

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 for-

aging 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 losing 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

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
<i>Ursus arctos</i>	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
<i>Ursus arctos</i>	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
<i>Ursus arctos</i>	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
<i>Ursus arctos</i> & <i>Ursus maritimus</i>	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
<i>Ursus maritimus</i>	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
<i>Ursus americanus</i>	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
<i>Ursus americanus</i>	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
<i>Ursus americanus</i>	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
<i>Ursus americanus</i>	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
<i>Ursus americanus</i>	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
<i>Ursus americanus</i>	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
<i>Ursus americanus</i>	USA, Alaska	Taste aversion using thiabendazol for general anthropogenic food	Unknown	Not effective	Not effective	-	McCarthy and Seavoy, 1994
<i>Ursus americanus</i>	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
<i>Ursus thibetanus</i>	Japan, Hyogo Prefecture	Unknown	Unknown	Successful in 60%	Unknown	-	Yokoyama et al., 2008 in Ohta et al., 2012

* In captivity.

**Average value.



mixed results, sometimes being effective for a short-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 food sources. Prevention of access to anthropogenic food sources must be assured in order to

achieve full effectiveness of aversive conditioning. 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 prob-

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

lem 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 Skrbinišek 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
Green	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 <i>habitat</i> .	Intensive monitoring (deterrence).	Provide targeted information on human-bear encounters to the inhabitants and visitors.
Yellow	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).
Orange	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
Low	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.
High	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.
2. Provide the bear with the necessary treatment

* 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.

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 onset 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

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