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 moun-

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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.

tain ranges 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

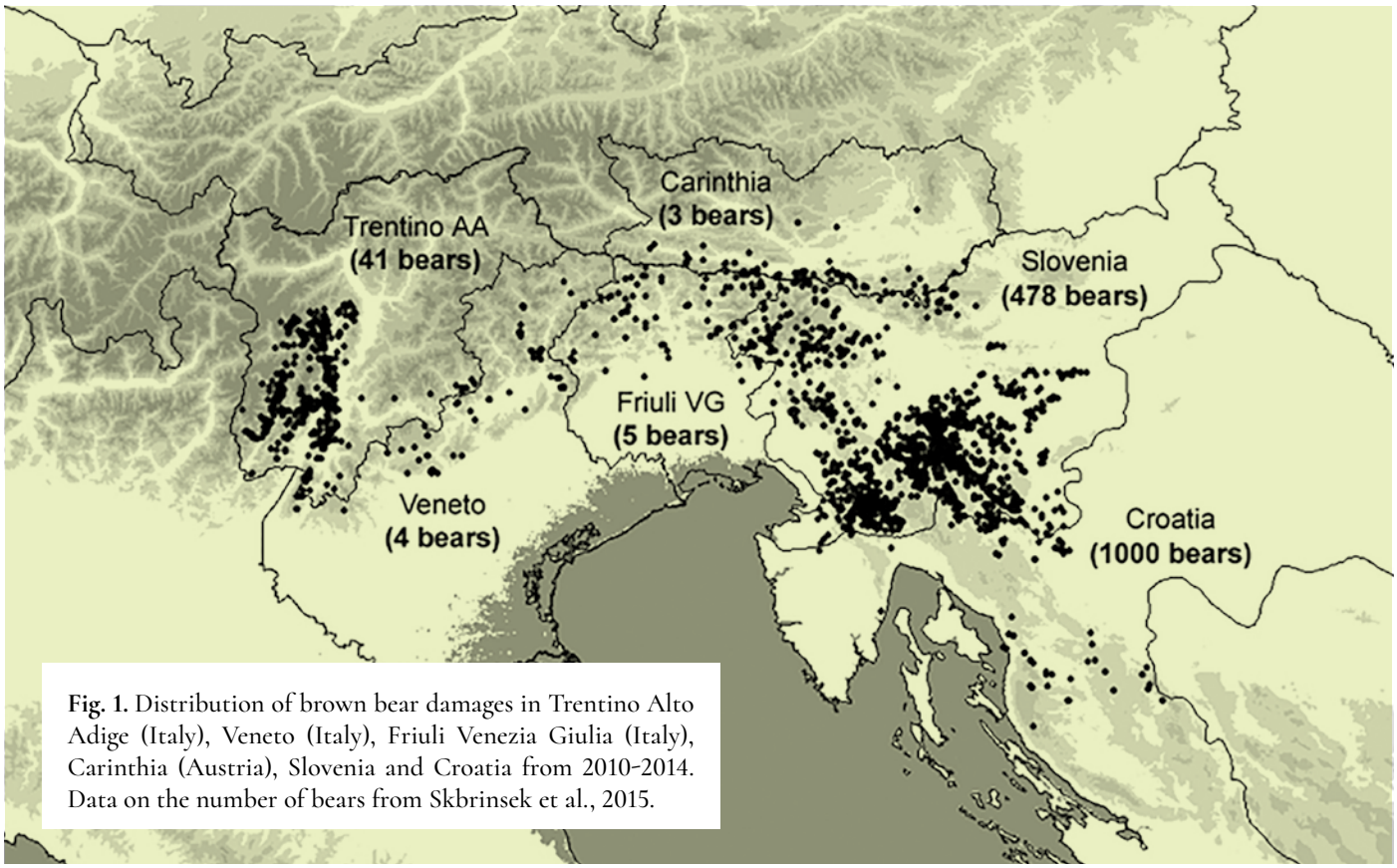
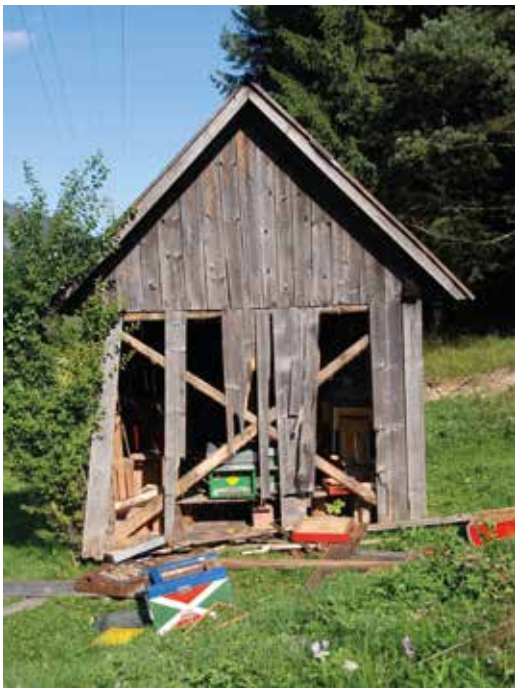


Fig. 1. Distribution of brown bear damages in Trentino Alto Adige (Italy), Veneto (Italy), Friuli Venezia Giulia (Italy), Carinthia (Austria), Slovenia and Croatia from 2010-2014. Data on the number of bears from Skbrinsek et al., 2015.

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
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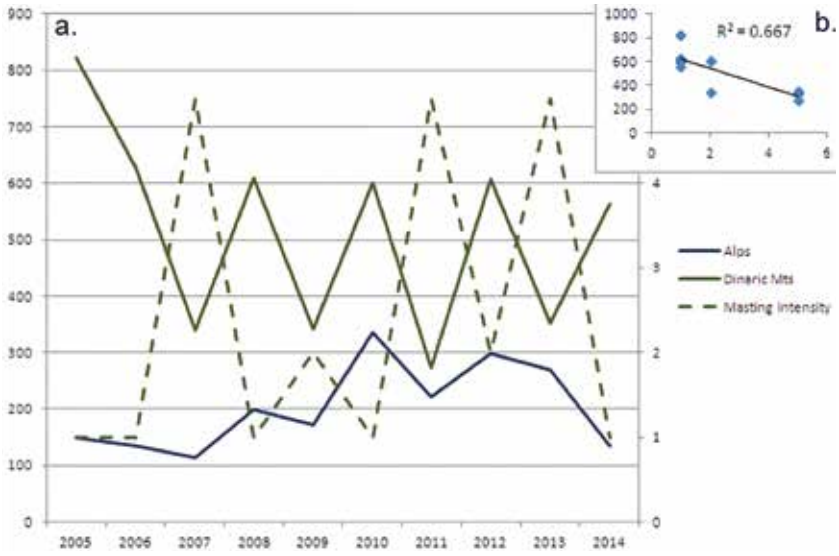

Fig. 2. a) Comparison of the trend in damage cases in the Dinaric Mountains and Alps. Beech mast intensity (right axis) was categorised in the Dinaric Mountains with: 1=very poor year, 2=poor year, 3=intermediate year, 4=good year, and 5=very good year (Jerina et al., 2015). **b)** Relation between beech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

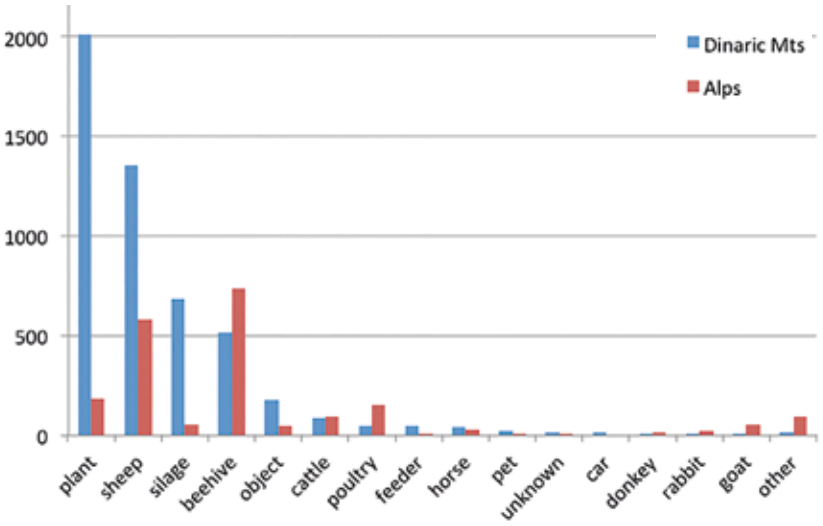

Fig. 3. Comparison of damage types in the Dinaric Mountains and Alps.

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.

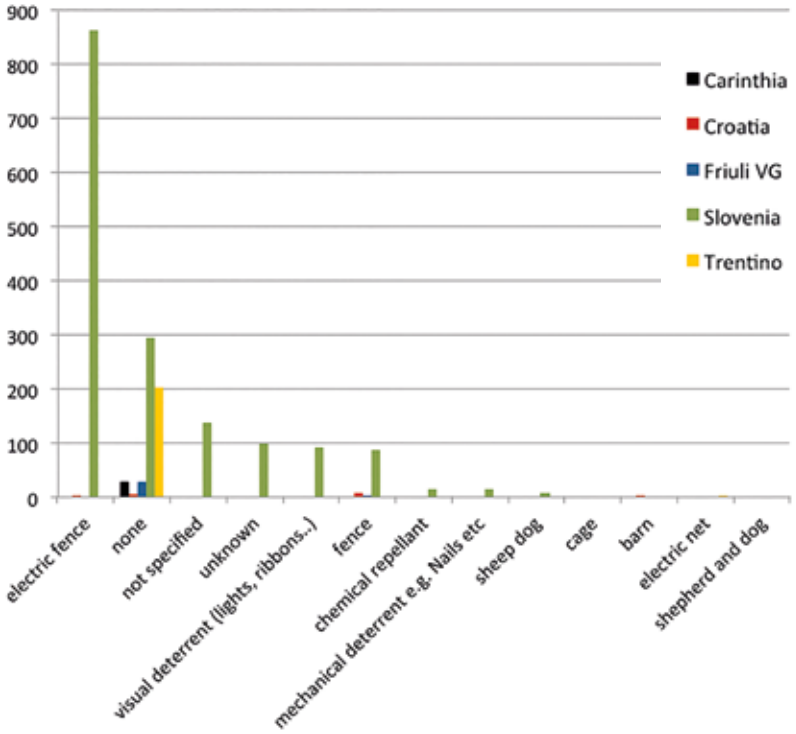

Fig. 4. In case of bear depredation on sheep, the type of preventive measure used. From Veneto we have no information about preventive measures.

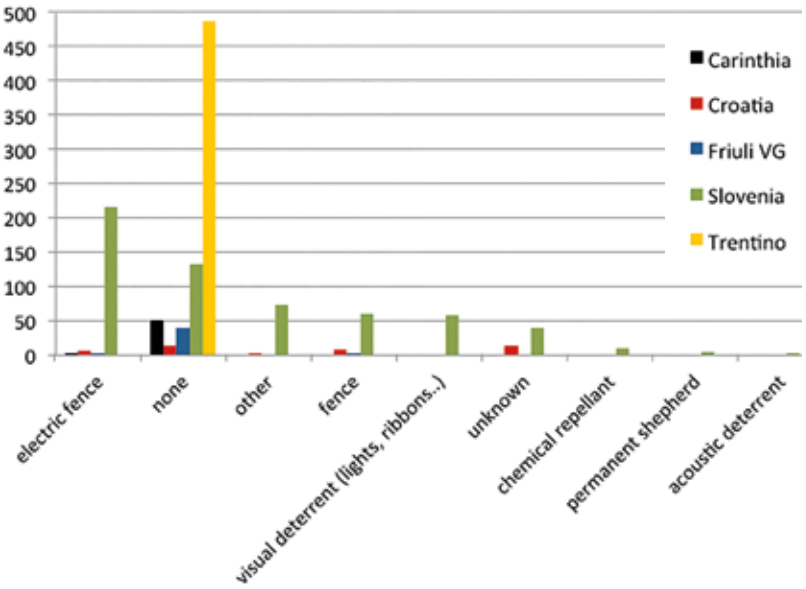

Fig. 5. In case of bear damage on beehives, type of prevention measure used. From Veneto we have no information about preventive measures.

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 de-

pendent 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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