

ASSESSING THE EFFICACY OF ELECTRIC FENCES TO PREVENT BEAR DAMAGE IN ITALY

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1. Introduction

The future of the brown bear (*Ursus arctos*) in Italy is rather uncertain. A recent reintroduction intervention in the Alps has temporarily avoided their extinction, while in the Apennines, a small population of ca. 60 individuals of Marsican brown bears (*Ursus arctos marsicanus*) (Ciucci and Boitani, 2008; Ciucci et al., 2015), representative of a unique sub-species, is highly endangered. Both populations are very small and face conservation risks, although of different severity and nature. The Alpine population is in contact with the Balkan population through Slovenia (although irregular and rare), while the Apennine population is endemic, isolated and struggles to expand its distribution from the core. The small and isolated Apennine population has been protected since the establishment of the National Park of Abruzzo, Lazio and Molise (PNALM) in 1923. Being almost exclusively distributed within the National Park and its immediate surrounding mountains, the Apennine brown bear

population suffered high human-caused mortality in the last decades. The main cause of persistent illegal killing is conflicts with human activities, namely the damages bears cause to livestock, beehives and crops (Ciucci and Boitani, 2008). In PNALM, a compensation program has been maintained since 1967, and since 1991 it is directly managed by the Park authority (National Law 394/91).

In the Alps, after a positive period following their reintroduction in 1999-2002 (Zibordi et al., 2010) the expansion of bears has slowed down and public acceptance seems to be lower (Groff et al., 2015) as damages to private property increases. The interventions required for guaranteeing the conservation of these populations are diverse (Boitani et al., 2015) and they require the joint effort of technicians, researchers, and administrators, as well as the fundamental support from public opinion and the main stakeholders.

The conservation of large carnivores in human-dominated landscapes needs to take in considera-

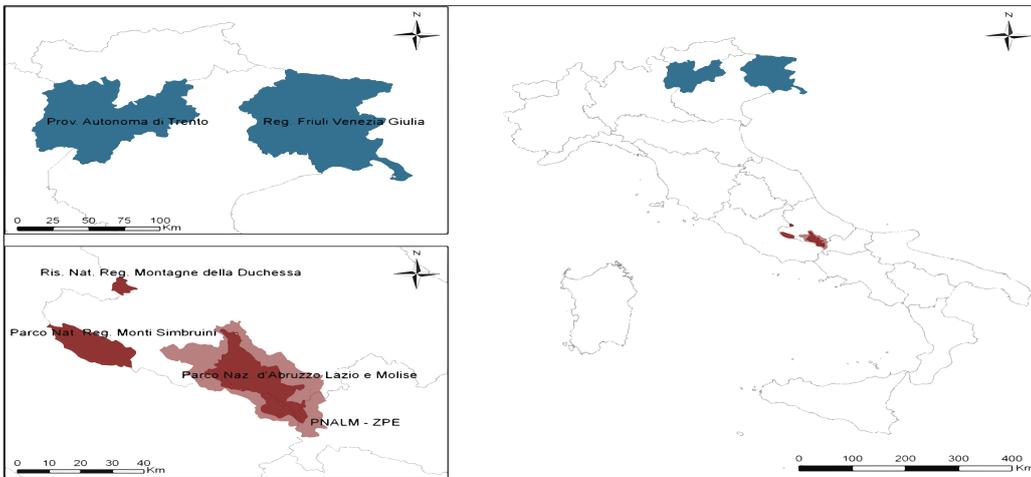


Fig. 1. Intervention area of the LIFE ARCTOS Project where fences were delivered and checked.

tion the social and economic acceptance of those potential competitors, otherwise it will not be possible to maintain viable populations of those species unless huge economic and human resources are invested. Furthermore, the importance of sharing experiences is often forgotten, and the impact of local programs or individual projects is often limited in time and space, focused mainly on the effects and neglecting the causes, not allowing them to penetrate into the cultural aspects surrounding agricultural activities and habits.

The development of a series of management measures aiming at promoting the conservation of the brown bear populations of the Alps and Apennines, and sustaining their recovery by reducing conflicts with the anthropic activities, was the goal of the LIFE ARCTOS Project “Brown Bear Conservation: Coordinated Actions in the Alpine and Apennine Range” (LIFE09NAT/IT/160) (www.life-arctos.it). The project was operated from 2009 to 2014 and involved ten different entities, from regional authorities to state departments, protected areas, the University of Rome and WWF Italy.

Apart from the promotion of information and awareness among the main stakeholders, the distribution of electric fences (either mobile or permanent) was used as a concrete conservation action to prevent bear damages to different production systems (e.g. livestock, crops and apiaries) and help advance social acceptance. In this article we present information on both our procedures and the effectiveness of the fences.

2. Study Area

The intervention area in the Apennines encompasses a wide territory, including the entire range of the Marsican bear, where its presence is stable, and also expansion areas. This area is delimited by the National Park of Sibillini in the North, the National Park Gran Sasso and Monti della Laga and Majella in the East, the National Park Abruzzo, Lazio and Molise (PNALM), and its External Conservation Zone (EPZ) in the South, and by the Regional Natural Park Monti Simbruini (PRMS) in the West (Fig. 1).

In the Alps the fences were provided within the Autonomous Province of Trento (PAT) and the Region Friuli Venezia Giulia (FVG), which represent the core area and the dispersal corridor towards the Dinaric Mountains’, respectively (Fig. 1). Some fences were also provided in the territory of Regione Lombardia, but no assessment of their efficacy was undertaken as bear presence is very sporadic in that region.



3. Material and Methods

In the Apennines the activities were undertaken by WWF Italy, responsible for the purchase of material for the fences, assignment, assistance to farmers, and evaluation of their effectiveness. In the Province of Trento and in Friuli Venezia Giulia the local administrations developed the whole procedures.

3.1. Types of fences

Livestock raising in the project areas are characterised by a seasonal management that sees the animals brought in Alpine pastures over summer periods. The fences are used for night enclosures and are overall of limited sizes (over 70% of perimeter < 100 m). In some cases large fixed fences were used for protecting fruit plantations. Fixed fences of smaller perimeters were also used for protecting apiaries in summer. Electric fences of different types (mobile and permanent) and characteristics were distributed, depending on the habitat conditions and the type of production system that was being protected.

Fences were made of 3 to 5 electric wires (either nylon or metal) supported by plastic or wooden poles, and could be either connected to the electric grid or equipped with batteries or solar panels. The voltage was designed to exceed 4 kV, the minimum value

needed to have an effective deterrent action against bears. Each user was informed and trained on the correct installation and maintenance of the fence and equipment, and alerted to possible problems and how to solve them.

An ammeter was provided to the farmers upon delivery of the fence to allow the detection of malfunctioning (low energy), thus allowing a self-control of the fence.

3.2. Selection of the holdings

Electric fences were assigned based on the requests received, and conditional on some variables: namely, the location of holdings had to be inside areas where high levels of damages were recorded in the previous 6 years (2006-2013), they had not benefited from other prevention measures before, and the holding management characteristics were compatible with the installation of a fence. In Friuli Venezia Giulia the beehives were nomadic, so the area was less precisely defined. In case conditions were not satisfied the requests were declines unless they represented exceptional and urgent cases of high damage.

Selected famers were first contacted by telephone to confirm their real need for prevention measure (e.g. persistent damage, recent bear observations). Following the first contact, a visit to selected farms was





made, to check the existing physical conditions (e.g. slope, type and height of vegetation) and define the type and characteristics of the equipment best suited to each type of production-livestock, orchards or beehives.

Upon delivery of the material the farmer signed an agreement stating the conditions for the loan of the equipment.

3.3. Monitoring of the fences

In the Apennines the functioning of the fences was checked every season for the whole duration of the project and those that had not been used in the previous season were given to other farmers. In the Alps the visits to installed fences were made during summer months, when they are more often used. Support was given in case of malfunctioning or improper use. Those that had deteriorated or had malfunctioning components were replaced with new ones. This support, as well as the delivering of new equipment, was also provided to other farmers in the region that had received fences in previous projects, in order to maximize the use of this prevention measure.

In order to have continuous updates on the functioning and effectiveness of the fences telephone calls were made to the farmers that had received the fences since 2010 and also to the farmers that had received fences in previous projects. These calls allowed a constant follow-up by the project staff across the territory and made it possible to identify problems associated

with negligent fence use by the farmers.

In all project areas, the main parameters assessed during the monitoring of the fences were:

1. Characteristics: related with the fences characteristics as defined in the original agreement;
2. Operationally: considered operational if the voltage exceed 4 kV;
3. Satisfaction: assesses the level of satisfaction of the farmers regarding the use of the fence and the maintenance interventions by the project staff.

3.4. Damage assessment and analysis

For the PNALM area all predation events were registered (e.g. number of animals attacked or beehives damaged) prior to the delivery of the fence and after its installation.

The data gathered from the database provided by PNALM, regarding damage caused by wildlife, was used to compare the number and value of damages before and after the fences became operational.

Damages occurring during the project period were verified through a preliminary telephone contact and a subsequent field inspection, to assess the damage and check the proper operation of the fences. Only the predation events that occurred while the fence was being properly used were considered for the analysis of damage, enabling an adequate and realistic assessment of its effectiveness. Visits to fences after a bear attack were made by the project staff in PNALM area.

A detailed analysis of damage to different types of production, from livestock to crops or apiaries, was made. A comparison was also made between four fences and other neighbouring holdings that were not using fences in four municipalities. The selection of compared holdings was made considering a distance not greater than 5 km, so as to ensure that different bear presence was not a factor affecting the occurrence of damages.

3.5. Satisfaction of the farmers

In order to assess the degree of satisfaction of the us-

ers and gather their opinion regarding the efficiency of the fences and of the quality of the support provided by the project's personnel, a semi-structured questionnaire was submitted to 147 farmers in PNALM area and 56 in FVG. The questionnaire was administered either face to face (116 in PNALM, and 56 in FVG) or by telephone (31) during 2014. This questionnaire included 15 questions about their previous experience with fences, the problems faced, and the importance of such actions and measures for bear conservation, the effectiveness and the quality of the equipment, and of the assistance provided by the project. Most questions were open and required a descriptive answer, but those on satisfaction were closed with fixed answers.

4. Results

4.1. Fences delivered and overall analysis of operationally

A total of 607 fences were assigned during the project lifespan (245 in PNALM, 278 in PAT and 84 in FVG). Different fences were delivered for different kinds of goods to be protected (Table 1). Only one fence was given to every selected farm except for very few cases where apiaries were owned by the same person and scattered in different places.

Table 1. Number of fences delivered to different kinds of production systems. PNALM: National Park Abruzzo, Lazio and Molise; PRMS: Regional Natural Park Monti Simbruini; PAT: Autonomous Province of Trento; FVG: Region Friuli Venezia Giulia.

	Apennines		Alps	
	PNALM, PRMS	FVG	PAT	
Apiaries	52	32	185	
Goats and Sheep	49	31	73	
Livestock	14	16		
Horses	10	3		
Pigs	6	1		
Deer		1		
Rabbits and poultry	50		19	
Fruits	18	0	1	
Orchards	46	0		
Total	245	84	278	

At the end of the project the percentages of installed fences were different in the three project areas: 82% of the fences were in use and functioning in PNALM; 82% were present in PAT; and 100% were in use in FVG.

In PAT an analysis of functionality undertaken on a sample of 189 beneficiaries through unannounced inspection at the end of the project revealed that 18% of the present fences were not being used for different reasons (e.g. awaiting for alpine meadows to be used by livestock, awaiting new apiaries, used only sporadically in certain periods of the year), while of those found in use 42% were not functioning adequately to ensure efficacy against bear attacks (either because the battery power was interrupted by external factors or because the wires were not continuous or at inadequate distances among each other).

4.2. Damage assessment and analysis

In PNALM 98 fences were given to producers who had suffered damages and received financial compensation previous to the project start. Considering the holdings that have received the fences within the project activities, 83.3% (± 34.8) of them never suffered damages after the fence was delivered and correctly used. The difference in damages suffered before and after the use of the fences was highly significant (Wilcoxon matched pairs test: $Z(25)=4.29$; $p<0.0000$), registering an overall average efficacy of 97.3% (± 6.7). Particularly, for apiaries, the efficacy was 100% for all beneficiaries. In FVG only one beneficiary had suffered bear damages after the delivery of the fence, and it was done on a group of sheep not being protected by the fence, hence the efficacy of the fences can be considered to be 100%.

4.3. Comparison of holdings with and without fences

Four cases will be presented, comparing holdings with and without fences in the same or neighbouring municipalities. Data are presented in forms of amounts of compensation claimed in euros for damages suffered by holdings after a bear attack. The holdings compared were in Lecce dei Marsi (where no

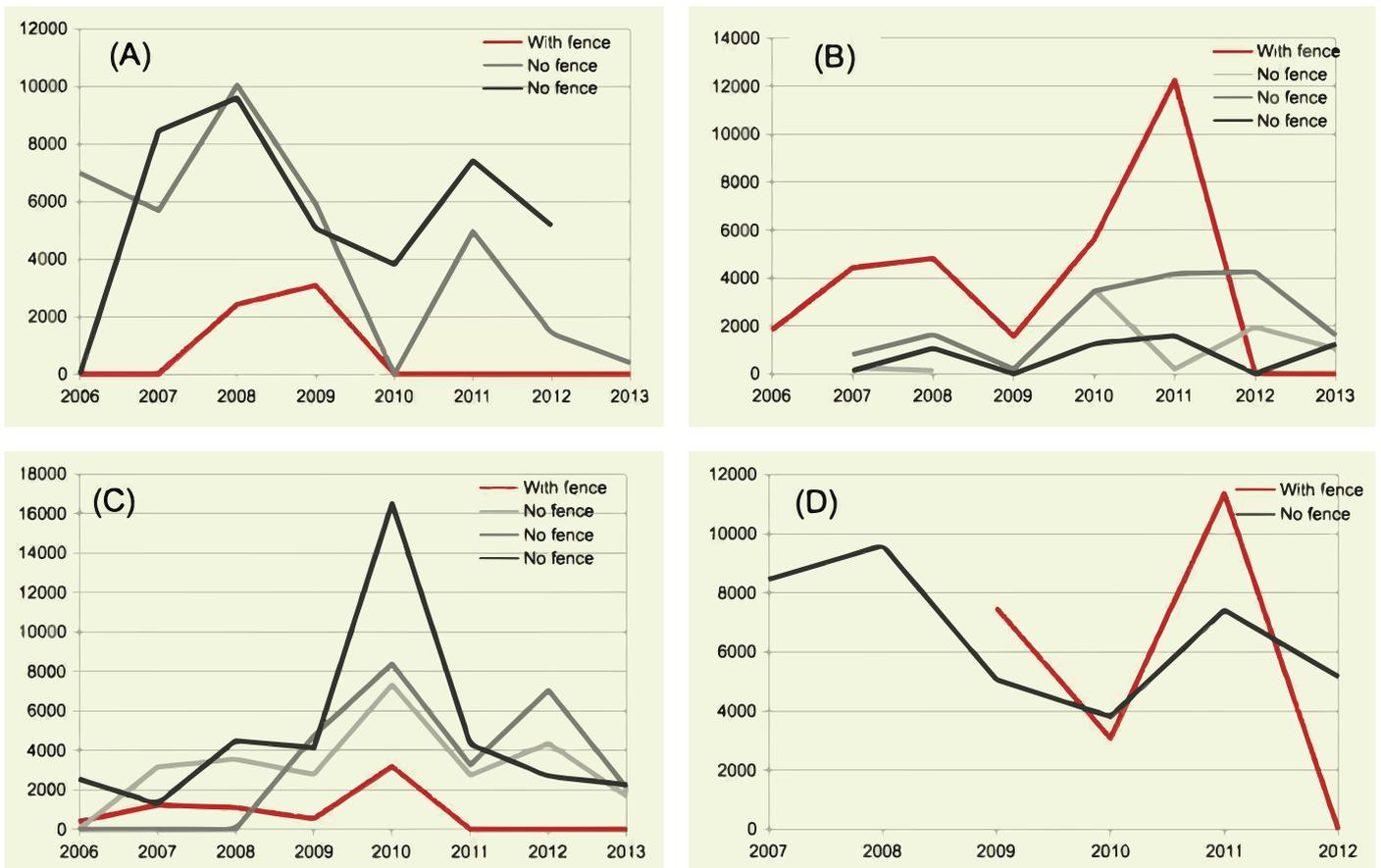


Fig. 2. The comparison of amounts claimed (€) for compensation of damages suffered by holdings with and without fences in four different townships: Lecce dei Marsi (A - upper left), Pescasseroli (B - upper right), Picinisco (C - lower left), and Gioia dei Marsi (D - lower right).

fences were requested, Fig. 2A), where the first two holdings had damage continued over time, while the third holding, located in an adjacent municipality, never again claimed damages after starting using the fence in 2010.

When considering the towns of Pescasseroli (Fig. 2B) or Picinisco (Fig. 2C), we can see that in the holdings without fences there is a persistence of damage over time, while the holdings that received the fences in 2011 show a progressive reduction, reaching zero damage. This is also evident when comparing two holdings in Gioia dei Marsi (Fig. 2D), where we can see how rapidly the one that has received the fence in 2011 reduced the damages to zero.

4.4. Satisfaction of the farmers

From the interviews undertaken in PNALM and FVG it appears that the majority of beneficiaries is satisfied with the measure received. Particularly, in PNALM up to 96% of interviewed people (N=137) expressed an excellent or very good level of satisfaction, while in FVG this amounts to 88% of respondents (N=56).

5. Discussion

The results obtained from the analysis of the effectiveness of the means of prevention confirm that electric fences give excellent results in the reduction of the damage caused by bears in the various sectors of agricultural and livestock production both in the Apennines and in the Alps but only if they are correctly used. It should be taken into consideration that the sporadic bear presence in FVG means that the frequency of attacks is lower than in the other two project areas, thus the non-occurrence of damages might be due to an absence of bears.

The results show the need for an adequate assistance to the agroforestry sector for the correct usage of the fences and their adoption and acceptance, and confirm that a continuous monitoring of the fences is necessary to prevent their slow but steady disuse by the farmers, and ensure they are properly used and maintained, thus guaranteeing their effectiveness in reducing damage. The responsibility for correct maintenance should be on the farmer, but assistance must be provided at least in the early phase. Beekeepers

show the highest level of satisfaction because most probably the holdings do not move, thus there is lower possibility for incorrect re-installation of the fence, although in some cases nomadic habits for production require them to install the fence more than once.

It is notable that in the Alps most livestock owners use the fences for livestock containment purposes rather than for preventing the attacks of predators, probably due to lower degree of cultural experience and knowledge about the potential danger of suffering an attack.

The results of the damage analysis stress the necessity by the regional management authorities to use these means of prevention for the conservation of endangered predator species, because it demonstrates high potential for the reduction of conflicts between these wild species and of productive activities, which would otherwise be economically difficult to sustain. Nevertheless, their use per se is not sufficient if not done correctly, requiring planning for maintenance and control.

The results of the satisfaction questionnaires confirm the good results of the project actions concerned

with prevention measures in terms of the effectiveness of the electric fences as reported by users and of the quality of the support provided and of the personnel responsible for the installation and maintenance of the fences.

Finally, the analysis also shows that not all farmers suffering damage requested a fence. This could be due either to the incomplete dissemination of the possibility of getting such fences from the LIFE ARCTOS project, or the fact that there is an established status quo in the territory regarding the reception of compensation. This certainly creates a socio-economic and management problem, which must necessarily be addressed for a proper conservation of the two bear populations in Italy. In as much as the results obtained demonstrate that the use of fences can be very effective, and that the use of this type of preventive actions would allow a most parsimonious economic management of the conflict between production activities and large carnivores, namely through the use of the amount saved in compensation in conservation actions and monitoring of the species.

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References

- Boitani L, Álvares F, Anders O, Andren H, Avanzinelli E, Balys V, Blanco JC, Breitenmoser U, Chapron G, Ciucci P, Dutsov A, Groff C, Huber D, Ionescu O, Knauer F, Kojola I, Kubala J, Kutal M, Linnell J, Majić A, Mannil P, Manz R, Marucco F, Melovski D, Molinari A, Norberg H, Nowak S, Ozolins J, Palazon S, Potocnik H, Quenette P-Y, Reinhardt I, Rigg R, Selva N, Sergiel A, Shkvyria M, Swenson J, Trajce A, Von Arx M, Wolf M, Wotschikowsky U, Zlatanova D (2015) Key actions for large carnivore populations in Europe. Istituto di Ecologia Applicata (Rome, Italy). Report to DG Environment, European Commission, Bruxelles, 139 p. Contract no. 07.0307/2013/654446/SER/B3.
- Ciucci P, Boitani L (2008) The Apennine brown bear: A critical review of its status and conservation problems. *Ursus* 19(2), 130-145.
- Ciucci P, Gervasi V, Boulanger J, Altea T, Boitani L, Gentile D, Paetkau D, Sulli C, Tosoni E (2015) Ex post non-invasive survey of the core Apennine bear population (*Ursus arctos marsicanus*) in 2014. Final technical report Action E3. LIFE09NAT/IT/160 ARCTOS, 49 p.
- Groff C, Bragalanti N, Rizzoli R, Zanghellini P (editors) (2015) 2014 Bear Report. Forestry and Wildlife Department of the Autonomous Province of Trento, Trento, 86 p.
- Zibordi F, Mustoni A, Viviani V, Liccioli S, Stefani G (2010) L'impegno del Parco per l'Orso: Il progetto LIFE URSUS. Documenti del Parco n. 18.