, Co.*: 1–3.
- European Parliament and Council, 2009. Regulation No. 1069/2009 of 21 October 2009. Available from <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:300:0001:0033:EN:PDF>.
- Fabbri E., Miquel C., Lucchini V., Santini A., Caniglia R., Duchamp C., Weber J-M., Lequette B., Marucco F., Boitani L., Fumagalli L., Taberlet P., Randi E., 2007. From the Apennines to the Alps: colonization genetics of the naturally expanding Italian wolf (*Canis lupus*) population. *Mol. Ecol.* 16(8): 1661–1671.
- Fourli M., 1999. Compensation for damage caused by bears and wolves in the European Union: experiences from LIFE-Nature projects, Office for Official Publications of the European Communities.
- Gazzola A., Capitani C., Mattioli L., Apollonio M., 2008. Livestock damage and wolf presence. *Journal of Zoology* 274(3): 261–269.
- Green J.S., Woodruff R.A., 1988. Breed comparisons and characteristics of use of livestock guarding dogs. *J. Range Manage.* 41(3): 249–251.

- Fritts S.H., Paul W.J., Mech L.D., Scott D.P., 1992. Trends and management of wolf–livestock conflicts in Minnesota. US Fish and Wildlife Service, Resource Publication 181. Northern Prairie Wildlife Research Center Online. Available from <http://www.npwrc.usgs.gov/resource/mammals/wolflife/index.htm>.
- Green J.S., Woodruff R.A., Andelt W.F., 1994. Do livestock guarding dogs lose their effectiveness over time. Proceedings of the 16th Vertebrate Pest Conference: 41–44.
- Green J.S., Woodruff R.A., Tueller T.T., 1984. Livestock-guarding dogs for predator control: costs, benefits, and practicality. *Wildl. Soc. Bull.* 12(1): 44–50.
- Green J.S., Woodruff R.A., 1999. Livestock guarding dogs: protecting sheep from predators. *Agriculture information bulletin (USA)*, 588, 31 pp.
- Linnell J.D.C., Smith M., Odden J., Kaczensky P., Swenson J., 1996. Strategies for the reduction of carnivore–livestock conflicts: a review. *Norw. Inst. Nature Res. Oppdragsmelding* 443: 1–118.
- Lorenz J.R., Coppinger L., 1986. Raising and training a livestock-guarding dog. *Extension circular, Oregon State University, Extension Service (USA)*: 8.
- Marucco F., Avanzinelli E., Dalmaso S., Orlando L., 2010. Progetto Lupo – Regione Piemonte. Rapporto 1999-2010, Torino, Italy.
- Marucco F., Avanzinelli E., Boitani L., 2012. Non-invasive integrated sampling design to monitor the wolf population in Piemonte, Italian Alps. *Hystrix (online first)* 23(1). doi:10.4404/hystrix-23.1-4584.
- Muhly T.B., Musiani M., 2009. Livestock depredation by wolves and the ranching economy in the Northwestern U.S. *Ecol. Econ.* 68(8-9): 2439–2450.
- Nyhus P., Osofsky S., Ferraro P., Madden F., Fischer H., 2003. Bearing the costs of human-wildlife conflict: the challenges of compensation schemes. In: Woodroffe R., Thirgood S., Rabinowitz A. (Eds.). *People and Wildlife: Conflict or Co-existence*. Cambridge University Press, Cambridge: 107–121.
- Regione Piemonte, 2009. Relazione annuale di attività dei servizi veterinari delle ASL Anno 2009. Available from <http://www.regione.piemonte.it/sanita/cms/animali/relazione-annuale-dei-servizi-veterinari/1006-relazione-annuale-servizi-veterinari-anno-2009.html>. [in Italian]
- Regione Piemonte, 2011. Importi periziati (in euro) a carico delle diverse specie o gruppi di specie in Piemonte nel periodo 2004-2009. Available from http://www.regione.piemonte.it/agri/osserv_faun/dwd/dati/agricoltura/danni_specie.pdf. [in Italian]
- Robel J.R., Dayton A.D., Henderson F.R., Meduna R.L., Spacht C.W., 1981. Relationship between husbandry methods and sheep losses to canine predators. *J. Wildl. Manage.* 45: 894–910.
- Rondeau D., Bulte E., 2007. Wildlife Damage and Agriculture: A Dynamic Analysis of Compensation Schemes. *Am. J. Agric. Econ.* 89(2): 490–507.
- Schwerdtner K., Gruber B., 2007. A conceptual framework for damage compensation schemes. *Biol. Conserv.* 134(3): 354–360.
- Wade D.A., 1982. The use of fences for predator damage control. *Proceedings of the Vertebrate Pest Conference*: 24–53.
- Zabel A., Roe B., 2009. Optimal design of pro-conservation incentives. *Ecol. Econ.* 69(1): 126–134.

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