Carnivore Damage Prevention
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BEAR DAMAGE PREVENTION
Switzerland, Spain, Italy

WASTE MANAGEMENT TO REDUCE CONFLICTS
Switzerland

PREVENTING ROAD ACCIDENTS
Greece

MANAGING PROBLEM BEARS IN EUROPE

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EDITORIAL

Dear Readers,

Brown bears are a special case within the field of human-wildlife conflicts. From an objective point of view they are the large carnivore species that is most regularly associated with injuring and killing humans in Europe. However, it is also the large carnivore species which receives the greatest degree of respect and affection from the public. In the pagan past the bear was a subject of worship with many associated rites and rituals. This respect is still visible in the way many rural people talk about bears, describing them as "the king of the forest", and treating them as near-human animals. In the urbanised present they are accorded a special status through their incarnation as the teddy bear with which many of our children sleep at night or the feature of many cartoons.

Brown bears also have a special ecology. They are the slowest breeders of our large carnivores implying that their populations can be slow to recover. Their omnivorous food habits also open for a very wide diversity of conflicts with humans. Not only do they kill livestock such as sheep, cattle and reindeer (as do wolves, Eurasian lynx and wolverines), but they also destroy beehives in their pursuit of honey, raid crops and orchards, break into deer and wild boar feeding stations, raid garbage bins, slaughter remains and even fish farms. There are even cases of bears developing a habit of consuming chainsaw oil! Bears are so large that vehicle collisions can also have serious consequences for both the bear and the driver! The potential for some bears to become habituated to people and conditioned on anthropogenic food sources can create uniquely challenging situations that potentially represent risky situations for both bears and humans. This special issue of CDPNews focuses on bears, and brings together experience from almost all these types of conflict from across southern Europe. The articles are very practical, focusing on local responses to real-world issues.

The conservation status of bears is also highly variable across Europe. On one hand there are four very large continuous populations in Scandinavia, the Finland-Baltic region, the Carpathian Mountains and the Dinaric-Pindos range that each contain many thousand individuals. In contrast are the many small and isolated populations in Cantabria, the Pyrenees, the Alps, the Apennines, and in Bulgaria that number in the tens and hundreds of individuals. This diversity of conservation contexts also affects the range of appropriate management responses – with there being a far stronger need to minimise the removal of individuals from the small populations than from the large ones.

Several themes emerge from this special issue that are worth noting. One issue concerns the importance of incorporating the relevant local management authorities, be they administrative or technical (such as garbage management or forest management authorities), in mitigation work. This is essential in order to mainstream bear-compatible practices into different sectors. A second related issue concerns the need for a long-term investment to provide technical assistance to those who adopt conflict prevention measures both in the initial adoption phase, and for many years later. This is necessary to ensure that the new practices become a matter of routine. A third issue concerns the potential for conflicts between different EU sectorial policies – where poorly considered agriculture and rural development policies may increase conflict potential with bear conservation. There is clearly a need to ensure a greater degree of cross-sectorial coordination at European, national, and local levels. Overall these articles give the impression that there is considerable experience with the technical processes of dealing with bear-human conflicts. The challenge for the future is to mainstream these practices such that they become routine considerations in the planning and practice of all human activities in bear areas.

The Editors

Project

LIFE DINALP BEAR:

A PROJECT TO INCREASE TOLERANCE TOWARD BEARS THROUGH CONFLICT MITIGATION AND THE DEVELOPMENT OF A POPULATION MANAGEMENT APPROACH

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1. Introduction

The LIFE DINALP BEAR project started in 2014 and has a duration of 5 years. Nine partners from Slovenia, Croatia, Italy and Austria joined forces, successfully applied to European funding and started to work on the project, coordinated by the Slovenia Forest Service. The project focuses on the northern Dinaric and southeastern Alpine brown bear population (Fig. 1).

The LIFE DINALP BEAR project has three main goals:

i) **Population-level monitoring, management and conservation of brown bears in northern Dinaric Mts. and south-eastern Alps**

One of the main objectives is to overcome the current local-scale practices of brown bear management and pave the way for a transition to population-level conservation, management and monitoring. We will establish a tightly-knit transboundary network of professionals involved in these issues, optimize monitoring methods and their application, initiate and start long-term transboundary monitoring, and provide first baseline data at a large-scale, transboundary level. We will create communication and data exchange channels required for such high-level cooperation, and provide expert and legislative backing. This will be one of the first efforts in Europe to start a transboundary management of a large carnivore, an idea endorsed and promoted by the European Commission through its "Guidelines for Population Level Management Plans for Large Carnivores", but that has rarely been achieved in practice. This goal will be achieved through implementation of the guidelines into national strategic documents that are the baseline for bear management.

ii) Promotion of natural expansion of brown bears from the Dinaric Mts. into the Alps

While habitat modelling has shown that the Alps are capable of supporting a bear population and the small reintroduced population in Trentino is thriving, natural expansion is slow. We will use a multidisciplinary approach to look into this issue and try to understand the social and physical barriers to expansion, and the corridors that need to be protected. We will provide solutions to slow down further habitat fragmentation, increase acceptability of bears in the areas where they currently aren't permanently present, but where we expect the expansion to occur, and decrease traffic mortality, while helping to resolve human-bear conflicts, as well as addressing monitoring and management issues.

iii) Decrease of human-bear conflicts and promotion of coexistence

We will explore what drives conflict "hot-spots", and use non-lethal solutions to provide best practice examples. We will demonstrate solutions to prevent bears from consuming anthropogenic food, and explore carrion from road-killed game species as an alternative natural source of protein. We will promote bears as an eco-tourist attraction. We will assess public attitudes towards bears, and use this for targeted educational and promotional activities to enhance understanding of this species and promoting coexistence.

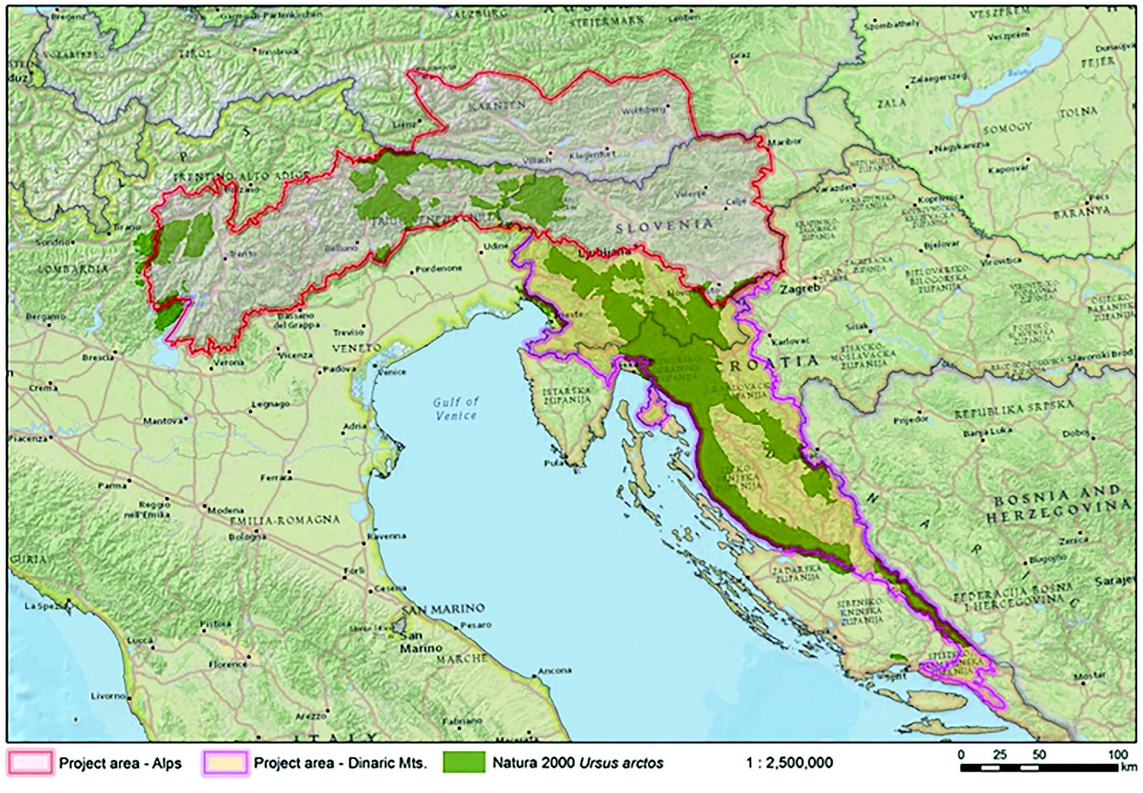

Fig. 1. Intervention area of the LIFE DINALP BEAR project in the Alps and the Dinaric Mts.

2. Conflict mitigation and protection of human property

Within this article, we are focusing just on the part of the LIFE DINALP BEAR project where we are addressing prevention damages and prevention of bear access to anthropogenic food sources. These attract bears, and often result in habituation of bears to human presence (Jerina et al., 2012). On the other hand, bears can cause significant damage on human property in the project area (Jerina et al., 2015). In all these cases, our goal is to prevent bears from approaching any kind of anthropogenic food sources. Two actions of the LIFE DINALP BEAR project directly address this issue and will be described in detail.

2.1. Access of bears to anthropogenic food sources in or in the vicinity of human settlements.

When such food sources are repeatedly obtained in close proximity to human settlements, bears eventually lose their fear of people (habituation to human presence), and sometimes even start to relate human presence with food (food-conditioning). This leads into ever more severe conflicts, often ending with the shooting of the problematic bear. Bears approaching settlements and causing potential threat to human safety also represent the most commonly reported human-bear conflict type in the region (Jerina et al., 2015). Therefore, preventing the bears from using anthropogenic food sources in close proximity to human settlements is a crucial part of the conflict prevention campaign.

Due to the variety of anthropogenic food sources used by bears in the project area (Jerina et al., 2015; Groff et al., 2015), this goal is extensive and demanding.

Food remains in regular garbage bins are easily accessible to bears, so they can attract bears into the vicinity of human settlements. Photo: Andrej Sila.

Demonstrations on how to effectively protect human property such as small livestock and beehives and how to prevent access to food sources around villages (especially garbage, slaughter remains and other organic waste, fruits and poorly protected small livestock) are therefore one of the central points of the LIFE DINALP BEAR project. Through installation of proper protection measures, we are planning to considerably reduce the frequency of human-bear conflicts in the pilot areas, improve tolerance among local inhabitants and consequently ensure long-term survival of the species. Activities are primarily designed to demonstrate through best practice examples that it is possible to coexist with bears. At the same time, we expect that these non-lethal mitigation measures will considerably reduce the number of conflicts in the project area, as we will focus on locations where conflicts are greatest and most frequent.

Proposed measures such as bear-proof garbage and compost bins are currently (except in the Trento region) not used by local people and wildlife managers, because of the lack of information and prejudices, lack of will and/or financial limitations (e.g. not many people are even aware of the existence of bear-proof garbage containers). Therefore the application of measures that prevent bears from accessing anthropogenic food around settlements is not only important because of

the direct reduction of conflicts, but even more as a demonstration of possible technical solutions and their effectiveness, which may later lead into region-wide changes in human behaviour and conflict prevention by local authorities. We expect that demonstrations of best practice examples will lead to considerable change in future conflict prevention management throughout the region, as local people will realize the real causes of their problems with bears and how they can effectively prevent them by behaving more responsibly.

The core area of the implementation of these mitigation measures is in Slovenia, where bear studies with the use of telemetry have shown that organic waste (e.g. slaughter remains, garbage, food left-overs, rotting fruits) is probably the most important attractant for bears in the vicinity of human settlements (Jerina et al., 2012).

Within the LIFE DINALP BEAR project we already made a detailed analysis of the conflicts (Jerina et al., 2015). Based on this analysis and the willingness for cooperation by the local authorities, we will choose 5 hot-spots with high conflict rate in local rural communities. We will make a list of all garbage containers that could be accessed by bears. We will upgrade or replace the most critical containers in the chosen hotspots in order to make them bear-proof. Before setting them in the field, we will test the containers in the Ljubljana ZOO bears' enclosure (as part of the demonstration). In the field, we will replace or modify at least 100 garbage containers of different sizes at chosen conflict hot-spots.

In rural Slovenia almost every house has a garden and a compost bin. Organic waste is often discarded in these compost bins and consequently they can become very attractive for bears. We will construct bear-proof organic bins and distribute them among selected communities and households.

Besides garbage and compost bins, illegal rubbish dumps, especially in the vicinity of human settlements, are some of the most important attractants for bears. The problem is even greater because of the disposal of slaughter remains on such dumps, which have been

Bear-proof garbage bins prevent bears to access food remains on highways in Croatia. Photo: Matija Stergar.

People in Slovenia often dispose of organic waste in compost bins in their backyards. Bear-proof compost bins prevent bears to gain access to this easily accessible food source in the vicinity of human settlements. Photo: Rok Černe.

shown to be especially attractive to bears. We will locate such sites during surveys with local inhabitants and during field-checking of GPS locations of collared bears near settlements. Within the LIFE DINALP BEAR project 22 bears will be collared. Locations of illegal rubbish dumps will be reported to the responsible inspection services and removed, with information given to the media to inform the general public.

Support and direct involvement of local authorities, opinion leaders and a broader local public will be crucial for the implementation of these measures. To ensure this, we will hold meetings with local authorities and workshops for local inhabitants. We will explain the importance of implementing these prevention measures for the safety of local inhabitants and the prevention of habituation of bears to human presence.

2.2. Proper protection measures to reduce damages on human property

The most commonly damaged property in the project area is livestock, beehives, orchards, fields, gardens and silage bales. Beside the loss or damage of property, these locations also act as additional attractant for bears to approach human settlements and can cause bear habituation to human presence and food-conditioning. We will use different protection techniques, with the main focus on electric fences. Livestock guarding dogs will be also promoted for the protection of small livestock. The project will place great emphasis on intensive work with the people that receive the protection measures.

2.2.1. Implementation of electric fences

Electric fences are one of the most important protection measures that are commonly used in the protection of livestock and other human property from damages caused by bears (Kavčič et al., 2013). Experience from Slovenia shows that simply distributing electric fences is not enough for preventing damage on livestock (Kavčič et al., 2013). We observed improper use of the donated electric fences in the LIFE SloWolf project and as consequence possible continuation

Beehives can be effectively protected by using electric nets or wired electric fences. It is crucial that pulses of strong electric current are present in the fence 24 hours a day all year long. Photos: Tomaž Berce, Matej Bartol.

of damage (Kavčič et al., 2013). Regular presence of electric pulses of at least 5 kV and proper maintenance of fences has been shown to be crucial for effective damage prevention. Regular work with farmers who receive donated protection devices and elimination of mistakes is crucial for preventing of damage occurrence. Without proper maintenance of the fences, damages can continue to occur (Kavčič et al., 2013). As a result the belief that electric fences are not an efficient protection measure and that nothing short of lethal control can be done for damage prevention could easily spread among farmers.

Therefore, in the LIFE DINALP BEAR project we will not just donate electric fences to the farmers who have damages. One of the crucial parts of our work will be to maintain regular contact and to work with selected livestock breeders. We will not only help and give advice to farmers and other affected property owners, but will also gather feedback from them with a view to improve our knowledge about their daily experience. Donations of the electric fences will be carried out in Slovenia and in the Italian Regione del Veneto.

2.2.2. Promotion of livestock guarding dogs

Livestock guarding dogs (LGDs) are a traditional and effective method for damage protection (Smith et al., 2000; Otsavel et al., 2009), that has been almost entirely abandoned in Slovenia and the SE Alps. Within the LIFE SloWolf project, we already donated guarding dogs to some interested sheep breeders in Slovenia and started to educate individual breeders on how to properly raise them. However, this action had a very limited scope and affected only selected breeders. In the LIFE DINALP BEAR project, we will build upon this foundation and establish breeding lines of working LGDs in Slovenia and in the Italian Provincia Autonoma di Trento. We will find and select at least ten motivated livestock breeders with interest and competences to develop such working lines of LGDs. Another requirement will be to bring up the LGDs among livestock and ensure the bonding with livestock since the pups are born. The breeders will also become future volunteer advisors in LGDs upbringing, and later follow up on the dogs placed with their new owners. Advisors will monitor the progress and report back to the LIFE DINAL BEAR project experts which will collect this information and provide additional advices if necessary.

After the selected livestock breeders receive pups and raise them successfully as guarding dogs, they will start breeding the animals in accordance with the legal demands (appropriate age – i.e. minimum 17 months), and develop an adequate breeding program following expert guidance from the DINALP BEAR project team and chosen dog breeding association. Experts will provide them with continuous support.

Proper training of LGDs has to be regularly checked and appropriate advices must be given to the users, to ensure an acceptable upbringing of the dogs. Guarding dog breeders have to be regularly visited by LGD experts and proper advices and suggestions have to be given directly in the field. We have to carry out regular contact out with the farmers. When a particular user reports a problem, immediate help and advice is provided. Without such guidance in problematic situations a belief that dogs are an inappropriate or even inefficient tool for protection of livestock can spread.

Sheep are approaching the high electric net (height 1.7 m) where they will spend the night. During the day, the sheep graze within the lower, 1 m high electric net. Photo: Rok Černe.

3. Conclusions

Until the beginning of the LIFE DINALP BEAR project the main focus in a large part of the project area was restricted to curative measures. Compensations for damages were and still are paid and effective intervention teams are established. Less attention has been given to preventive measures. For successful management of bears it is crucial to install proper prevention measures with which to prevent the emergence of conflicts.

When implementing and distributing prevention measures such as bear-proof garbage and compost bins, people living in the area must be made aware why these measures are implemented and how they work. Without local understanding of why bear-proof garbage or compost bins are set into the communities, the scope of the implemented preventive measures would probably be very limited.

Experiences from Slovenia, gathered during the SloWolf project within which fences and guarding dogs were distributed, also show that problems occur regularly (e.g. guarding dogs may kill sheep or fences may have lower voltages than required) (Kavčič et al., 2013). Such cases must be well assessed and explained; otherwise it may quickly be assumed that the implemented protection measures are not efficient. Therefore, one of the crucial aspects of the LIFE DINALP BEAR project and of similar conservation actions is to actively work with the farmers. In addition it is crucial to provide them with proper protection tools and to transmit proper knowledge for ensuring their efficient use and therefore propitiate the success of the project.

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I thank all the partners in the project for great collaboration. The partners are: Motorway Rijeka – Zagreb, ERICO Velenje – Ecological Research & Industrial Co-operation Ltd., Research Institute of Wildlife Ecology – University of Veterinary Medicine Vienna, University of Zagreb – Faculty of Veterinary Medicine, Provincia Autonoma di Trento – Servizio Foreste e Fauna, Progetto Lince Italia, Regione del Veneto – Unità di Progetto Caccia a Pesca, University of Ljubljana, Slovenia Forest Service. The European Commission, Ministry of the Environment and Spatial Planning of the Republic of Slovenia, Ministry of Agriculture of the Republic of Croatia, Bernd Thies Foundation and Euronatur financially support the LIFE DINALP BEAR project.

References

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.

Jerina K, Krofel M, Stergar M, Videmšek U (2012) Factors affecting brown bear habituation to humans: a GPS telemetry study. Final Report – Summary for Users. Department of Forestry and Renewable Forest Resources, Biotechnical Faculty, University of Ljubljana, Ljubljana, 18 p.

Jerina K, Krofel M, Mohorovič M, Stergar M, Jonozovič M, Seveque A (2015) Analysis of occurrence of human-bear conflicts in Slovenia and neighbouring countries. Report prepared within A.1 action of the LIFE DINALP BEAR project (LIFE13 NAT/SI/000550). Department of Forestry and Renewable Forest Resources, Biotechnical Faculty, University of Ljubljana, Ljubljana, 44 p.

Kavčič I, Vidrih M, Černe R, Zahariaš K, Emeršič M, Skrbinšek T, Muhič P, Žgavec R, Udovič U, Sulič T (2013) Primeri dobre prakse: Poročilo akcije C.6 projekta LIFE+ SloWolf. University of Ljubljana, Ljubljana, 33 p.

Otsavel T, Vuori KA, Sims DE, Valros A, Vainio O, Saloniemi H (2009) The first experience of livestock guarding dogs preventing large carnivore damages in Finland. Estonian Journal of Ecology 58, 216-224.

Smith ME, Linnell JDC, Odden J, Swenson JE (2000) Review of methods to reduce livestock depredation: I. Guardian animals. Acta Agriculturae Scandinavica 50, 279-290.

Short Communication

COMPARISON OF THE OCCURRENCE OF HUMAN-BEAR CONFLICTS

BETWEEN THE NORTHERN DINARIC MOUNTAINS AND THE SOUTH-EASTERN ALPS

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1. Introduction

Coexistence of brown bears (*Ursus arctos*) and humans in Europe depends strongly on the level of conflicts. Today human-bear conflicts are identified as the single most important threat to long-term conservation of the species in Europe. Habitat fragmentation and high density of human settlements are the causes of high encounter rates between bears and humans or their property. Brown bear management aims to ensure human safety and to reduce damages of brown bears on property. Effective conflict resolution is of top priority for bear conservation and the first step towards this is good understanding of the problem.

To understand the causes of human-bear conflicts and parameters that affect them we analysed conflict cases over the past 10 years (2005-2014) that were systematically collected across four countries in the northern Dinaric Mountains and south-eastern Alps: Austria, Croatia, Italy, and Slovenia. The two mountain ranges

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Bears are agile and potent predators. From a lamb up to an adult horse they can kill everything. Photo: Jaroslav Vogeltanz.

differ considerably in various aspects: landscape, forest typology, agricultural system, bear density, history and wildlife management among others. During the study period, the brown bear in Croatia was managed as a game species, with 10-15% of the population allocated for trophy hunting annually. The current bear population in Croatia is estimated to be about 1,000 individuals (Kocijan and Huber, 2008), and it is believed that the bear population is increasing under this management strategy (Huber et al., 2008). The current bear population in Slovenia is estimated to be almost 500 individuals, most of them occurring in the Dinaric range (Jerina et al., 2013). In Slovenia, brown bears are managed with intensive supplemental feeding and regular harvesting of on average 20% during the past 10 years (Krofel et al., 2012). From the Dinaric Mountains, bears have regularly moved north and north-west into the Alps of Slovenia, Italy and Austria. Currently, the bear number in the south-eastern Alps is estimated at about 10-15 individuals. They are almost exclusively males with large home ranges, and during the mating season, many of them return to the core area in the Dinaric Mountains searching for females to mate with (Krofel et al., 2010). The turnover of the individuals is quite high. Presence of females and thus offspring is very rare. However, a small portion of those bears is composed of older individuals that have been resident for many years (Progetto Lince Italia, unpublished data). Additionally, a reintroduced and increasing population of brown bears lives in the Trentino and neighbouring areas with currently 41-51 individuals (Groff et al., 2014). Brown bears in Austria and Italy are not harvested.

The different conflict types can differ in respect to how seriously they are perceived by the public. The focus of our analyses was on bear damage on human property. We were particularly interested in the types of conflicts, potential trends and their spatial distribution, as well as whether conflict mitigation measures were in place. We do not consider aggressive behaviour towards humans, but we need to point out that bears attacking humans and even bluff attacks have by far the most important influence on the acceptance of bear presence by the public.

2. Material and Methods

Data on human bear conflicts were collected from the competent authorities of the respective countries. In Slovenia, the government reimburses each reported damage case proved to be caused by brown bears. Officials of the Slovenian Forest Service are responsible for field-checking and reporting details on each reported damage case. In Croatia, hunting-rights owners inspect damage cases and send reports about each case to the Ministry of Agriculture although they paid the damage cost by themselves. Data on all types of damage cases in Carinthia, Austria, is derived from genetic samples taken on damage cases and gathered by the University of Veterinary Medicine, through personal communication with individual damage evaluators (damage cases are in most, but not all cases checked by evaluators), or from media reports and the hunting association of Carinthia. In Italy, the data was provided by the provincial and/or regional authorities who also pay for compensation, as well as by the Italian National Forest Service. In the region of Veneto, two provinces have provided data: the province of Belluno from 2009-2014 and the province of Vicenza from 2010-2014.

3. Results and Discussion

In total 7,177 damage cases were reported, 5,133 in the Dinaric Mountains and 2,044 in the Alps. We recorded a high diversity of bear-caused damages, ranging from damage on livestock, pets, captive game animals, and fish to various damages in agriculture and forestry, to equipment and other human property. We also noted substantial differences among the Dinaric Mountains and Alps as well as between countries, both regarding extent and distribution of damages. The distribution of damages clearly indicates two damage hot spots, one in southern Slovenia and the other in the western Trentino province of Italy (Fig. 1). With the exception of Croatia, these are the two areas with permanent brown bear occurrence and with regular presence of female bears with cubs. Croatia is a very specific case as far as bear damage is concerned as it hosts the highest number of bears but the number of damages is only slightly higher than in Friuli VG or Carinthia, where the number of bear is 200 times lower.

In the Alps, no clear temporal trend in damage cases is obvious (Fig. 2). In 2014, the same amount of damages occurred as in 2005, although the number of bears

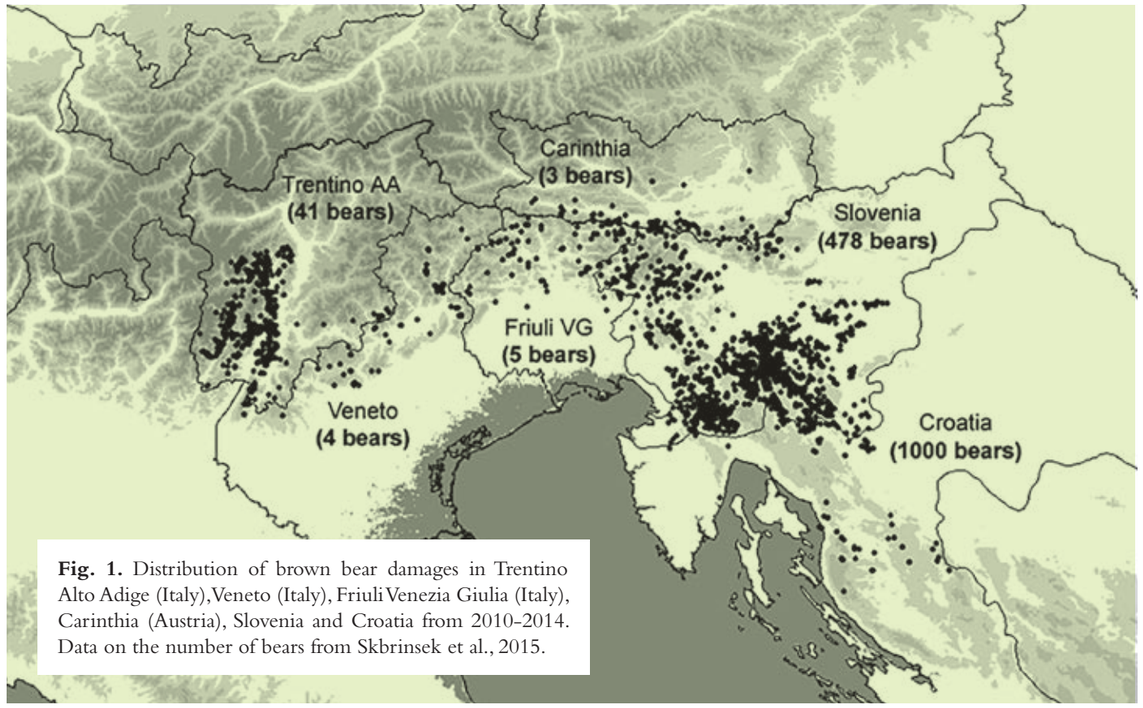

Fig. 1. Distribution of brown bear damages in Trentino Alto Adige (Italy), Veneto (Italy), Friuli Venezia Giulia (Italy), Carinthia (Austria), Slovenia and Croatia from 2010-2014. Data on the number of bears from Skbrinsek et al., 2015.

present had almost doubled from an estimated 25-31 in 2005 (at least 18 in Trentino and 7-13 in the triangle area of Veneto, Friuli VG, Carinthia and Slovenia) to 51-66 in 2014 (Trentino 41-51, 10-15 in the triangle area of Veneto, Friuli VG, Carinthia and Slovenia). The yearly amount of damage is related to the presence of single individuals, classified as problem bears. The loss of one of these bears can considerably reduce the amount of damage. In the Dinaric Mountains, general regression models showed that the number of damages is clearly reduced in years with good beech mast (Jerina et al., 2015; Fig. 2). Beechnuts represent a large part of bear diet in Slovenia and are among the most important natural food sources (Kavčič et al., 2015), especially in mast years.

In Austria and Italy the most common damage type by far was on domestic animals, mainly sheep and beehives. An exception is Veneto where one bear specialized in killing cattle and donkeys. In Slovenia and Croatia the most frequent damages recorded were in agriculture, mainly on corn and orchards, followed by damage on domestic animals, again mainly sheep and beehives (Fig. 3). Sheep occupy the second rank in both regions. Sheep is also the category for which the highest amounts of compensation is paid across the study area (Table 1), followed by beehives. Slovenia spends on average 177,000 € for damage compensation annually, followed by Trentino with 57,000 €. Croatia with the highest number of bears only spends 10,000 € and Friuli VG with about 5 bears 3,000 €. The lower proportion of damages in agriculture in Italy and Austria is likely the result of less intensive agriculture in the Alpine regions compared to the Dinaric Mountains of Slovenia and Croatia.

The bear procured access to the beehives.
Photo: Paolo Molinari.

Brown bear at a killed cow
in the Italian Alps.
Photo: Servizio Faunistico-Provincia
Autononoma Trento.

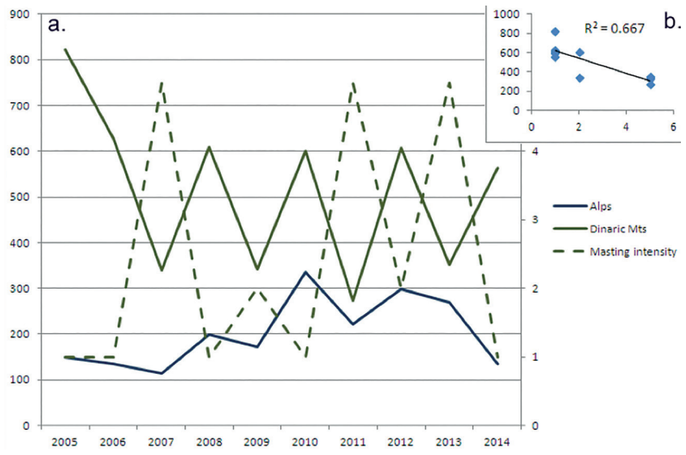

Fig. 2. a) Comparison of the trend in damage cases in the Dinaric Mountains and Alps. Beech mast intensity (right axis) was categorised in the Dinaric Mountains with: 1=very poor year, 2=poor year, 3=intermediate year, 4=good year, and 5=very good year (Jerina et al., 2015). **b)** Relation between beech mast and number of damage cases in the Dinaric Mountains.

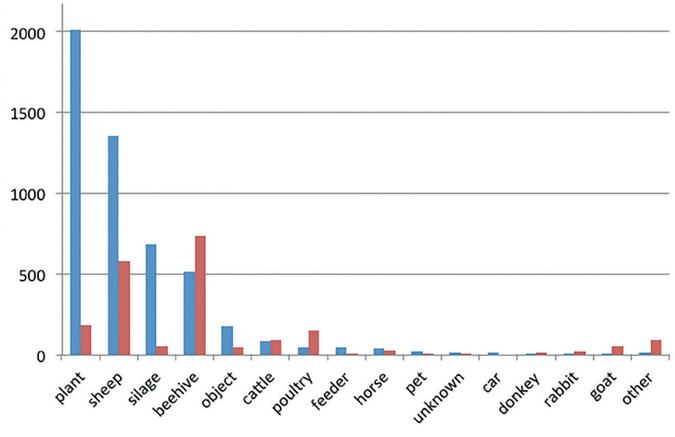

Fig. 3. Comparison of damage types in the Dinaric Mountains and Alps.

Table 1. Mean annual costs of bear damages in € per country/region and damage category over the past 10 years. In Carinthia the cost is not publically available and from Veneto the data is not available.

Damage type	Slovenia	Trentino	Croatia	Friuli VG	Total
Beehive	35,581	24,394	2,851	1,186	64,011
Car	0	0	1,139	0	1,139
Cattle	10,144	3,821	240	0	14,206
Deer	88	0	250	263	601
Dog	26	0	9	0	35
Donkey	531	0	0	40	571
Feeder for wildlife	2,958	0	1,254	63	4,275
Fish pond	466	0	0	0	466
Goat	0	1,665	122	306	2,093
Horse	6,451	2,608	109	0	9,168
Constructed facility	8,380	90	87	0	8,557
Other	366	2,616	11	0	2,994
Other pet	1,108	0	0	0	1,108
Pig	34	0	21	0	55
Crop, trees, fruit,…	27,287	7,826	2,515	0	37,628
Poultry	274	3,028	320	22	3,643
Rabbit	0	337	64	0	401
Sheep	71,315	10,468	789	1,217	83,789
Silage	12,149	669	206	0	13,023
Unknown	117	0	1	0	118
Total	177,276	57,523	9,987	3,095	247,882

The greatest differences among the countries are noted when frequencies and costs of damages are calculated per bear living in a country (Table 2). The highest number of damages per bear occurs in Carinthia followed by Veneto, the two regions with the lowest bear numbers. In Croatia hardly any damages are reported per bear. Similarly, large differences were noted in the costs per bear, which are more than 3 times higher in Trentino than in Friuli and Slovenia. In absolute terms, the total number of damages and costs was highest in Slovenia, three times higher than in Trentino. This could be expected due to a combination of high bear densities and large amount of damage caused per bear.

Table 2. Average annual number of damages per bear and annual cost of damages per bear, by country/region from 2012-2014.

Country/region	Average nr. of damages per year	Average cost per year (€)	Estimated annual nr. of bears	Average annual nr. of damages per bear	Average annual cost per bear (€)
Carinthia	19	data not available	3	6.44	no data
Croatia	21	6,409	1,000	0.02	6
Friuli VG	12	2,734	5	2.33	547
Slovenia	568	22,0751	478	1.19	462
Trentino	113	73,528	41	2.76	1,793
Veneto	16	data not available	4	4.25	no data

We assume that there are four main reasons for the huge differences among countries in damages per bear:

1. Differences in bear management, especially who is responsible to pay for the damage

Management differences affect the amount of damage caused as well as the likelihood of it being reported. It is important to note that the amount of damages increases with increasing level of protection of bears in a country: in Italy bears are strictly protected and in Austria bears are a game species but with a closed season all year. No bears are legally shot in either country. In Slovenia bears are protected species, but hunting quotas for lethal removal of about 20% of the population are issued every year, while in Croatia bears had the status of a game species with annual hunting quotas[1]. Therefore in Croatia damages caused by bears were not compensated by the government, but by the hunting organizations. Since members of these organizations are predominantly local people, the compensation claims were often informally settled with goods (e.g. sacks of corn) rather than money (Knott et al., 2014). Consequently a significant proportion of the damages were likely not reported. Additionally, local hunters likely paid more attention to prevent fraud by the owners and also reacted faster to prevent costly damages reoccurring at single localities, which are for example characteristic for Slovenia (Černe et al., 2010).

2. The historic presence of bears in the region

Higher damages per bear in Austria and Italy compared to Slovenia and Croatia could be at least partly explained by the differences in the history of bear occurrence. In Slovenia, especially in the Dinaric part, and Croatia, bears have never been exterminated and have occurred in relatively high densities already for several decades (Jerina and Adamič, 2008; Huber et al., 2008). Therefore local people are generally accustomed to living with bears and there is some tradition in adopting measures to prevent human-bear conflicts. On the other hand, bears were completely exterminated in most of the Alps and re-colonized these areas relatively recently. Thus large part of the knowledge of how to coexist with bears was lost, as were the conflict preventive measures. Similar patterns were actually observed also within Slovenia. Between 1994–2002 bear damage in the Alpine and sub-Alpine (north-western) parts of Slovenia accounted for 67% of all compensation payments for bear damage in the country, even though fewer than 5% of the country's bears were estimated to live there (Kaczensky et al., 2011).

3. The age/sex of the bear

Another consideration is that in the expansion zone, mainly in Veneto, Friuli VG and Carinthia, the majority of bears present consist of subadult dispersing males. This age/sex class is the one that usually causes most damages (Majić Skrbinšek and Krofel, 2015). Therefore the relative amount of damage in areas with only dispersing males present is expected to be higher compared to areas with more even age/sex structure.

4. The presence of opportunities for bears to cause the damage

Likely the main factor influencing the occurrence of damages. Obviously the amount of damage is linked with availability of livestock, beehives and other potential sources of conflict in the bear area. Especially the availability of various types of livestock has a huge influence on the amount of damage (e.g. in Veneto cattle and donkeys). Availability is connected with presence, as well as access to livestock. Here damage prevention plays an important role. But damage prevention is never 100% effective, e.g. sheep were occasionally killed despite the use of a diverse range of preventive measures (Fig. 4). The same applies for the protection of beehives (Fig. 5). In Slovenia farmers often use electric livestock fences which are intended to keep sheep or cattle on the pasture but useless for the prevention of bear attacks. Proper use of preventive measures is important. Presently, it is impossible to compare the effectiveness of the different types of preventive measures, as only the data on damage is available. We do not know how many sheep flocks and beehives are protected with which kind of preventive measure and how often bears were turned away by the preventive measure. The only data available is from Trentino: During the past 10 years, the LIFE ARCTOS project spent between 15,000 and 57,000 € per year for damage prevention, compared to an average of 73,500 € per year spent for compensation. Annually 60-120 electric fences were distributed to livestock owners or bee keepers.

[1]At the end of the study period in 2013 Croatia joined the European Union and consequently bears became protected species. However, they were game species during most of the study period.

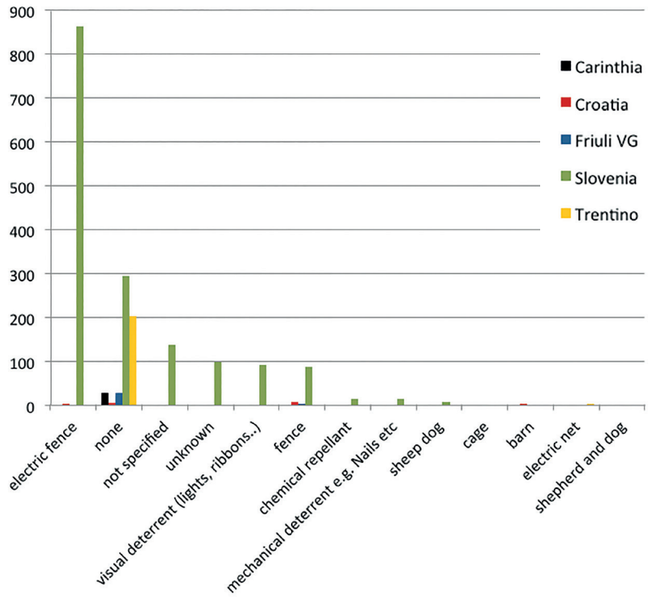

Fig. 4. In case of bear depredation on sheep, the type of preventive measure used. From Veneto we have no information about preventive measures.

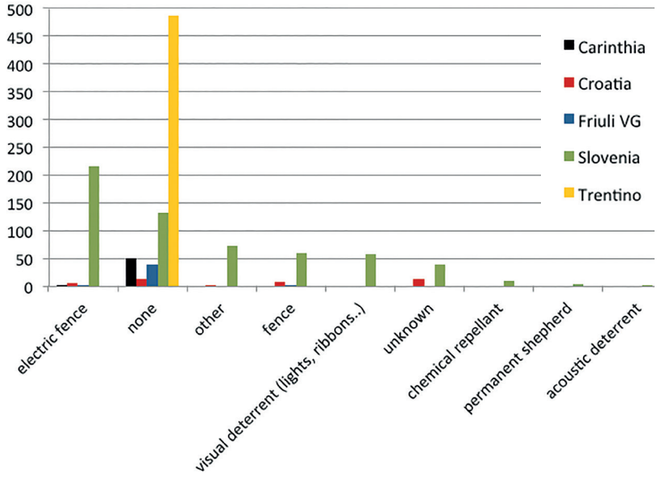

Fig. 5. In case of bear damage on beehives, type of prevention measure used. From Veneto we have no information about preventive measures.

Bear scat with beechnut. Photo: Paolo Molinari.

Cubs learn everything from their mother, also the naughty behavior. This is why it is particularly important to intervene on the mother problem bear. Photo: Jaroslav Vogeltanz.

4. Conclusion

Based on our analysis, Croatian brown bear management appears to be the most successful: The bear is accepted and valued by local communities (Majić et al., 2011), with poaching occurring only very rarely (Reljić et al., 2012). Damage caused by bears is compensated by the hunting organizations that profit from hunting bears, and the members of these organizations are predominantly local people, hence they have an interest in ensuring harmonious relationships. This management system may change since Croatia has joined the EU and has to conform to EU legislation.

EU agricultural policies can under certain circumstances be in conflict with the conservation of large carnivores. Especially in marginal rural and mountain areas livestock breeding (mainly sheep) is actively encouraged even in regions where there is no such tradition and where the presence of large carnivores represents a high potential for conflicts. Brown bear management and conflict minimisation are highly dependent on external factors, such as the management

of the rural areas and the way the landscape is used by livestock. The example of Trentino shows that preventive measures can be effective resulting in a considerable reduction of damages. This however implies proper use of preventive measures and regular controls. One problem is that prevention is not possible everywhere. Some sheep breeds (e.g. Kärntner Brillenschaf) are, based on their social organization, widely scattered while grazing instead of moving as a flock. Therefore the use of livestock guarding dogs is impossible. Replacing these breeds with others may be one solution, but it might be in contrast to the aim of maintaining local breeds.

Another problem is grazing livestock in the forest. Pasture-woodland is a form of land use where cattle, goats, horses, pigs and sheep are allowed to graze and browse in woodland. Such use of forest for traditional animal husbandry was very common until the middle of the nineteenth century and led to forest stands that were light, open and richly structured (Kipfer, 2006). As a consequence however, rejuvenation was impeded and forests consisted mainly of older aged stands what led to a ban of grazing livestock in forest (Kipfer, 2006). Nowadays new projects are being initiated for the revival of pasture-woodland, especially for sheep and cattle grazing, with the objective of increasing plant and animal biodiversity in forests (Weiss, 2006). Pasture-woodland is also considered a modern strategy of grazing for the benefit of the forest, livestock and other species such as e.g. capercaillie (*Tetrao urogallus*). However, in the context of coexistence with large carnivores, the revival of this practice may lead to future conflicts.

The risk for future conflicts is also increased, to a certain extent, by controversial EU policies. On one side a high investment is made for the conservation of large carnivores, and on the other hand projects in the field of agriculture and rural development are strongly promoted, which results in additional conflict potential. The investment in prevention measures will accordingly have to be higher than at present. There are several projects within the programming period at EU level for 2014-2020: Starting from the EU regulations 1083/2006, 1303, 1305, 1307/2013 of the European Parliament and the Council of 17 December 2013 laying down common provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund, the European Agricultural Fund for Rural Development and the European Maritime and Fisheries Fund have been launched that have the mountains as target areas. These programs promote the recovery of the economy in marginal regions (e.g. agriculture, local crafts, tourism). The challenge for the future will be to find a balance between these contrasting policies. Implementation of effective damage prevention measures will be crucial aspect in achieving the dual goals of large carnivore conservation and rural development.

Livestock within the forest is more exposed to large carnivore predation. Photo: Alessandro Viviani.

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References

Černe R, Jerina K, Jonozovič M, Kavčič I, Stergar M, Krofel M, Marenče M, Potočnik H (2010) Škode od volkov v Sloveniji (Wolf damages in Slovenia). Report of LIFE+ SloWolf Project. Biotechnical Faculty, University of Ljubljana, Ljubljana, 33 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.

Huber D, Kusak J, Majič Skrbinšek A, Majnarič D, Sindičič M (2008) A multidimensional approach to managing the European brown bear in Croatia. Ursus 19, 22–32.

Jerina K, Adamič M (2008) Fifty years of brown bear population expansion: effects of sex-biased dispersal on rate of expansion and population structure. Journal of Mammalogy 89(6), 1491-1501.

Jerina K, Jonozovič M, Krofel M, Skrbinšek T (2013) Range and local population densities of brown bear *Ursus arctos* in Slovenia. European Journal of Wildlife Research 59, 459-467.

Jerina K, Krofel M, Mohorovič M, Stergar M, Jonozovič M, Anthony S (2015) Analysis of occurrence of human-bear conflicts in Slovenia and neighbouring countries. Report of LIFE DINALP BEAR Project. University of Ljubljana, Ljubljana, 44 p.

Kaczensky P, Jerina K, Jonozovič M, Krofel M, Skrbinšek T, Rauer G, Kos I, Gutleb B (2011) Illegal killings may hamper brown bear recovery in the Eastern Alps. Ursus 22(1), 37-46.

Kavčič I, Adamič M, Kaczensky P, Krofel M, Kobal M, Jerina K (2015) Fast food bears: brown bear diet in a human-dominated landscape with intensive supplemental feeding. Wildlife Biology 21, 1-8.

Kipfer T (2006) Waldweide – Eine alte Nutzung neu entdeckt. Master Thesis, Institute for Systematic Botany, University of Zürich, Zürich, 77 p.

Knott E, Bunnefeld N, Huber Đ, Reljič S, Kereži V, Milner-Gulland EJ (2014) The potential impacts of changes in bear hunting policy for hunting organisations in Croatia. European Journal of Wildlife Research 60(1), 85-97.

Kocijan I, Huber Đ (2008) Conservation genetics of brown bears in Croatia. Final Report. Project Gaining and Maintaining public acceptance of Brown bear in Croatia (BBI-Matra/2006/020 through ALERTIS).

Krofel M, Filacorda S, Jerina K (2010) Mating-related movements of male brown bears on the periphery of an expanding population. Ursus 21, 23–29. Doi:10.2192/09SC015.1

Krofel M, Jonozovič M, Jerina K (2012) Demography and mortality patterns of removed brown bears in a heavily exploited population. Ursus 23, 91-103.

Majic A, Taussig de Bodonia AM, Huber D, Bunnefeld N (2011) Dynamics of public attitudes toward bears and the role of bear hunting in Croatia. Biological Conservation 144, 3018–3027.

Majič Skrbinšek A, Krofel M (2015) Defining, preventing, and reacting to problem bear behaviour in Europe. European Commission, Brussels, 56 p.

Reljič S, Srebočan E, Huber D, Kusak J, Šuran J, Brzica S, Cukrov S, Prevendar-Crnič A (2012) A case of a brown bear poisoning with carbofuran in Croatia. Ursus 23, 86–90.

Skrbinšek T, Bragalanti N, Calderolla S, Groff C, Huber Đ, Kaczensky P, Majič Skrbinšek A, Molinari-Jobin A, Molinari P, Rauer G, Reljič S, Stergar M (2015) 2014 Annual Population Status Report for Brown Bears in Northern Dinaric Mountains and Eastern Alps. Annual Report of LIFE DINALP BEAR Project. University of Ljubljana, Ljubljana, 23 p.

Weiss M (2006) ALP Austria – Programm zur Sicherung und Entwicklung der alpinen Kulturlandschaft: multifunktionale Neuordnung von Wald und Weide. Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Land Kärnten, Land Oberösterreich, Land Salzburg, Land Steiermark, Land Tirol, Land Vorarlberg.

Short Communication

HOW TO PREVENT DAMAGES FROM BEARS ON BEEHIVES

THE PRACTICE OF THE SWISS SYSTEM

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1. The comeback of the brown bear in Switzerland

In 2005 a brown bear reappeared for the first time in 100 years in the southeast of Switzerland. This bear immigrated from the Trentino population of Italy, where 50 bears live at the moment. In the last 10 years, 10 different individuals from this population have dispersed to Switzerland, where they permanently stayed in the area bordering Italy. Although 3 of these juvenile bears overwintered in Switzerland, no bear stayed longer than 2 years. Two problem bears were preventively shot by the local authorities because of their problematic behaviour closed to villages and humans.

The damages caused by the brown bears concentrated mainly on the small domestic animals (sheep and goats) summering on alpine pastures and on beehives, both in the valley and in the alpine area. An average of 20 domestic animals (mostly sheep) and 10 unprotected apiaries were killed/damaged by bears each year (Fig. 1).

Other conflicts with humans were mostly due to bears being attracted by anthropogenic food sources such as waste bins and compost heaps. However, there were no incidents where people were injured by bears. The preventive killing of two bears was justified by the Swiss management plan to prevent any kind of bear attacks on humans.

Fig. 1. Bear damage on apiary hut during the winter.

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2. Situation of beekeeping in the Canton of Graubünden

Because of the damage situation in the first years after the immigration of the bears, the national prevention program had to focus on sheep and apiaries. In the whole canton of Graubünden, where the bears have migrated during the past 10 years, there are 10,000 beehives, which are managed by about 900 beekeepers. But there were only 3 mainly concerned sections in the south-east to the Italian Border (Fig. 2).

The whole region is divided into 15 sections, where a beekeeper association organizes the keeping and breeding of the bees. Regarding the protection of the apiaries 3 different husbandry systems had to be considered:

1. Apiaries (solid house with built-in beehives) (Fig. 3);

2. Magazine of Styrofoam (individual boxes with different sizes) (Fig. 4);

3. Wooden Magazine (individual boxes with different sizes) (Fig. 5).

In addition the difference between transhumance (migratory) bees that change regularly the location and sedentary bees, which stay in the same place throughout the whole year, had to be taken into account.

Fig. 2. Southeastern project region on Swiss map.

Fig. 3. Protected apiary hut during winter season in the region of Engadin.

Fig. 4. Protected site of bee-breeding station in the region of Unterengadin.

Fig. 5. Protected mobile beehives in the region of Poschiavo.

Fig. 6. Model-fenced apiary hut in the region of Engadin.

3. Fencing of apiaries as priority damage prevention

3.1. Political and organisational approach 2005-2007

The return of bears challenged beekeepers in an entirely new way. Therefore, we took the necessary steps to protect the first apiaries with emergency measures. It was important that the associations of the affected sections participated in the organization and the communication from the beginning, so that they could take the responsibility for the preventive measures as soon as possible. To obtain the fairest possible compensation for the material costs, we conducted a survey among the beekeepers, as well as a material and price evaluation with some suppliers to determine the financial support of the state. With an average financial contribution of SFr. 700/apiary we found a fair solution that would take the different topographical conditions into account.

3.2. Technical aspects

Thanks to the experiences gained from the surrounding bear-regions (Trentino, Abruzzees, Pyrenees) it soon became clear that only a robust electrical fencing of apiaries could discourage the bears from attacking the beehives. So we tried to recommend the fence material that was adapted to the circumstances. Again, we made sure to give the beekeepers as much responsibility as possible, so original and creative solutions for fencing became possible. The sections coordinated themselves differently, so the fences were either standardized, built with commonly ordered material, or they were built depending on individual assessment (Fig. 6). Our technical guidelines were limited to the following basic guidelines:

1. Height: 1.20 m should be flexibly adjusted to the slope;

2. Solid wooden stakes of 1.60 m should be embedded 2-3 meters apart on of each other;

3. Use of high quality electrical tapes (diameter of 12 mm), that are fixed with insulators from the outside, at intervals of 20-30 cm;

4. Recommended voltage: 5000 V (a standard energizer is sufficient);

5. Regular maintenance of the conductivity and the tension of the wires is necessary.

3.3. Implementation practice 2007-2015

After the first apiaries have been electrified as immediate measures with an emergency budget, both the technical and the financial support could be integrated into our national carnivore damage prevention program from 2007. The implementation during the following years was therefore financially secured and the organization could be realized in a quite simple form. Because the actual costs and the amount of work per apiary were different, all the financial contributions for each site have been paid to the responsible beekeepers association, so that it could manage the contributions of its members in a flexible manner. So the better the beekeepers organized themselves, the smoother was the implementation. With an annual control, we tried to sustainably improve the quality of the fencing and mutual trust. So far 70% of the 1,500 beehives, which is corresponding to 250 apiaries, are protected by electrical fences in the most affected regions. The main concern has increasingly become the maintenance of the fences because there were no more bears in the area. Meanwhile, when a bear appears, we are trying through rapid communication to ask the beekeepers to build respective fences prematurely. The bear monitoring and the communication is organised by the local wildlife-guards and a regular transboundary exchange.

4. Conclusions

After the return of the brown bear to Switzerland no more damages were recorded to properly fenced beehives. It took about 5 years from the beginning of the immediate measures over the test phase until the transition to the "daily business" with secure compensation for the costs of prevention. Since 2013, the state contributions for the protection of bees are guaranteed by law and thus secured over the long-term. The participatory approach since the first damages until the institutional anchoring at the legislative level has proven to be a successful model. There are a few factors to emphasize that were critical to the successful process:

1. Good networking and organization of beekeepers through beekeepers associations;

2. Evidence of efficiency of the measures for motivation and sustainability;

3. Local and national political will to support the finances and technical support;

4. Willingness of technical support unit to offer simple and non-bureaucratic solutions;

5. Amount of work for any possible maintenance and adjustments to the measures that is reasonable for long term;

6. Appreciation of the engagement and exchange of information between beekeepers and the general public.

Through the interplay of these factors, the bee prevention case could serve as a model for other prevention measures. However, our ability to effectively adapt sheep farming to the presence of bears has been less successful because one or more of the above mentioned factors has not been present.

In Switzerland the immigration of bears can also be expected to continue in the future. The conflicts with beekeeping have been largely mitigated by the prevention concept and its implementation in recent years.

The co-existence between bears and human activities will find its key challenges mainly in the sheep and goat farming, and through direct encounters between bears and humans.

Short Communication

PILOT PROJECT ON WASTE MANAGEMENT AND BROWN BEAR DAMAGE PREVENTION

IN THE VAL MÜSTAIR BIOSPHERE NATURAL PARK

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1. Introduction

After more than 100 years, the bears came back to Switzerland. Since 2005, young male bears repeatedly immigrated from northern Italy to Graubünden, in the southeast of Switzerland (Fig. 1). Until now there is no stable population and the bear is strictly protected. Except for two of them, they emigrated again after several months. The other two, so named JJ3 and M13, had to be culled by local authorities because they were classified as dangerous for the public. This classification was based on the Swiss Management plan for the conservation of brown bears. Since these two bears did not fear people, they came too close to them, especially while foraging. In addition to other food sources near settlements that are interesting for bears they raided garbage containers.

Fig. 1. The project region Val Müstair Biosphere Natural Park.

2. A pilot project for waste management

The immigrant bears have shown that adequate habitat for bears is present in Switzerland, but that there is still a lot of work to do to allow a low-conflict coexistence with them. Among other things, this relates to waste management. The Federal Office for the Environment (FOEN) has recognized this, and initiated the elaboration of a specific strategy plan (Molinari and Theus, 2008). The Biosfera Val Müstair Natural Park subsequently started to implement this concept with a pilot project. An inventory was conducted recording potential food sources that are interesting for bears and have a connection to humans. This survey concluded that a high number of such sources exists (Rempfler et al., 2011).

After a detailed analysis this number could be restricted taking only the geographically important areas and the most attractive food sources into account. In this context it should be noted that those bears, which raided waste containers in Graubünden, always first raided the containers along the streets. Thus already a lot would have been achieved if these containers were made bear-safe. Thanks to the responsible authorities of the Canton of Graubünden this first step of waste management has been realized in the project area since 2010 (Fig. 2). Another step relates to potential food sources in the areas of responsibilities of the municipalities. And a third category relates to the food sources for which private people are responsible. It became obvious during the project period that the pressure to act in each type of property must be high until a community is actually active, not least due to the high costs of adaptation.

Fig. 2. Container test. Photo: Mario Theus.

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3. The challenge of implementation

To implement a practical and effective waste management, it should be sufficient if only the most important of the theoretically available food sources are made inaccessible to bears, provided one chooses the locations with the highest potential for conflicts. Such a waste management concept should also be feasible in larger areas than the one of the pilot project. Nevertheless if problem bears, which previously sought their food in garbage, immigrate, a significant additional effort is necessary. Depending on the degree of habituation of a bear, prevention measures can get very costly or just impossible for a sustainable implementation. The concept in the described form with relatively limited prevention resources is therefore promising for the presence of discreet, shy bears. If bears that already have often conspicuously appeared close to settlement areas, immigrate, the prevention measures reach their limit, because the costs become disproportionately large to change the bad habits of bears.

4. Conclusion

In the project area a total of 2304 anthropogenic food sources were registered (Table 1). This large number in an area of about 200 km^2 gives the impression that waste management in the context of bears is challenging. However, if one limits the food sources due to its location and its attractiveness, the situation can be rationalized. Since the project intends to prevent shy bears from becoming problem bears, and since 2005 the regional experience showed, that it is impossible to make all the sources inaccessible to bears, a prioritization of the sites as well as the type of food sources is crucial for the implementation of such a waste management.

So, regarding the implementation, it was decided to limit the 35 registered potential food sources to 16 (see potential food sources priority 1 and 2 in Table 1, based on the experiences made in Switzerland and the Province of Trento, Italy, Groff et al., 2014). The categories "bees" and "livestock" were not integrated in this project because they were treated in another two different projects.

Table 1. Potentially interesting anthropogenic food sources for bears (Extract from Rempfler et al., 2009).

Human caused potential food sources		
Group	Priority 1	Priority 2
Waste	Waste container	Recycling
	Waste bin	
	Garbage can	
	Open waste	
	Other waste	
Human food		Leftover food
		Food
		Vegetables/fruits
		Drink residues
Organic waste	Compost	Manure heap
	Organic landfill	
	Green waste	
Animal food	Deposited fish feed	Animal feed
	Bowl for dogs or cats	Animal keeping
Grill	Barbecue fireplace	
	Barbecue area	
	Mobile grill	
Miscellaneous	Bio-oil tank	Bait
		Bird food
		Toiletry
		Seeds
		Others
Others	Camp site	Silo
	Bait station	
Livestock, domestic animals and pets		
Bee keeping		Bee house
		Beehive
		Honey/honeycombs
Animals		Pets
		Small domestic animals
		Cattle and horses

Fig. 3. Region of the pilot project Val Mustair with protected food sources. Photo: AJF Graubünden.

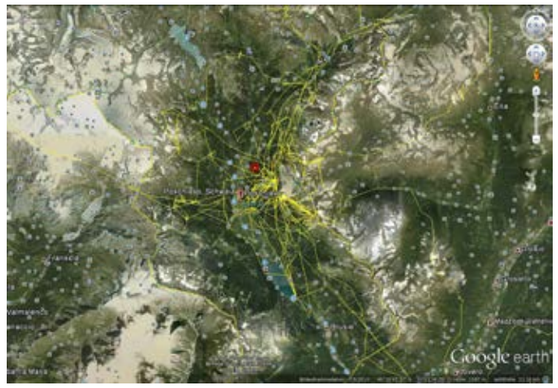

Fig. 4. Region of Val Poschiavo without any protected food sources. Photo: AJF Graubünden.

Locations within settlements have not been dealt with as bears that enter populated areas are usually already problem bears. That's why the food sources in the villages were not included in the project. Therefore, the focus was on the sites along the transport routes and hiking trails, as well as on buildings and infrastructures outside of densely populated areas.

Since the concept was implemented in 2012, the pressure of bears was very low in the chosen region for the prevention measures. So only some sporadic visits of bears happened and a systematic evaluation about the efficiency of the measures couldn't be realized. But the comparison of the behaviour of one immigrant individual (M13) gives us quite obvious signs that the protection of potential food sources could influence the spatial behaviour of bears and their potential for conflict and future survival.

The following two maps (Figs. 3, 4) show the two regions of comparison where the bear M13 was GPS-tracked. In Figure 1 there is the region with protected food sources along the main roads and hiking tracks. In Figure 2 there is the region where no prevention measures where implemented. There is no statistical val-ue in this comparison, but it shows, that the offer of human-caused food sources could influence the spatial behaviour and the acquisition of bad habits by bears. In the Region of Val Mustair there weren't any damages during 2012 meanwhile in the region of Val Posciavo the individual was causing damages and was eventually shot as a problematic individual after coming closer to humans and getting used to anthropogenic food sources.

References

Groff C, Bragalanti N, Rizzoli R, Zanghellini P (editors) (2014) 2013 Bear Report. Forestry and Wildlife Department of the Autonomous Province of Trento, Trento, 78 p.

Molinari P, Theus M (2008) Konzept für den Umgang mit organischen Abfällen und andere Futterressourcen menschlicher Herkunft. KORA, 13 p.

Rempfler T, Bächtiger M, Graf RF, Robin K (2011) Bärenprävention – Zum Umgang mit anthropogenen Nahrungsquellen in Bärengebieten – Kurzbericht. Zürcher Hochschule für Angewandte Wissenschaften ZHAW in Wädenswil, Institut für Umwelt und Natürliche Ressourcen IUNR, Fachstelle Wildtier- und Landschaftsmanagement WILMA, 34 p.

Short Communication

EFFECTIVENESS OF BROWN BEAR DAMAGE PROTECTION MEASURES TO PROTECT APIARIES IN THE CANTABRIAN MOUNTAINS

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1. Introduction

Human-wildlife conflicts associated with large carnivores have led to their persecution and eradication from large areas of the Earth since ancient times (Ripple et al., 2014). In recent times, large carnivore populations have recovered in Europe with new populations in many areas becoming established in highly humanized environments. This is resulting in increasingly frequent human-wildlife conflicts, mainly due to damages caused to human properties (Chapron et al., 2014; Treves and Karanth, 2003). Finding solutions to resolve the conflicts thus arisen (economic, social, and emotional) is an important challenge to ensure the conservation of these species (Treves and Karanth, 2003).

To mitigate the conflict and improve tolerance over these species, monetary compensation is commonly utilized (Dickman et al., 2011); although this procedure has been often criticized because of its low efficiency at reducing conflicts (Boitani et al., 2010; Bulte and Rondeau, 2005). To reduce these conflicts, it is necessary to improve the knowledge about the factors that cause them, (demographic, ecological, socioeconomic; e.g. Naves et al., 2012; Suryawanshi et al., 2013) and integrate this knowledge into the design and use of effective prevention and dissuasive measures (e.g. Salvatori and Mertens, 2012).

In the case of the brown bear (*Ursus arctos*), recurrent damages can stimulate bear habituation behaviour to human presence, when approaching villages

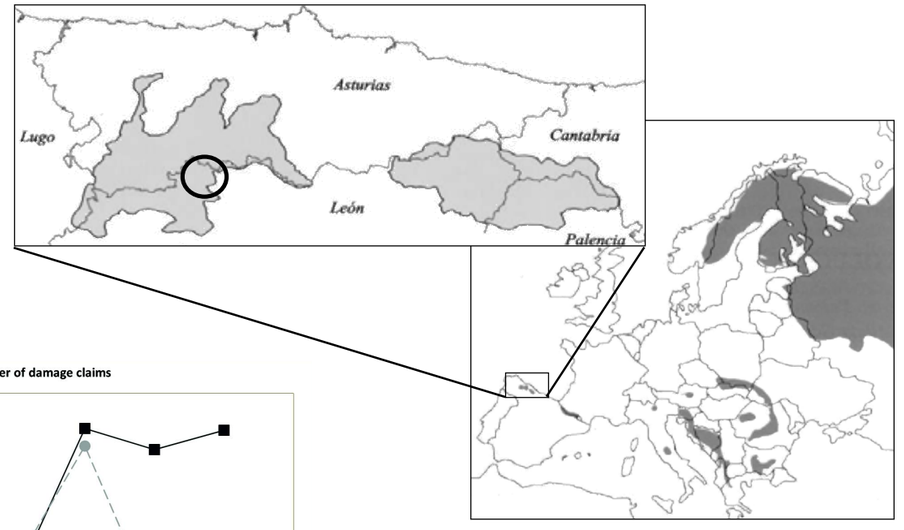

Fig. 1. Distribution map of brown bear in Europe. a. Present distribution of brown bear in Europe. b. Distribution of brown bear in the Cantabrian Mountains and location of the study area (circle).

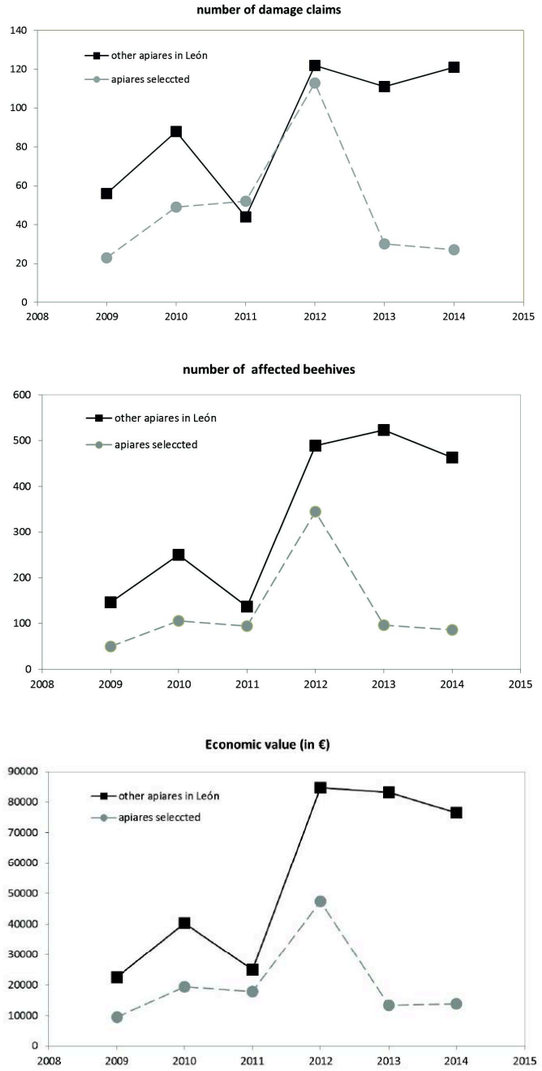

Fig. 2. Number of total bear-related damage records, beehives affected and economic losses in the apiaries of the essay, compared to the rest of the León province.

or places with human activities in search of food resources (Swenson et al., 2000). The risk of accidents from encounters between bears and people can increase in these situations and the resulting effects on conservation policies can be very dramatic (Loe and Roskaft, 2004).

The brown bear population in the Cantabrian Mountains is included in the Spanish Catalogue of Endangered Species in the category "Endangered Species" and is one of the most endangered brown bear populations in the world (Zedrosser et al., 2001). The conservation policies for this population has included, for over three decades, the payment of monetary compensation and in some cases provision of material, namely electric fences, to farmers to protect their property. This population may represent a model case not only for Spain but also for all Europe, since its recent population growth (Pérez et al., 2014) is combined with a significant increase in damages (Sánchez-Corominas and Vázquez, 2006 - for Asturias 1988-2003 period; Pollo, 2006 - for León 1974-2003 period); and in some regions, i.e Asturias, during the 1991-2008 period, the rate of increase in damages to beehives was three times higher than the rate of increase in the bear population (Naves et al., 2012).

These data could indicate that other factors may be contributing to this trend but also confirms the need to quickly reduce the human-wildlife conflicts being generated. In the Cantabrian Mountains there are about 400 claims for damages attributed to bears (annual average for 2005-2010) of which 70% involve beehives (Javier Naves and Juan Seijas, unpublished data), a figure that gives an idea of the importance of this type of human-wildlife conflict.

In the case of bear attacks to beehives, the use of electrified fences has been one of the most common protection procedures (Honda et al., 2009; Otto and Roloff, 2015). In the Cantabrian Mountains the authorities as well as NGOs promote the use of different types of electrified enclosures or fences to protect the apiaries. However there have not any systematic evaluations about the efficiency of these prevention systems.

In the framework of a new program of the Spanish Ministry of Agriculture, Food and Environment for promoting methods to mitigate human-wildlife conflicts caused by large carnivores, this study evaluates the effectiveness of different electric fence systems to protect apiaries from bears.

2. Study Area

The study area was located in the León province (northern Spain) (Fig. 1). Here, during 2009 and 2012 there was an annual average of 137 claims for bear attacks on apiaries; this meant an average of 400 beehives affected each year. The annual economic cost accounted for 66,700 € (Servicio Territorial de León - Junta de Castilla y León, unpublished data).

3. Material and Methods

The five apiaries with most damage records were selected to be provided with protection measures. These five apiaries had suffered an annual average of 59 bear damage claims and 148 affected beehives during the 2009-2012 period. This represents 42% of bee damage and 34% of beehives affected in the whole of Leon province. The damage caused on these five apiaries reached in the previous four years 94,000 €, 21% of the total for the province (Servicio Territorial de León - Junta de Castilla y León, unpublished data).

This disproportionate amount of damage is due to these five apiaries being part of very productive farms, with 72 beehives on average per unit, which is relatively high compared to those in other areas of the Cantabrian Mountains. Also, bear "habituation" cases possibly occurred in these farms.

The apiaries selected for the study had already installed a simple fence with 3-4 electrified wires, and

Brown bear digging around an apiary to avoid electrified wires. Photo: Junta de Castilla y León.

Brown bear pushing the wood stake of an electrified fence to avoid electrical discharge. Photo: Junta de Castilla y León.

the fifth apiary had a double fence of similar characteristics. But these fences had not always worked properly, supposedly due to poor wire insulation in contact with vegetation, malfunctioning electrical grounding and poor maintenance of batteries.

Since 2013, several improvements were installed in successive stages to test their effectiveness in different settings (levels of incidence or intensity of attacks). The improvements consisted in clearing the vegetation around apiaries to avoid electrical shunts, periodical checking on the effectiveness of the electrical grounding depending on ground moisture, installation of fences with aluminium wire (better conductor than nylon) to ensure electrical conduction and/or installation of 1,5 m high electrified fences and finally, photovoltaic energizers installation that ensured continuity in the intensity of the power supply (9,2 kV), without requiring constant maintenance (as in the case of batteries). These materials were provided by the project.

Inspection of a bear damage event by an official ranger from the competent authority. Photo: J.M. Seijas.

Maintenance work during the essay. Photo: J.M. Seijas.

Photovoltaic energizer used during the essay. Photo: J.M. Seijas.

Monitoring work. Verification of the continuity of the electric discharge's intensity over time. Photo: J.M. Seijas.

4. Results

Considering the two years in which this protection measures have been applied up to now (2013 and 2014, Fig. 2), the percentage of bear-damage records associated with these five improved-protection beehives changed from 48% (of the total of the León province) in the previous year (2012) to 20%. Considering the number of beehives attacked, these holdings accounted for 16% against 41% of previous year.

From an economic point of view, damage caused in these five beehives during 2012 account for 47,500 €, against an annual average of 13,600 € for 2013 and 2014. A cost of 750 € in raw materials was required to build a photovoltaic energized mesh fence and 450 € for the energized wire fence. The labour for installation, mowing and maintenance should also be considered in addition.

In general, trial results suggest that in some cases the electrified fence (1.5 m seems high enough), whether mesh or wire, with no derivation set up (e.g. no contact with vegetation), a good electrical grounding connection and a maintenance program that ensured continuity in the intensity of the electric discharge overtime could be enough to prevent or reduce the bear attacks to beehives. For cases in which repeated attacks occurred (possible "habituation" cases), a double fencing or netting fence electrified at a suitable distance (20-30 cm), with independent energizing wires, can solve the problem by significantly reducing the number of damages or even preventing them totally.

5. Conclusions

A primary conclusion is that effective protection requires the right equipment set-up and constant maintenance.

The test results are quite satisfactory because they demonstrate the possibility of reducing or eliminating the number of damages in a bee farm in an efficient manner, by installing and maintaining relatively cheap protective measures.

Due to the practical goal of this trial, these preliminary results were used to develop technical recommendations – "Protecting apiaries" – for good practices or improved techniques to prevent damage to beehives. This document is included in the "Catalogue of measures to protect agriculture and livestock

interactions with wildlife," by the Ministry of Agriculture, Food and Environmental Affairs (MAGRAMA (http://www.magrama.gob.es/es/biodiversidad/temas/conservacion-de-especies/ce_silvestres_resolucion_oso_pardo_colmenares_tcm7-358443.pdf).

The project will continue throughout 2015 and 2016. Besides confirming the previous results and deploying these measures in other apiaries of Cantabrian mountains, we will try to develop new protective methods to study the relationship between natural food availability and intensity of the damage on apiaries, habituation of some individuals and the effect of protective measures applied to other apiaries or other types of farming (cattle, orchards) around the study area.

Acknowledgements

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References

Boitani L, Ciucci P, Raganella-Pelliccioni R (2010) Ex-post compensation payments for wolf predation on livestock in Italy: a tool for conservation? Wildlife Research 37(8), 722-730.

Bulte EH, Rondeau D (2005) Research and Management Viewpoint: Why compensating wildlife damages may be bad for conservation. The Journal of Wildlife Management 69(1), 14-19.

Chapron G, Kaczensky P, Linnell JDC, von Arx M, Huber D, et al. (2014) Recovery of large carnivores in Europe's modern human-dominated landscapes. Science 346, 1517-1519.

Dickman AJ, Macdonald EA, Macdonald DW (2011) A review of financial instruments to pay for predator conservation and encourage human-carnivore coexistence. Proceedings of the National Academy of Sciences of the United States of America, 108, 13937–13944.

Honda T, Miyagawa Y, Ueda H, Inoue M (2009) Effectiveness of newly-designed electric fences in reducing crop damage by medium and large mammals. The Mammalogical Society of Japan 34, 13–17.

Loe J, Roskaft E (2004) Large carnivores and human safety – A review. Ambio 33, 283–288.

Naves J, Fernández-Gil A, Ordiz A, Revilla E, Delibes M (2012) Influence of demographic and environmental factors on economic damages caused by brown bears in the endangered Cantabrian population (NW Spain). 21st International Conference on Bear Research and Management (November 26-30, 2012), New Delhi, India.

Otto TE, Roloff GJ (2015) Black bear exclusion fences to protect mobile apiaries. Human–Wildlife Interactions 9(1), 78–86.

Pérez T, Naves J, Vázquez JF, Fernández-Gil A, Seijas J, Albornoz J, Revilla E, Delibes M, Domínguez A (2014) Estimating the population size of the endangered Cantabrian brown bear through genetic sampling. Wildlife Biology 20, 300-309.

Pollo C (2006) Tipología, estacionalidad, evolución temporal y distribución espacial de los daños atribuidos al oso pardo (*Ursus arctos*) en la Provincia de León (1974-2005). Galemys 18, 3-17.

Ripple WJ, Estes JA, Beschta RL, Wilmers CC, Ritchie EG, Hebblewhite M, Berger J, Elmhagen B, Letnic M, Nelson MP, Schmitz OJ, Smith DW, Wallach AD, Wirsing AJ (2014) Status and ecological effects of the world's largest carnivores. Science 343, 1241484.

Salvatori V, Mertens AD (2012) Damage prevention methods in Europe: Experiences from LIFE nature projects. Hystrix 23, 73–79.

Sánchez-Corominas T, Vázquez VM (2006) Daños producidos por el oso pardo (*Ursus arctos*) en Asturias. Real Instituto de Estudios Asturianos. I Congreso Mundial de Estudios Asturianos. Volumen VI, 467-490.

Suryawanshi RK, Bhatnagar YV, Redpath S, Mishra C (2013) People, predators and perceptions: Patterns of livestock depredation by snow leopards and wolves. Journal of Applied Ecology 50(3), 550-560.

Swenson JE, Gerstl N, Dahle B, Zedrosser A (editors) (2000) Action Plan for Conservation of the Brown Bear (*Ursus arctos*) in Europe. WWF, Council of Europe, Strasbourg, 70 p.

Treves A, Karanth KU (2003) Human-carnivore conflict and perspectives on carnivore management worldwide. Conservation Biology 17, 1491–1499.

Zedrosser A, Dahle B, Swenson JE, Gerstl N (2001) Status and management of the brown bear in Europe. Ursus 12, 9–20.

Short Communication

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.

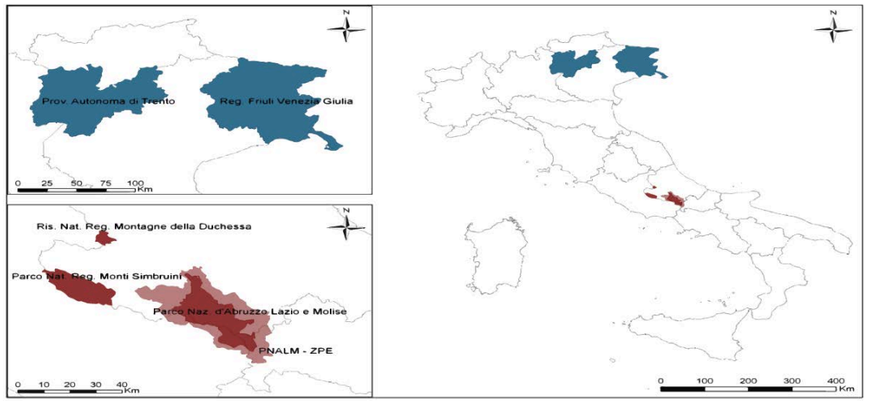

Fig. 1. Intervention area of the LIFE ARCTOS Project where fences were delivered and checked.

The conservation of large carnivores in human-dominated landscapes needs to take in consideration 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 users 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 were 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 fences were requested, Fig. 2a), where the first two

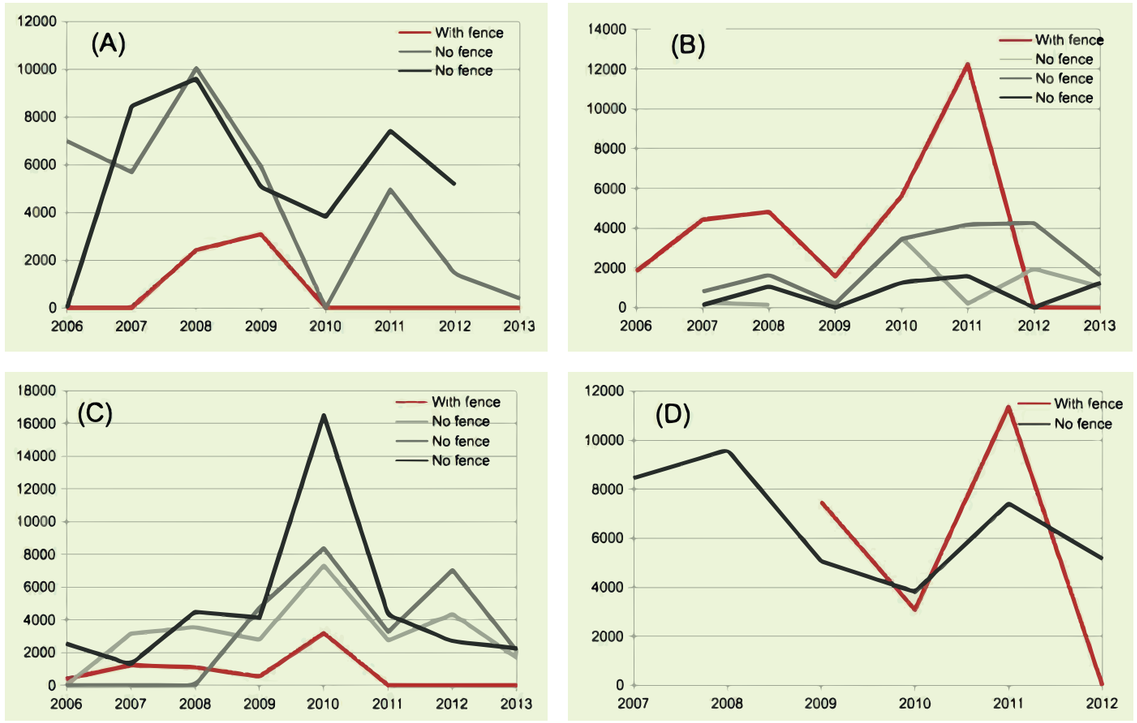

Fig. 2. The comparison of amounts claimed (€) for compensation of damages suffered by holdings with and without fences in four different townships: Lecce dei Marsi (A - upper left), Pescasseroli (B - upper right), Picinisco (C - lower left), and Gioia dei Marsi (D - lower right).

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), were 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 though the use of the amount saved in compensation in conservation actions and monitoring of the species.

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This paper is dedicated to Massimiliano Rocco, who coordinated most fieldwork and analyses and participated to the drafting of the article, but unexpectedly left us in December 2015 without seeing it published.

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, Majic 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, Wolfl 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.

Short Communication

RESULTS OF THE LIFE ARCTOS/KASTORIA PROJECT

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1. Introduction

This article summarises the results of the project LIFE ARCTOS/KASTORIA (LIFE09 NAT/GR/333) - "Improving conditions of bear-human coexistence in Kastoria Prefecture, Greece: Transfer of best practices". The project was designed by the Environmental NGO CALLISTO specialised in large carnivores' research and management and was implemented between October 2011 and September 2015, in cooperation with local authorities. Coordinating beneficiary was the Region of Western Macedonia, while other associated beneficiary (besides CALLISTO) was the local Development Agency of Kastoria (ANKAS). See the project area in the following maps.

The conditions before the realisation of the project were the following. From 2000 traffic accidents involving brown bears *(Ursus arctos)* evolved into both an important cause of human caused mortality for this carnivore in Greece, and into a serious threat for public safety. According to several memoranda submitted to the competent authorities by environmental organizations (including CALLISTO), there have been 26 fatal road accidents involving bears from 2000 to 2010, 19 of which occurred along the Egnatia Motorway network. Fortunately, no human lives were lost in these accidents.

Fig. 1. LIFE ARCTOS/KASTORIA project area.

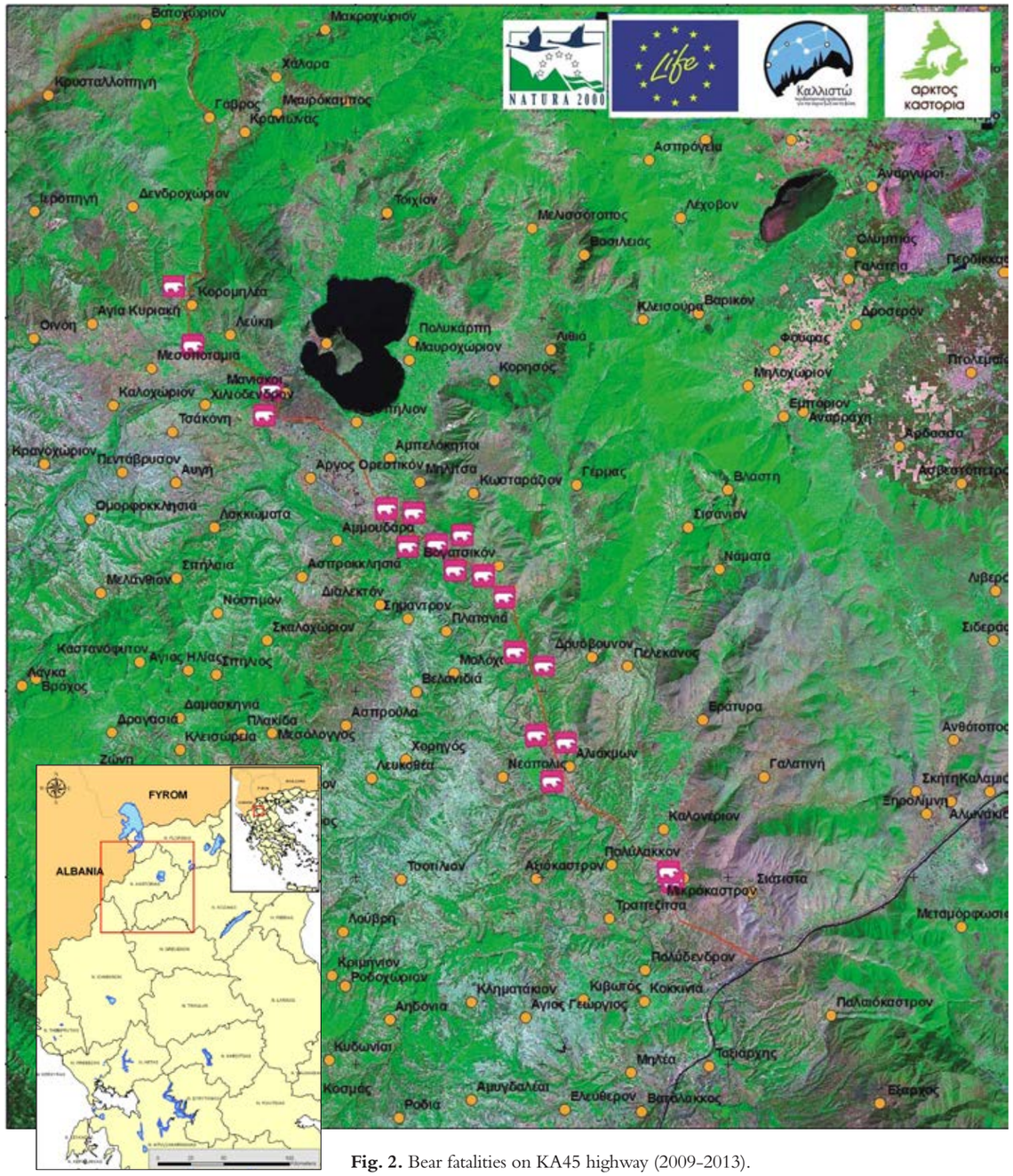

Fig. 2. Bear fatalities on KA45 highway (2009-2013).

The frequency of traffic accidents increased immediately after the construction company handed over the road to traffic in June 2009. During 2009-2010, in the above mentioned areas, there were eight (8) cases of traffic accidents with bears, out of which six (6) died in the end. In summer 2010 an adult male bear (5 years old and weighing about 120 kg) died in a road accident. In this part of the motorway, from 2009 to 2013, totally 19 fatal traffic accidents with bear victims were recorded (Fig. 2). The fence along the road was a conventional one (1.60 m height only, Fig. 3). Moreover, apart from the insufficiency of the fence, no special wildlife passages have been built, nor distinct warning signs and artificial deterrents aiming at keeping wildlife away from the road had been installed, putting the life of both drivers and animals in danger. Actually, the motorway builders had not taken under consideration the presence of bears and other large mammals in the area.

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In the same time, in the prefecture of Kastoria there has been an increase in the number of bears that tend to approach residential areas (e.g. villages of Nestorio and Klisoura). In order to address these incidents, specific preventive measures are required. These measures need to be deployed according to a precise technical protocol, depending on the case and the complexity of each incident. It was absolutely necessary, therefore, to establish and operate a special "Bear Emergency Team" (BET), which could intervene to such cases, either providing advices to local authorities (e.g. on management of garbage dumps or small orchards close to villages), or undertaking implementation of recommended methods and techniques (relocation, aversive conditioning).

Moreover, in the district of Kastoria, the agricultural sector (farming, animal breeding, and apiculture) plays a very important role for the economic and social life of the community. The damages caused by bears on livestock, apiaries, fruit trees and crops are a significant nuisance in rural areas and sometimes result in illegal methods of human caused bear mortality. Between 2011 and 2014 192 sheep/goats, 49 cattle, 4 equine and 147 beehive losses were recorded by the Greek Agricultural Insurance Organisation in the project area.

Finally, environmental education programs, awareness-raising campaigns, mobilization of volunteers and involvement of stakeholders, are essential actions for the successful implementation of conservation measures.

2. Results

The project was implemented between October 2010 and September 2015 in Kastoria Prefecture with emphasis on areas of permanent or seasonal presence of brown bears. The most important achievements of the project are presented below, categorized under the 3 major set of actions that have been implemented.

2.1. Reducing-eliminating the phenomenon of road accidents involving bears

Using radio-telemetry data from nine (9) radio-tagged bears and other input from in situ extensive surveys conducted by CALLISTO for identification of sections of the road and highway network with a high risk of bear traffic fatalities, 5400 optical Wildlife Warning Reflectors (WWR - deflecting the light from headlights of approaching vehicles towards the roadside to create a constantly changing optical warning fence, which prompts large mammals to stop moving or to flee back into the woods/fields deterring wildlife from crossing the road in the path of approaching vehicles, Figs. 4, 5) and 22 Warning Road Signs (WRS - alerting drivers to potential collision with bears and other wildlife species, Figs. 6, 7) were installed along the newly constructed highway as well as the old national and county roads network.

Fig. 3. The conventional fence on the highway before intervention from CALLISTO and the LIFE project.

Fig. 4. WWR (Wildlife Warning Reflector) installed on the jersey of the highway.

Fig. 5. WWR installed on delineator post of a county road.

Fig. 6. WRS (Warning Road Signs) installed on the highway by the project LIFE ARCTOS/KASTORIA.

Fig. 7. WRS installed on a county road by the project LIFE ARCTOS/KASTORIA.

Following successful pressure by CALLISTO, EGNATIA ODOS SA (the company that constructed the highway) installed additional warning signs at crucial points of the highway segments (Fig. 8).

EGNATIA ODOS SA proceeded with the installation of an upgraded 130 km bear-proof fence. The new fence (Figs. 9, 10) has been constructed according specific standards with a height of 3 m, and reinforced, galvanized fencing wire. The distances between the piles, which have been fastened on the ground with concrete, is maximum 2 m.

Fig. 8. Additional WRS installed on the KA45 highway by EGNATIA ODOS SA.

Fig. 9. Installing the "bear-proof" reinforced fence on the highway after successful efforts of CALLISTO.

Fig. 10. Another view of the "bear-proof" reinforced fence, installed on the highway.

Fig. 11. An electric fence installed around beehives near human settlements.

Fig. 12. Bear-proof refuse containers installed by the project near human settlements.

2.2. Addressing incidents of bears approaching populated areas and supporting implementation of prevention measures to minimize bear caused damages

Following a preliminary assessment of damage caused by bears in the project area, 32 electric fences (Fig. 11) and 40 bear-proof garbage containers (Fig. 12) were placed in high risk human-bear conflict areas.

Following a preparatory phase during which a Livestock Guarding Dog (LGD) owner registry was created (data and useful information were retrieved from databases of all registered farmers provided by the General Directorate of Rural Development as well as the Veterinary Services of the Region of Western Macedonia), a network of LGD owners was developed (23 participants). Whenever a dog owned to a member of the Network was giving birth to puppies, the relevant info was provided to both ANKAS and CALLISTO, who in turn were informing the other members of the network possibly interested in adopting the LGD puppy(ies) (e.g. giving also details on condition of the puppies, gender). The requested puppies were transported either by the interested receiver or the facilitator of the Network employed by CALLISTO. Moreover, during the action's implementation period, an expert (veterinarian), staff member of CALLISTO, provided technical support to the implementation of the action by paying visits to members of the Network, for confirming the quality of the dog/s and for providing advices and veterinarian care for free. Following this procedure, facilitating and monitoring the LGD Owners' Network, twenty eight (28) LGDs were provided to livestock breeders for free, during the project's implementation period. The LGDs provided preferably belong to local breeds: the "Ellinikos Poimenikos" (Fig. 13) and the "Molossikos Ipeirou" (Fig. 14).

A Bear Emergency Team (BET) (consisting of 2 experienced veterinarians and 2 biologists) dealt successfully with approximately 50 cases of human-bears conflict. Moreover, the operation of the BET was institutionalised by the Greek Government after official approval of the BET's operating protocol. The approval was made through a Common Ministerial Decision of the Ministers of Environment, and of Rural Development and Food. Green Fund (a na-

Fig. 13. Typical Greek Shepherd Dog (LGD local breed). Photo: Alexis Giannakopoulos.

Fig. 14. Typical Epirus Molossian Dog (another LGD local breed). Photo: Alexis Giannakopoulos.

tional organisation supervised by the Ministry of Environment, which finances environmental activities) will cover the costs of interventions when necessary.

The project actions contributed substantially to the activation of the Measure 216, Action 1.1 of the Greek Rural Development Programme (RDP) 2007-2013, under which beekeepers and livestock breeders received financial support, in order to cover the cost of purchasing and installing portable electric fences devices, as a means to prevent bear damages on their properties.

2.3. Increasing/enhancing public awareness of the aforementioned issues

An "Eco-Volunteers Programme" was established in the project area, through which ninety two volunteers were engaged. They disseminated leaflets, conducted special meetings (15 in total) and informed more than 500 visitors and residents of the area.

The project printed and disseminated more than 38,000 copies of informative leaflets, brochures, best practice manuals etc. as well as 2,500 copies of posters, regarding different aspects of coexistence between bears and humans, including application of preventive measures.

More than 14 information meetings and seminars were conducted, targeting either the broad public or special groups of stakeholders (e.g. agriculture professionals, livestock raisers and bee-keepers, hunting associations, local authorities' employees).

Thirty (30) environmental education actions were implemented in the project area (18 actions for 307 primary school students, 9 actions for 71 secondary school students, and 3 actions for 60 adults). Educational activities were starting with presentations and discussion on the natural values of the region, the flora and fauna of the area and the problems of bear/human coexistence. They were followed by site visits in representative bear habitats and "hot spots" of bear-human conflicts.

3. Discussion

The technical implementation of the preventive measures has proven to be very straightforward, simple and effective in deterring damage from carnivores to livestock and apiaries. The practical experience that has been accumulated since the early 1990s has allowed fine-tuning of the technical characteristics, procedures and conditions of these measures.

However, long-term monitoring of carnivore populations and the extent of damage caused by them is also a prerequisite in order to assess the impact of the measures. This requires a close collaboration and coordination between the National Agricultural Insurance Organisation (ELGA), which holds data on carnivore damage and reimbursements, and conservation bodies, such as NGOs and the Management Bodies of the National Parks, which monitor carnivore populations. The inclusion of preventive measures in the Rural Development Programme back in 2003 can be hailed as a major success thanks to the substantive efforts of NGOs. The implementation of the aforementioned measures has failed in the first (2003-2006) and second (2007-2013) programming periods of the RDP, possibly due to the inadequate promotion of the measures to potential beneficiaries, or unduly strict conditions for application. This has implied that a large part of the funds attributed to the preventive measures have been left unused. Nevertheless, a similar measure is included in the national RDP of Greece 2014-2020 (Measure 4.4 - Support for non-productive investments for environmental purposes). Hopefully, the measure will be implemented more effectively.

The efforts so far have been driven mainly by NGOs or LIFE projects aiming at carnivore's conservation, whereas the role of other stakeholders (mainly state authorities) has been relatively limited.

During the efforts to develop the LGD-Owners Network, several practical problems arouse, which are worth-mentioning. The social relationships among some shepherds may in certain cases become a limiting factor (when negative or hostile). Shepherds may refuse to cooperate in efforts to breed and distribute livestock guarding dogs.

Another problem is the lack of trust shown by certain shepherds to the project team. The situation gets even worse when the project team needs to carry an adult genitor from one livestock raiser to another one during the dogs' mating period. Usually shepherds are not willing to carry the dogs themselves as they consider its time consuming.

Several livestock raisers are suspicious regarding their participation in the network as they perceive it as a mandatory commitment which in case of failing to fulfil certain obligations they will be sanctioned. The creation of trust between livestock raisers and the project action team requires a certain time margin, regular contacts and practical activities.

It is frequent that livestock raisers with good quality LGDs usually avoid giving puppies to neighbouring shepherds (with lower quality dogs). This happens because they believe that large carnivores will attack the less well protected flock and avoid the flocks with good LGDs, and thus minimizing the probability of suffering damage. The livestock raisers with this mentality are willing to give puppies only to shepherds based at a much greater distance and with whom they maintain long standing friendly relationships.

CALLISTO was included in the finalists for the Natura 2000 awards with the LIFE ARCTOS/KASTORIA project.

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Alexis Giannakopoulos, Coordinator/Facilitator of the LGD Owners Network; Constantinos Godes (1961-2012 RIP), Co-Facilitator of the LGD Owners Network; Dr. Yorgos Mertzanis, Scientific Coordinator, CALLISTO; Liana Bousiaki, Communication Expert, CALLISTO; Thanos Tragos, Yiannis Tsaknakis, Suzan Riegler, and Armin Riegler, Bear Emergency Team and Field Team members; All animal breeders and shepherds who participate and support the operation of the LGD Owners Network.

References

Progress Reports and Final Report of the LIFE ARCTOS/KASTORIA Project (unpublished).

Short Communication

BEAR MANAGEMENT: THE CASE OF A BEAR ATTACK ON HUMANS IN TRENTINO, ITALY

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1. Introduction

The bear vanished from all over the Alps in the XX century, out of a very small and isolated population that survived till the end of the 90's in Trentino, Italy. This was mainly due to human persecution and habitat loss.

The bear reintroduction project carried out in Trentino, from 1997 to 2004 by the Autonomous Province of Trento, the Adamello-Brenta natural Park and the National Wildlife Institute, to ward off the extinction in the Alps, has been very successful so far. The population of bears in the Alps, almost extinct in the late 1990s with no more than 3-4 specimens still present, has now reached around 50 animals (41-51 individuals in 2014), and in the 2002-2014 period there were 41 litters, with 88 cubs, born.

Despite these encouraging results, ensuring a social acceptance of the project, and especially for the return of the bear to the Italian Alps, remains a major challenge to address in a successful way.

The dramatic collapse of the support of the local inhabitants towards both the recovery project and the bears (positive attitude drop from 73% to 30% between 2003 and 2011) calls for an even more effective policy of damage prevention and compensation, transparency in information transmission, constant monitoring of the population, and for a rapid response framework that allows an efficient and rapid reaction even to cases that pose risks for human safety; this last topic become a problem since 2014. Social acceptance and cohabitation between bears and human activities is the key for the conservation of many bear populations, but especially for the smaller southern European ones.

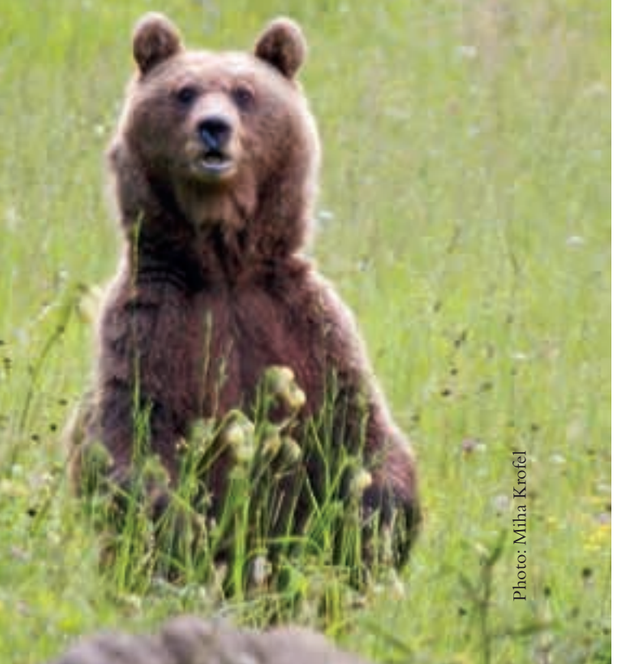

Photo: Miha Krofel

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In every area of bear presence in the world, there are cases where individual animals show problematic behaviours including some risks to humans. These cases must be primarily addressed by preventing the occurrence of these behaviours, and when possible trying to correct them. But it must be clear that there are cases where the removal of individual bears (captivity or culling) can become a necessary measure that must be taken based on a rigorous, but timely, evaluation of the bear's behaviour, as well as all the other related aspects such as ecological conditions, human attitude and social/political context.

For the first time in the last 150 years in Trentino a bear attack on human occurred in 2014, requiring a rapid reaction. A second one occurred in 2015, still involving a female with cubs that seriously injured a man. The article will focus on the first case.

2. The facts

On the 15th August 2014, close to the village of Pinzolo (Trentino, Italy), a mushroom picker inadvertently approached to within a few meters a bear that was resting with two cubs of the year. This bear, named Daniza, aged 19 years was considered a problematic bear since she had caused damage to livestock, beehives and orchards, and was often near to human activities, and since 2007 had been fitted with a GPS-VHF collar to monitor her movements and to implement aversive conditioning when necessary.

According to the man's testimony as soon as he realized he immediately started to move away but was followed and attacked by the bear. During the scuffle that followed the man was wounded, requiring 40 stitches to the injuries that were taken care of on that day at the hospital. Later on he had to stay for several days in the hospital due to a subsequent infection.

Despite the behaviour of the bear has been considered not abnormal (female defending her cubs), it was decided to capture the bear for reasons of public

Photo: Miha Krofel

safety, following an order of the President of the provincial government. This decision was supported by the Ministry of the Environment and ISPRA (National Wildlife Institute), as it was in accordance with the provisions of the PACOBACE (National Alpine Action Plan on Bear Management). Almost three weeks were required to capture the bear. During this time forestry staff patrolled the area where Daniza occurred, to reduce further unpleasant encounters. On the 10th September Daniza was captured darting her while feeding on a carcass of a preyed sheep, but died during the capture. Subsequent investigations showed that the tranquilizer and the dosage used as well as the shot fired with the tranquilizer gun were adequate, but for unknown reasons the female did not tolerate the anaesthesia.

The Autonomous Province of Trento applied the law and the National Action Plan - both acts state that human safety comes first. The decision to remove the bear was also taken as a way to improve human attitudes (mainly of local residents) toward bears in Trentino by demonstrating that the authorities would react to dangerous situations.

The event had a big media impact, fuelled by a strong divergence between animal rights groups and local residents. The case of Daniza and her cubs received a very high attention of a large part of the Italian society concerned with the welfare of bears. This incident stresses the need for improved communication with the public, and of a rigorous approach to the management of the bear population that should be based on authoritative science based evaluations made by the competent authorities of all the possible alternatives to address the conflicts. This is particularly important when the removal of animals is being considered, which should be used as a last option, only when no other measures are applicable.

The cubs were left in the wild, considering the likelihood for cubs of this age (8-9 months) to survive, and in line with the suggestions of the literature on the subject. Furthermore it was proposed to:

1. Fit one of the cubs with a VHF ear tag radio transmitter;

2. Make food available to the cubs in the initial phase, immediately after the loss of their mother;

3. Monitor the movements of the cubs intensively (initially via radio, then with camera traps and direct observation by raising the awareness of hunters and encouraging them to report sightings);

4. Establish specific guidelines for the best management of the cubs, in collaboration with ISPRA and the Ministry of the Environment, and by exchanging ideas with international experts;

5. Preparing road signs in the most dangerous areas to reduce the risk of road accidents;

6. Prepare targeted communication material (a special brochure sent to all the families living in the area frequented by the cubs, updating the website, press releases, press conference with the mass media, meetings with environmental and animal protection associations, among other measures);

7. Organise a round table of experts (30th October 2014), for a direct exchange of ideas on these matters.

All these actions permitted us to monitor the cubs in a continuous manner until the 10th of November, precisely the time when most bears in the alpine region go into hibernation, after which no more data were received. Genetic monitoring carried out at the beginning of 2015 after bears emerged from their winter dens confirmed the presence of both young bears and their survival through the winter season. The data seems to confirm the good survival rates of orphan cubs aged more than 6 months, but it is too early to state the impact on the behaviour of the cubs in a long run.

3. Conclusions

Without effective policies to address the conflicts between bears and humans, including the management of bears that pose risks to humans, the efforts to recover a population of bears in the Alps risk failure, and there is the concrete possibility of an increase in the illegal killing of bears, as it has happened in other regions of Europe.

Short Communication

DEFINING, PREVENTING AND REACTING TO PROBLEM BEAR BEHAVIOUR IN EUROPE

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1. Introduction

Throughout history people have had conflict with bears. A good understanding of the causes of human-bear conflicts is the first step for reaching an effective solution. In this article we first review existing knowledge of human-bear conflicts and experiences with different mitigation measures. We also provide an overview of official frameworks for dealing with problem bears in 15 European countries, and finally, we propose a set of recommendations for effective management of problematic bear behaviour. This article is a summary of the report "Defining, preventing and reacting to problem bear behaviour in Europe" that was published by the European Commission in the beginning of 2015.

2. Human-bear conflicts

Human-bear conflicts are very diverse and are mainly connected with the bear's opportunistic foraging and consumption of food. There are two main processes that define the potential of bears to systematically exhibit problematic behaviour: habituation to human presence, and conditioning to anthropogenic food. Habituation is an adaptive mechanism through which bears become tolerant of people, thus loosing fear of people, while food conditioning is a learning process through which certain behaviours are reinforced by positive stimuli. Bears that are habituated to people and/or conditioned to food of anthropogenic sources are much more prone to causing problems to humans.

Several factors affect the risk of human-bear conflict but probably the most important one is access to anthropogenic food sources (e.g. garbage and slaughter remains, among others).

Other factors that influence the risk of occurrence of human-bear conflict are:

Season: spring and autumn are the two seasons with the highest incidents of human-bear conflicts.

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Both are related to a seasonal increase in bear feeding activity, when bears emerge from dens in the spring, and excessive feeding in preparation for the denning period in the autumn (i.e. hyperphagia).

Natural food availability: in years of poor natural food availability (e.g. due to annual variations in tree mast production) bears more often search for food in the vicinity of people; this causes a considerable increase in bear-related incidents and/or use of anthropogenic food by bears.

Cover for bears: better cover availability (e.g. dense vegetation) in human-dominated landscapes facilitates use of areas in immediate vicinity of human settlements and thus increases the probability for human-bear conflicts.

Status of bears: subadult bears and adult females with cubs are the two categories that most often cause bear incidents, and are most frequently removed as problem bears.

Other factors that specifically increase the risk of bear attacks on people include wounded animals (e.g. during hunting or in traffic accident), the presence of a dog, sudden unexpected close encounters, the proximity to a den and the presence of a carcass used by a bear.

Although problem bears represent only a small part of bear population, they usually cause the majority of human-bear conflicts, while other bears rarely or never come into conflict only rarely or never. For example, during the telemetry monitoring of habituated male "Rožnik" in Slovenia, this single bear was responsible for 40% of all reported bear incidents with approximately 400-500 bears in Slovenia (Jerina et al., 2011).

3. Conflict mitigation measures

Various measures have been developed in attempts to solve human-bear conflicts. Among them is the **aversive conditioning** of bears, which denotes a procedure when a negative stimulus to bears is applied by managers to prevent future unwanted behaviour (Table 1). **Aversive conditioning** of bears, as well as of other wildlife, generally has met with mixed results, sometimes being effective for a short-

Table 1. Review of reported aversive conditioning trials on bears and their effectiveness.

Species	Region	Methods used	No. of treatments per bear	Short-term effects	Long-term effects	Other observations	Source
Ursus arctos	Europe, Austria	Capture, rubber bullets, warning shots, pyrotechnics	2-7	Variable	Long-term increase in wariness in one female and cubs of another female	Not effective with severely habituated bears	Rauer et al., 2003
Ursus arctos	Europe, Italy, Trentino	Capture, rubber bullets and chasing with dogs	Unknown	Limited short-term effectiveness	Not successful with habituated bears	More effective on young bears	Groff et al., 2013
Ursus arctos	USA, Yellowstone N.P.	Rubber bullets paired with conditioning stimulus (bird call)	1-15	Temporarily effects in some bears; pairing with bird call unsuccessful	Not successful	Less effective with more habituated bears and bears in poor condition	Gillin et al., 1994
Ursus arctos & *Ursus maritimus*	Canada, Manitoba*	Loud sounds and repellent chemicals	Unknown	Effective as deterrent	Not effective	-	Miller, 1983

Table 1. Review of reported aversive conditioning trials on bears and their effectiveness (continued).

Species	Region	Methods used	No. of treatments per bear	Short-term effects	Long-term effects	Other observations	Source
Ursus maritimus	Canada, Manitoba	Rubber bullets, loud sound and electric fence used to prevent access to bait sites	1.9**	Rubber bullets effective in deterring bear from the site, 66% returned within a week	Unknown	Rubber bullets most effective in deterring bears when used, electric fence gave mixed results, audio deterrents without effect	Derocher and Miller, 1985
Ursus americanus	USA, Nevada	Capture, pepper-spray, rubber bullets, cracker shells, chased by dogs	1	Effective on average for about 1 month	No long-term effect in 92% of treated bears	Longer effects when dogs were used in combination with other methods	Beckmann et al., 2004
Ursus americanus	USA, Great Smoky Mountains N.P.	Capture and on-site release	1	58-73 % success in preventing incidents in the next year	Unknown	Most effective when bears were captured early in their progression toward nuisance behaviour	Clark et al., 2002
Ursus americanus	USA, Louisiana	Capture, rubber bullets and some also chased with dogs	1-2	Limited short-term effectiveness	Successful in 9% of treated bears	Bears conditioned in combination with dogs refrained from nuisance activity slightly longer	Leigh and Chamberlain, 2008
Ursus americanus	USA, New Jersey	Capture, rubber bullets, pyrotechnics and chasing with dogs	1	Effective for max. 17 days	Not effective	Effective for deterring from the capture site for on average 57 days	Huffman et al., 2010
Ursus americanus	USA, Sequoia N.P.	Rubber bullets, rock-throwing, slingshots, pepper spray, chasing (without dogs)	20.3**	Successful in 79% bears	Successful in 59% of bears	Higher success when applied soon after bears obtained human food; less successful on yearlings and strongly habituated bears; rubber bullets and chasing more effective than rock-throwing, slingshots or pepper spray	Mazur, 2010
Ursus americanus	USA, Alaska	Rubber bullets	1.8**	Successful in 52% of bears	Successful in 7% of treated bears	Might be more effective where single source of anthropogenic food occur	McCarthy and Seavoy, 1994
Ursus americanus	USA, Alaska	Taste aversion using thiabendazol for general anthropogenic food	Unknown	Not effective	Not effective	-	McCarthy and Seavoy, 1994
Ursus americanus	USA, Minnesota	Taste aversion using thiabendazol for specific food	Unknown	Effective for the same type of food	Effective for >1 year, but not for 2 years	Not effective for other types of anthropogenic food	Ternent and Garshelis, 1999
Ursus thibetanus	Japan, Hyogo Prefecture	Unknown	Unknown	Successful in 60%	Unknown	-	Yokoyama et al., 2008 *in* Ohta et al., 2012

*In captivity.
**Average value.

term, but long-term behavioural changes are often limited. However, certain patterns emerged during the bibliographic review which indicate that in specific situations some of the aversive stimuli can have a long-term effect when applied properly. . Well-established monitoring that quickly detects problem behaviours in bears is crucial for successful application of aversive conditioning. Pain stimuli (e.g. rubber bullets) proved to be the most successful, although taste aversion can also be effective for specific foods sources. Prevention of access to anthropogenic food sources must be assured in order to achieve full effectiveness of aversive conditioning.

Table 2. Overview of the main types of human-bear conflicts and most effective measures to mitigate them according to the experiences reported so far. In italic are measures used to prevent conflicts before they occur.

Conflict type	Main measures for conflict prevention
Livestock depredations	*Protection of livestock using electric fences and/or livestock guarding dogs* *Night-time enclosures for livestock* Removal of the problem bear *Transition to livestock species less vulnerable to bear attacks*
Damage on beehives, crops, orchards and other human property	*Protection of property using electric fences* Removal of the problem bear Aversive conditioning *Removing dense vegetation (cover for bears)*
Damage in forestry	*Supplemental feeding*
Bear occurrence near human settlements	*Preventing bear access to anthropogenic food* Removal of the problem bear *Education of local inhabitants* Aversive conditioning *Removing dense vegetation (cover for bears)*
Attacks on humans	Removal of bear exhibiting aggressive behaviour towards people *Public education* *Decreasing bear habituation to humans and food conditioning (e.g. through preventing access to anthropogenic food and aversive conditioning)* Use of bear spray *Temporary limiting public access to most critical bear habitats and bear dens*
Vehicle collisions	*Appropriate planning when constructing transportation networks so that risk of vehicle collisions with bears is minimal* Construction of safe under- or over-passes for bears in combination with electric fences *Removing or preventing access to attractants (e.g. garbage bins) near roads and railways* *Measures used to prevent bear habituation to humans*

It must also be understood that application of aversive conditioning can be very costly and demands a considerable effort. Based on our current knowledge, aversive conditioning of bears is most warranted in the following cases:

1. When potential conflict behaviour is detected early in the development of the bear's behaviour.
2. When a short-term solution is needed.
3. When adequate resources are available for continuous treatments of each problem bear.
4. When possibilities for removal of the bear are limited.

Removal from population can be an effective short-term solution for individuals strongly habituated to human presence or conditioned to anthropogenic food. However, these measures must be coupled with other measures to prevent development of new problem bears (e.g. implementation of damage prevention measures on pastures, use of bear-proof garbage bins). Application of this measure may be limited in small and threatened bear populations.

Limiting access to anthropogenic food is often regarded as the most effective way to prevent conflicts with bears,. First systematic approaches to limiting access to anthropogenic food were implemented in North America. Strict garbage management, regulations on human food storage, prohibition of bear feeding and intensive public education about proper behaviour in bear habitat proved very successful. After application of these measures, human-bear conflicts decreased considerably. For example, in Yellowstone National Park, attacks on people dropped for almost 90% and at the same time there was less need for management removals of bears (Meagher and Phillips, 1983; Gunther and Hoekstra, 1998).

Preventing access to anthropogenic food and public education have so far received less attention in Europe, although also here local initiatives have given good results (e.g. in Trentino, Groff et al., 2013) and despite the fact that these measures are prescribed in the Action Plan for the conservation of the brown bear in Europe (Swenson et al., 2000).

Other potentially effective measures for preventing human-bear conflicts include use of **bear spray** to deter bear attacks on humans and adjustments in **land-use practices** (e.g. transition from sheep to cattle farming, maintaining open landscape around human settlements). **Compensations** can, when well-designed, address inequities of distribution of damages caused by bears across society and improve tolerance towards bears, but they do not affect the occurrence of bear incidents. For summary of main types of human-bear conflicts and most effective measures to mitigate them see Table 2.

4. European management frameworks

The analysis of existing scientific knowledge would suggest that preventive proactive measures should be a priority. Nevertheless, European brown bear management plans mostly deal with reactive management of specific unwanted bear behaviours. These documents provide variable levels of detail, but generally foresee the following management measures: close monitoring, aversive conditioning, removal or fencing of the attractant, removal of individual animals (lethal or translocations to nature/captivity), compensation payments for the damages, and information campaigns. Often special emergency teams are formed to take urgent actions regarding problem bear management.

Proactive management aimed at preventing the occurrence of problem bears is typically related to implementation of individual projects and in most cases it is not systematically organized. Such measures include: prevention of damages to agriculture, prevention of access to organic waste, enhancing the trophic value of bear habitat (i.e. feeding of bears at feeding stations, planting of wild fruit trees), information campaigns to influence problematic human behaviour (intentional or unintentional feeding or disturbing of bears), dialogue with stakeholders, emergency teams, green bridges and specific road signs as well as abandoning the practice of rehabilitation of orphaned bears. In general, countries with smaller (more endangered) populations tend to have more complex and better defined protocols for dealing with problem bears. Social context defined mostly by different tolerance levels seems to play a considerable role in the (1) identification of the problem bears, and the (2) selection of the reactive management measures (Majić Skrbinšek and Krofel, 2015).

5. Risk assessment protocol and management recommendations

Thirty four European brown bear experts and managers were brought together in two workshops, in Ljubljana (Slovenia) and in Venzone (Italy), during 2014, to discuss and develop a general approach to risk assessment regarding brown bear behaviours that can threaten human safety. In Table 3 is the final output of those meetings, organized as a risk assessment protocol. The protocol indicates the degree of problem and urgency of the action in three categories identified with different colours: green (least problematic, not urgent), yellow (problematic, action needed), and red (most problematic, urgent reaction needed). For each of the identified bear behaviours a set of management actions is recommended. Additional recommendations for specific bear categories are discussed in the next section.

Table 3. Risk assessment protocol with management recommendations.

Degree of problem and urgency of action	Individual bear behaviour	Recommended management actions	Recommended public communication actions
	A bear unaware of human presence continues its natural behaviour.	No action towards the bear.	Provide information on bear biology. Provide information on human-bear encounters (how to behave) to the inhabitants and visitors of the bear areas.
	Upon an accidental close encounter bear retreats immediately.	No action towards the bear (surveillance).	
	Upon an accidental close encounter the bear rises onto its hind legs.	No action towards the bear (surveillance).	
	A bear is causing damages in uninhabited areas.	Damage prevention and basic monitoring to assess the effectiveness of damage prevention.	Provide targeted information on why damages happen and how to prevent them (including where to get help).
	A bear is repeatedly causing damages in uninhabited areas in spite of prevention measures.	Intensive monitoring, re-evaluate and adjust damage prevention measures (deterrence).	Provide targeted information on why damages occur and how to improve damage prevention.
	A bear is aware of your presence but is not running away and ignoring your presence in normal bear *habitat*.	Intensive monitoring (deterrence).	Provide targeted information on human-bear encounters to the inhabitants and visitors.
	A bear is repeatedly coming close to permanently inhabited houses.	Intensive monitoring, remove attractants and dense vegetation – cover for the bears, if appropriate (damage prevention), aversive conditioning.	Provide targeted information to increase understanding of habituation and food conditioning processes and its consequences; information on avoidance of human-bear conflicts.
	A female with cubs makes a false attack.	Monitoring.	Provide targeted information on avoidance of human-bear conflicts to the inhabitants and visitors and explain causes and possible consequences of the bear behaviour both for the bear and for people. Provide information on human-bear encounters (how to behave when you meet a bear).
	A bear makes a false attack when surprised or provoked.	Investigation, monitoring.	
	A bear defends its food by threatening and making a false attack.	Investigation, monitoring.	
	A bear is searching for food or is causing damages close to inhabited houses.	Monitoring, damage prevention (remove attractants), aversive conditioning, removal of the dense vegetation (cover for the bear).	Provide targeted information on avoidance of human-bear conflicts (especially damage prevention) to the inhabitants and visitors and explain causes and possible consequences of the bear behaviour both for the bear and for people. Provide channels for two-way communication with the public (e.g. bear management hotline, online Q&A section).
	A bear enters uninhabited buildings such as barns, stables and sheds close to inhabited houses several times.	Removal of attractants, intensive monitoring, aversive conditioning, removal of dense vegetation (cover for the bear). In populations classified as **endangered (IUCN) or better*** or depending on the social context removal may be considered as the first option.	Provide targeted information on avoidance of human-bear conflicts (especially damage prevention) to the inhabitants and visitors and explain causes and possible consequences of the bear behaviour both for the bear and for people. Provide channels for two-way communication with the public (e.g. bear management hotline, online Q&A section).
	A bear attacks (with physical contact) a human after being provoked (e.g. by dogs, disturbance of the den).	In populations classified as **endangered (IUCN) or better*** or depending on the social context removal may be considered as the first option. Intensive monitoring, regardless of the conservation status of the population.	Provide targeted information and instructions on avoidance of human-bear conflicts to the inhabitants and visitors and explain causes and possible consequences of the bear behaviour both for the bear and for people.

Table 3. Risk assessment protocol with management recommendations (continued).

Degree of problem and urgency of action	Individual bear behaviour	Recommended management actions	Recommended public communication actions
	A bear repeatedly intrudes into densely populated residential areas.	Removal of attractants. In populations classified as **endangered (IUCN) or better*** or depending on the social context removal may be considered as the first option. Intensive monitoring and aversive conditioning is preferred in **critically endangered (IUCN)** populations.	Provide targeted information and instructions on avoidance of human-bear conflicts to the inhabitants and visitors and explain causes and possible consequences of the bear behaviour both for the bear and for people. Provide channels for two-way communication with the public (e.g. bear management hotline, online Q&A section).
	A bear defends its food by attacking.	Intensive monitoring, (deterrence), possibly removal of the bear.	Provide targeted information and instructions on avoidance of human-bear conflicts and rationalize management decision by explaining the causes and consequences of the bear behaviour both for the bear and for people.
	A bear follows humans at a close distance.	Intensive monitoring, deterrence, removal of the bear if deterrence is not successful.	Provide targeted information and instructions on avoidance of human-bear conflicts and rationalize management decision by explaining the causes and consequences of the bear behaviour both for the bear and for people. Provide channels for two-way communication with the public (e.g. bear management hotline, online Q&A section).
	Injured bear attacks a human.	Removal of the bear.	Rationalize management decision by explaining the causes and consequences of the bear behaviour both for the bear and for people. Provide channels for two-way communication with the public (e.g. bear management hotline, online Q&A section).
	A bear cannot be deterred successfully by an expert team from residential areas or from repeatedly entering uninhabited buildings next to an inhabited house.	Removal of the bear.	
	A bear enters inhabited buildings.	Removal of the bear.	Provide targeted information and instructions on avoidance of human-bear conflicts and rationalize management decision by explaining the causes and consequences of the bear behaviour both for the bear and for people. Provide channels for two-way communication with the public (e.g. bear management hotline, online Q&A section).
	A bear attacks a human without being intentionally or unintentionally provoked.	Removal of the bear.	Rationalize management decision by explaining the causes and consequences of the bear behaviour both for the bear and for people.

6. Considerations for specific bear categories

6.1. Injured/handicapped bears

An injured bear will more likely exhibit problematic behaviours. When an injured or otherwise handicapped bear occurs, an ad hoc assessment should be carried out by a bear manager (intervention group) and a veterinarian. Taking into account the conservation status of the population and the likelihood of the bear's recovery, the following decisions can be made:

1. The bear will recover by itself, no other actions beyond intensive monitoring are recommended.

*The IUCN Red List of Threatened Species categories include: Extinct (EX), Extinct in the wild (EW), Critically endangered (CR), Endangered (EN), Vulnerable (VU), Near threatened (NT) Least concern (LC), Data deficient (DD), Not evaluated (NE). Endangered or better would thus include: EN, VU, NT and LC.

2. Provide the bear with the necessary treatment and if feasible, return it to the wild and closely monitor its recovery.

3. If complete recovery is unlikely, or treatment is not feasible, and the population is considered viable, remove the bear from the population.

6.2. Orphaned cubs

Orphaned bear cubs are not able survive without their mothers until they are at least six months old (Swenson et al., 1998. Bear cubs which have been raised by humans have a high chance of developing problematic behaviour due to their habituation to humans (Huber, 2009). The practice of rehabilitation of human-raised brown bears is thus generally not recommended in Europe.

6.3. Females with cubs and subadult bears

Females with cubs and subadult bears are more likely to become exposed to situations which lead to habituation and food conditioning. For these two categories it is especially important to implement habituation and food conditioning prevention measures (i.e. instructing the public not to offer food to the female with cubs) and aversive conditioning as soon as possible.

7. Conclusions

Human-bear conflicts are complex and diverse. Consequently there is no single one-size-fits-all solution to effectively prevent all problems. Since a few problem bears are often responsible for most bear incidents, special attention needs to be given to preventing the o of repetitive conflict behaviour. According to available knowledge, preventing access to anthropogenic food in combination with public education is in many cases the most effective approach. Experiences from several regions suggest that this approach gives best results when local inhabitants are actively involved. Successful preventive management is also more acceptable by the public than reactive responses after the conflicts have already occurred. Once problem behaviour is developed in a bear, changing it can be a considerable challenge. Well-established monitoring that quickly detects such behaviours is crucial for successful application of aversive conditioning techniques that reverse the process of habituation to human presence and/or conditioning to anthropogenic food. Once this process has proceeded to higher stages, considerably more effort will be needed to prevent further conflict behaviour and in some cases bear removal may be the only option.

The full text report can be found here:
http://ec.europa.eu/environment/nature/conservation/species/carnivores/pdf/pa_bear_problem%20bear%20pilot%20action%202015.pdf

References

Groff C, Bragalanti N, Rizzoli R, Zanghellini P (editors) (2013) 2012 Bear Report. Forestry and Wildlife Department of the Autonomous Province of Trento, Autonomous Province of Trento, Trento, 72 p.

Gunther KA, Hoekstra HE (1998) Bear-inflicted human injuries in Yellowstone National Park, 1970-1994. Ursus 10, 377-384.

Huber D (2010) Rehabilitation and reintroduction of captive-reared bears: feasibility and methodology for European brown bears Ursus arctos. International Zoo Yearbook 44(1), 47-54. doi: 10.1111/j.1748-1090.2009.00089.x

Huffman J, Skirta E, Zellner AS (2010) New Jersey Bear Aversive Conditioning Report. Northeast Wildlife DNA Laboratory, East Stroudsburg University, 69 p.

Jerina K, Krofel M, Stergar M, Videmšek U (2011) Factors affecting brown bear habituation to humans: a GPS telemetry study. Final report. University of Ljubljana, Biotechnical Faculty, Department of Forestry and Renewable Forest Resources, Ljubljana, 18 p.

Majić Skrbinšek A, Krofel M (2015) Defining, preventing, and reacting to problem bear behaviour in Europe. Institute of Applied Ecology (Rome, Italy). Report to DG Environment, European Commission, Bruxelles, 56 p. Contract no. 07.0307/2013/654446/SER/B3.

Mazur RL (2010) Does aversive conditioning reduce human—black bear conflict? The Journal of Wildlife Management 74(1), 48-54.

McCarthy TM, Seavoy RJ (1994) Reducing nonsport losses attributable to food conditioning: human and bear behavior modification in an urban environment. International Conference on Bear Research and Management 9, 75-84.

Meagher M, Phillips JR (1983) Restoration of natural populations of grizzly and black bears in Yellowstone National Park. Int Conf Bear Res and Manage 5, 152-158.

Ohta U, Jusup M, Mano T, Tsuruga H, Matsuda H (2012) Adaptive management of the brown bear population in Hokkaido, Japan. Ecological Modelling 242, 20-27. doi:10.1016/j.ecolmodel.2012.05.011

Swenson JE, Gerstl N, Dahle B, Zedrosser A (2000) Action Plan for the conservation of the Brown Bear (Ursus arctos) in Europe. Council of Europe Publishing, Strasbourg, 70 p.

Swenson JE, Franzen R, Segerstrom P, Sandergren F (1998) On the age of self-sufficiency in Scandinavian brown bears. Acta Theriologica 43(2), 213-218.

Ternent MA, Garshelis DL (1999) Taste-aversion conditioning to reduce nuisance activity by black bears in a Minnesota Military Reservation. Wildlife Society Bulletin 27(3), 720-728.

Journal Article Abstract

BEHAVIORAL CORRELATES OF SUPPLEMENTARY FEEDING OF WILDLIFE: CAN GENERAL CONCLUSIONS BE DRAWN?

Sam M.J.G. Steyaert, Jonas Kindberg, Klemen Jerina, Miha Krofel, Matija Stergar, Jon E. Swenson, Andreas Zedrosser

Basic and Applied Ecology 15, 669–676 / ***2014***

Supplementary feeding is a common, but controversial, tool in wildlife management, because it can benefit both humans and wildlife (e.g., increased wildlife densities), but has certain downsides (e.g., increased disease transmission). For species that are often involved in human-wildlife conflicts, two opposing paradigms with respect to supplementary feeding exist, i.e., (i) that supplementary feeding is efficient to lure animals away from undesired places (i.e., diversionary feeding; hypothesis 1), and (ii) that supplementary feeding stimulates 'nuisance' behavior (i.e., increased tolerance for humans and selection for human facilities; hypothesis 2). We formulated an alternative hypothesis (hypothesis 3); i.e., that behavioral variation among individuals dilutes population-wide, general patterns with respect to supplementary feeding. Based on GPS relocation data and resource selection functions, we show that neither of the two opposing management paradigms (hypothesis 1 and 2) hold in a particularly 'conflict rich' species, the brown bear (*Ursus arctos*), because individual variation in selection behavior with respect to supplementary feeding diluted population-wide patterns (hypothesis 3), even under very different environmental contexts (Sweden vs. Slovenia; i.e., different human and bear population density, history and intensity of supplementary feeding, topography, etc.). Our results emphasize that individual variation is an important component of behavioral ecology and should be considered in wildlife management and conservation.

Journal Article Abstract

BLACK BEAR EXCLUSION FENCES TO PROTECT MOBILE APIARIES

Tammy E. Otto, Gary J. Roloff

Human–Wildlife Interactions 9, 78–86 / ***2015***

Demand for commercial bee (*Apis mellifera*) services recently has increased, resulting in greater use of mobile apiaries for crop pollination. When commercial apiaries are moved into areas occupied by black bears (*Ursus americanus*), conflicts between beekeepers and bears sometimes occur. Commercial pollination often involves moving apiaries among agricultural fields, and, thus, permanent fencing is not a viable option for reducing damage by bears. In 2010, we tested the effectiveness of 4 temporary electric fence designs for excluding black bears from bait sites in northern Michigan. We determined the effectiveness of each fence design by observing bear behavior obtained from 24-hour video surveillance. From >433 minutes of bear–fence interactions (BFI), we recorded 168 BFIs in 73 visits by an estimated 15 bears. The only fence design deemed 100% effective at excluding bears consisted of 3 polytape strands charged with 5,000 V and spaced 0.58, 0.39, and 0.23 m from the ground, respectively. Proper fence construction and maintenance are critical elements of effectiveness, and we provide guidance on each. Our results demonstrate that low-cost temporary fencing can be an effective tool for excluding bears from localized sites, such as apiaries.

Journal Article Abstract

FAST FOOD BEARS: BROWN BEAR DIET IN A HUMAN-DOMINATED LANDSCAPE WITH INTENSIVE SUPPLEMENTAL FEEDING

Irena Kavčič, Miha Adamič, Petra Kaczensky, Miha Krofel, Milan Kobal, Kiemen Jerina

Wildlife Biology 21, 1-8 / ***2015***

Distribution, quantity and quality of food resources affect the diet and several other life-history traits of large mammals. Supplemental feeding of wildlife has high potential for influencing the behaviour and diet of opportunistic omnivores, such as bears. Supplemental feeding of brown bears *Ursus arctos* is a common practice in several European countries, but the effects of this controversial and expensive management measure on bear diet and behaviour are poorly understood. We analysed 714 brown bear scats collected throughout the year in three regions of Slovenia with different densities of supplemental feeding sites. Supplemental food was the most important food category in the bear diet and represented 34% of the annual estimated dietary energy content (maize: 22%, livestock carrion: 12%). The proportion of supplemental food in the diet varied with season and region, being highest in spring and in the region with the highest density of feeding sites. However, considerable seasonal changes in bear diet, despite year-round access to supplemental food, suggest that bears prefer high-energy natural food sources, particularly insects, fruits, and hard mast, when available. Despite high availability and use of supplemental food, human-bear conflicts are frequent in Slovenia. In addition, evidence from earlier studies suggests that changes in diet and foraging behaviour due to supplemental feeding may affect several aspects of bear biology and in some cases increase the probability of human-bear conflicts. Thus, we caution against promoting unconditional supplemental feeding as a measure to prevent or reduce human-bear conflicts.

Journal Article Abstract

THE POTENTIAL IMPACTS OF CHANGES IN BEAR HUNTING POLICY FOR HUNTING ORGANISATIONS IN CROATIA

Emma J. Knott, Nils Bunnefeld, Djuro Huber, Slaven Reljić, Vesna Kereži, E.J. Milner-Gulland

European Journal of Wildlife Research 60, 85–97 / **2014**

The brown bear (*Ursus arctos*) in Croatia is currently being managed through trophy hunting, with quotas allocated to local hunting organisations. Human–bear conflict is present at a low level, but any losses are compensated by the hunting organisations that benefit from bear hunting. Attitudes towards bears are generally positive, and the bear population appears stable, or even increasing. Croatia's cur- rent bear hunting policy relies upon both the ecological sustainability of the quotas and the economic sustainability of the hunting organisations. To address the first of these pillars of current policy, we used a two-sex matrix model of the bear population to investigate the biological sustainability of current hunting levels. The model suggests that if the annual allocated quota were fully realised, the population would suffer a considerable decrease over 10 years. A likely explanation for the mismatch between this result and the observed stability of the population is that the bear population size is underestimated. To address the second pillar, we quantified the current structure, costs and benefits of bear hunting to hunting organisations through an interview survey with hunting managers. We found that bear hunting is a substantial component of hunting organisations' income, supporting the other activities of the organisation. Croatia's recent accession to the EU will require changes in their bear management system, potentially stopping bear trophy hunting. Therefore, we assessed the changes in hunting organisations' budgets in the absence of bear hunting. Our results demonstrate that a loss of bear trophy hunting would result in a substantial loss of income to the hunting organisations. Moving bear hunting and compensation mechanisms from local management and responsibility to a more centralised system without trophy hunting, as suggested by EU legislation, will lead to considerable uncertainties. These include how to make centralised decisions on population targets and offtake levels for population control, given the uncertainty around population estimates, and on compensation payments given the loss of the current system which relies heavily on local income from trophy hunting, local relationships and informal monetary and non-monetary compensation.

Journal Article Abstract

DOES DESPOTIC BEHAVIOR OR FOOD SEARCH EXPLAIN THE OCCURRENCE OF PROBLEM BROWN BEARS IN EUROPE?

Marcus Elfström, Andreas Zedrosser, Klemen Jerina, Ole-Gunnar Støen, Jonas Kindberg, Lara Budic, Marko Jonozovič, Jon E. Swenson

The Journal of Wildlife Management 78, 881–893 / **2014**

Bears foraging near human developments are often presumed to be responding to food shortage, but this explanation ignores social factors, in particular despotism in bears. We analyzed the age distribution and body condition index (BCI) of shot brown bears in relation to densities of bears and people, and whether the shot bears were killed by managers (i.e., problem bears; n=149), in self-defense (n=51), or were hunter-killed non problem bears (n=1,896) during 1990–2010. We compared patterns between areas with (Slovenia) and without supplemental feeding (Sweden) of bears relative to 2 hypotheses. The food-search/food-competition hypothesis predicts that problem bears should have a higher BCI (e.g., exploiting easily accessible and/or nutritious human-derived foods) or lower BCI (e.g., because of food shortage) than nonproblem bears, that BCI and human density should have a positive correlation, and problem bear occurrence and seasonal mean BCI of nonproblem bears should have a negative correlation (i.e., more problem bears during years of low food availability). Food competition among bears additionally predicts an inverse relationship between BCI and bear density. The safety-search/naivety hypothesis (i.e., avoiding other bears or lack of human experience) predicts no relationship between BCI and human density, provided no dietary differences due to spatiotemporal habitat use among bears, no relationship between problem bear occurrence and seasonal mean BCI of nonproblem bears, and does not necessarily predict a difference between BCI for problem/non problem bears. If food competition or predation avoidance explained bear occurrence near settlements, we predicted younger problem than nonproblem bears and a negative correlation between age and human density. However, if only food search explained bear occurrence near settlements, we predicted no relation between age and problem or nonproblem bear status, or between age and human density. We found no difference in BCI or its variability between problem and nonproblem bears, no relation between BCI and human density, and no correlation between numbers of problem bears shot and seasonal mean BCI for either country. The peak of shot problem bears occurred from April to June in Slovenia and in June in Sweden (i.e., during the mating period when most intraspecific predation occurs and before fall hyperphagia). Problem bears were younger than nonproblem bears, and both problem and nonproblem bears were younger in areas of higher human density. These age differences, in combination with similarities in BCI between problem and nonproblem bears and lack of correlation between BCI and human density, suggested safety-search and naïve dispersal to be the primary mechanisms responsible for bear occurrence near settlements. Younger bears are less competitive, more vulnerable to intraspecific predation, and lack human experience, compared to adults. Body condition was inversely related to the bear density index in Sweden, whereas we found no correlation in Slovenia, suggesting that supplemental feeding may have reduced food competition, in combination with high bear harvest rates. Bears shot in self-defense were older and their BCI did not differ from that of nonproblem bears. Reasons other than food shortage apparently explained why most bears were involved in encounters with people or viewed as problematic near settlements in our study.

Publications*

BOOKS

Bears in the Backyard: Big Animals, Sprawling Suburbs, and the New Urban Jungle Hardcover

By Edward Ricciuti / **2014** / Countryman Press / 248 pp

Fang and claw have jumped the white picket fence as encounters with cougars in Chicago, alligators in Florida, and bears virtually everywhere have become increasingly commonplace. Author Edward Ricciuti explores cutting-edge research into why it's happening, how it impacts all of us, and how to deal with it on both societal and personal levels.

As cities and suburbs sprawl, and conservation efforts enable wildlife populations to recover, large wild animals are encroaching on human turf. These creatures might be thrilling to see, but they can bite, scratch, and even kill, and attacks on humans will only increase as we come face to face in the man-made landscape. Readers will learn how to protect against potential dangers even as they are being thoroughly entertained by hair-raising tales of real-life encounters.

The Predator Paradox: Ending the War with Wolves, Bears, Cougars, and Coyotes

By John Shivik / **2014** / Beacon Press / 208 pp

An expert in wildlife management tells the stories of those who are finding new ways for humans and mammalian predators to coexist. Stories of backyard bears and cat-eating coyotes are becoming increasingly common - even for people living in non-rural areas. Farmers anxious to protect their sheep from wolves aren't the only ones concerned: suburbanites and city dwellers are also having more unwanted run-ins with mammalian predators. And that might not be a bad thing. After all, our government has been at war with wildlife since 1914, and the death toll has been tremendous: federal agents kill a combined ninety thousand wolves, bears, coyotes, and cougars every year, often with dubious biological effectiveness. Only recently have these species begun to recover. Given improved scientific understanding and methods, can we continue to slow the slaughter and allow populations of mammalian predators to resume their positions as keystone species?

As carnivore populations increase, however, their proximity to people, pets, and livestock leads to more conflict, and we are once again left to negotiate the uneasy terrain between elimination and conservation. In "The Predator Paradox", veteran wildlife management expert John Shivik argues that we can end the war while still preserving and protecting these key species as fundamental components of healthy ecosystems. By reducing almost sole reliance on broad scale "death from above" tactics and by incorporating non-lethal approaches to managing wildlife - from electrified flagging to motion-sensor lights - we can dismantle the paradox, have both people and predators on the landscape, and ensure the long-term survival of both.

As the boundary between human and animal habitat blurs, preventing human-wildlife conflict depends as much on changing animal behaviour as on changing our own perceptions, attitudes, and actions. To that end, Shivik focuses on the facts, mollifies fears, and presents a variety of tools and tactics for consideration.

Blending the science of the wild with entertaining and dramatic storytelling, Shivik's clear-eyed pragmatism allows him to appeal to both sides of the debate, while arguing for the possibility of coexistence: between ranchers and environmentalists, wildlife managers and animal-welfare activists, and humans and animals.

The Carnivore Way: Coexisting with and Conserving North America's Predators

By Cristina Eisenberg / **2014** / Island Press / 288 pp

What would it be like to live in a world with no predators roaming our landscapes? Would their elimination, which humans have sought with ever greater urgency in recent times, bring about a pastoral, peaceful human civilization? Or in fact is their existence critical to our own, and do we need to be doing more to assure their health and the health of the landscapes they need to thrive?

In "The Carnivore Way", Cristina Eisenberg argues compellingly for the necessity of top predators in large, undisturbed landscapes, and how a continental-long corridor - a "carnivore way" - provides the room they need to roam and connected landscapes that allow them to disperse. Eisenberg follows the footsteps of six large carnivores - wolves, grizzly bears, lynx, jaguars, wolverines, and cougars - on a 7,500-mile wildlife corridor from Alaska to Mexico along the Rocky Mountains. Backed by robust science, she shows how their well-being is a critical factor in sustaining healthy landscapes and how it is possible for humans and large carnivores to coexist peacefully and even to thrive.

University students in natural resource science programs, resource managers, conservation organizations, and anyone curious about carnivore ecology and management in a changing world will find a thoughtful guide to large carnivore conservation that dispels long-held myths about their ecology and contributions to healthy, resilient landscapes.

*Texts from the books' publishers.

MEETINGS OF INTEREST

27th Vertebrate Pest Conference
7-10 March 2016
Newport Beach, California, USA
http://www.vpconference.org/

5th International Conference on Biodiversity
10-12 March 2016
Madrid, Spain
http://biodiversity.conferenceseries.com/

24th International Conference on Bear Research & Management
12-16 June 2016
Anchorage, AK, USA
http://www.cvent.com/events/24th-international-conference-on-bear-research-and-management/event-summary-0536820866ca4e26a375f-ba0375d8e2b.aspx

19th Meeting of the FAO-CIHEAM Mountain Pastures Network
14-16 June 2016
Zaragoza, Spain
http://www.iamz.ciheam.org/mountpast2016/

53rd ATBC - Tropical Ecology and Society: Reconciling Conservation and Sustainable Use of Biodiversity
19-23 June 2016
Montpellier, France
http://www.atbc2016.org/

5th Canine Science Forum
28 June - 1 July 2016
Padova, Italy
tp://www.csf2016.com/

COMING TOPICS

The next issues of the CDPNews will feature general topics, but with a special focus on shepherding and livestock management to prevent carnivore damage as well as socio-economic aspects related with livestock breeding and damage prevention. If you are developing a project or study dealing with such topics send us a proposal. But contact us in advance for the authors guidelines.
Thank you for your collaboration!
The Editors

To be added to the mailing list or for further information, contacts us at: lifemedwolf@fc.ul.pt

You can download the Carnivore Damage Prevention News on the MedWolf website:

www.medwolf.eu

CDPnews

Carnivore Damage Prevention