

Experiences with aversive conditioning of habituated brown bears in Austria and other European countries

Georg Rauer^{1,4}, Petra Kaczensky^{2,5}, and Felix Knauer^{3,6}

¹World Wide Fund for Nature Austria, Ottakringerstr, 114-116, A-1160 Vienna, Austria

²Institute of Wildlife Biology and Game Management at the University of Agricultural Sciences in Vienna, Peter Jordan Strasse 76, A-1190 Vienna, Austria

³Wildlife Research Unit, Faculty of Forestry at the Technische Universität München, Linderhof 2, D-82488 Ettal, Germany

Abstract: In 1995, a team was formed to respond to problem brown bears (*Ursus arctos*) in Austria. As part of that team, during 1995–2000 we performed 16 aversive conditioning experiments and attempted an additional 10 experiments on 7 target animals. We used rubber bullets, cracker shells, warning shots, and other fireworks. The effects varied considerably from no change in bear behavior to a long-term increase in wariness. We also compare the handling of bear problems in Austria with the problem bear management in other European countries. The use of aversive conditioning techniques have been reported from 8 countries, yet the effect of such actions were either limited or not clearly documented. The few relocations conducted in Europe were not successful. In Europe, regular exchange of experiences concerning problem bear management and cooperation in the education of field staff is needed.

Key words: Austria, aversive conditioning, brown bears, Europe, problem bear management, *Ursus arctos*

Ursus 14(2):215–224 (2003)

In Europe brown bears and people are living in much closer proximity than do grizzly bears and humans in North America (Mattson 1990). Consequently, bear habitat in Europe is influenced by a number of human activities such as agriculture, forestry, hunting, and tourism (Swenson et al. 2000). In a densely settled and human-altered landscape there is a high potential for bears to lose their fear of people and become habituated or to associate humans with food and become food conditioned, especially when negative stimuli to reverse such behavior are missing.

In Europe the persecution of brown bears for centuries is the conventional explanation of their “natural wariness.” Swenson (1999) reviewed literature from Eurasia and found evidence to support the hypothesis that hunting makes bears more wary of humans. However, in expanding populations bears may lose their wariness,

even under hunted conditions, because there is no tradition of bear-proofing possible food sources near human dwellings (Swenson 1999).

On the other hand there are no wilderness areas into which bears can retreat and thus a certain degree of habituation is necessary for bears to survive in the multi-use landscapes of Europe (Kaczensky 2000). This close coexistence is facilitated by the fact that brown bears in Europe are less aggressive (Swenson et al. 1996) and have a higher reproductive potential (Garshelis 1994, McLellan 1994, Sæther et al. 1998) than North American grizzlies. In this respect, European brown bears tend to be more similar to North American black bears (*Ursus americanus*) than grizzly bears. But whereas the range of the American black bear is still largely continuous and population numbers exceed 400,000, the range of the brown bear in Europe, outside of Russia, is highly fragmented and numbers are less than 15,000, of which nearly 50% live in Romania (Servheen 1989, Kaczensky 1996, Zedrosser et al. 2001).

Therefore, methods used in North America for managing problem bears are often not applicable in European countries. Small population size makes lethal control the very last option in protected populations, whereas relocation, a technique commonly used in

⁴email: georg.rauer@baer.wwf.at

⁵Present address: Zoo Salzburg, Morzgerstrasse 1, A-5081 Anif, Austria, email: P.Kaczensky@aon.at

⁶Present address: Alterra Green World Research, Landscape Centre, Team Ecological Modelling and Monitoring, P.O. Box 47, NL-6700 AA Wageningen, The Netherlands, email: Felix.Knauer@wur.nl

North America (Interagency Grizzly Bear Committee 1986, Paquet 1995), is hindered by national borders and the lack of remote areas. Aversive conditioning (Woolridge 1980, Hunt et al. 1987), on the other hand, requires establishing a link between a pain-inducing unconditioned stimulus (such as rubber bullets, chemicals, repellents) and some environmental clue as the conditioning stimulus (such as animal activity or location, human presence). As a result of this negative reinforcement, the animal should avoid the formerly attractive stimulus (McCarthy and Seavoy 1994, Linnell et al. 1996).

Although very little literature on aversive conditioning of European brown bears was available, during discussions with other European bear biologists and managers we realized that there was a vast body of anecdotal experience, but that exchange of information was hindered by language barriers and the absence of readily available reports. Therefore, we evaluated the success of aversive conditioning experiments on 7 individual bears in Austria during 1995–2000 and summarize the use of aversive conditioning from 12 other European countries. These data should help improve future conservation efforts in small European bear populations.

The Austrian bear situation

For the past 100 years, bears in Austria were only occasional migrants from Slovenia (Gutleb 1998). However, total protection in Austria and a more liberal bear expansion policy in Slovenia beginning in 1991 resulted in increased dispersal of bears into the Alps. In addition, from 1989–93, 3 bears (2 females and 1 male) were released in the northeastern part of the Austrian Alps within the range of a single male bear that had immigrated from Slovenia in 1972 (Rauer 1997, Rauer and Gutleb 1997, Zedrosser et al. 1999). From 1991 to 2000 at least 21 cubs have been born, and the number of bears in this area is estimated to be about 15–20 animals; an additional 5–10 bears is estimated to live in southern Austria, mainly along the border with Slovenia (Fig. 1; Rauer et al. 2001).

In 1992 the first habituated and food-conditioned bear was observed, and in 1994 2 problem bears were shot (Rauer and Gutleb 1997). These events resulted in the formation of a bear emergency team (ET), an interagency group of experienced field personnel. The task of the ET was to capture, radiomark, and monitor problem bears, and to modify nuisance bear behavior by aversive conditioning (Kaczensky et al. 1997). Additionally 2 bear biologists from WWF (World Wide Fund

for Nature) Austria were designated “bear advocates.” Besides collecting information on bear presence and investigating damages, their primary task was to act as a non-bureaucratic and mobile institution that residents could address in case of bear problems (Rauer and Gutleb 1997). In this capacity, bear advocates were the first to be told of observations of unwary bear behavior. Upon careful examination, responses were discussed with other members of the ET and a strategy for aversive conditioning was developed.

Study area

The range of the central Austrian bear subpopulation encompasses the Limestone Alps of the provinces Styria, Lower Austria, and Upper Austria. Valley bottoms lie at 400–600 m and mountain ridges reach 2000–2500 m. Forest cover is about 65% and human population density averages 55 inhabitants/km². Cattle production, dairy farming, forest exploitation, and tourism are important to the local economy.

Methods

Documentation of habituated bears

During the 10 years of 1990–99, we collected 789 reports of bear observations in Austria. In our analysis of these reports, we defined bear behavior as “habituated” when the distance between bear and observer was <50 m, the bear was aware of the observer, and the bear behaved in an indifferent or curious manner toward the observer.

Aversive conditioning in Austria

We tested types of rubber bullets readily available at the time in Austria (including Fiocchi Law Enforcement, SAPL Slug, SAPL Buckshot, Italcaccia AR 2, Calibra) by shooting an artificial bear back made of boards, rags, and a car rug. The Italcaccia AR 15 (Paini Sistemi Italcaccia s.r.l., Polesine, Parma, Italy) was the only one powerful and accurate enough to be used for distances >20 m.

We treated 7 individuals: 3 females aged 1–5 years (Mariedl, Mona, and Christl, a daughter of Mona), a yearling cub of unknown sex (Sibchristl, a sibling of Christl) and 3 cubs (of the year) of Mona (Table 1). Three of these bears had been previously captured with Aldrich foot snares, radiomarked, and eartagged, using methods described by Kaczensky et al. (2002) for Slovenia. Before aversive conditioning, bears were feeding at, approaching, or staying near a roe deer (*Capreolus capreolus*)

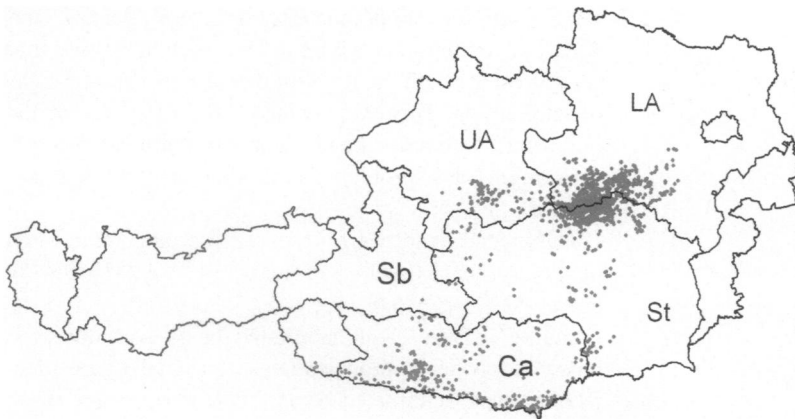


Fig. 1. Distribution of brown bears from records in Austria in 1993–99 (Rauer et al. 2001). Abbreviations for Austrian provinces are LA: Lower Austria; UA: Upper Austria; Sb: Salzburg; Ca: Carinthia; St: Styria.

feeding site ($n = 11$), lying in a daybed ($n = 5$), moving through the forest ($n = 4$), approaching a felling area in the forest ($n = 3$), or waking up from anesthesia ($n = 2$); on one occasion cubs were scared away from their anesthetized mother.

From 1995 to 2000, we performed 26 aversive conditioning experiments. Ten (38%) failed because bears either fled before we started, all projectiles missed, or the bear did not appear at the site where we were waiting for it. All 16 experiments were conducted with at least 2 people present. We waited for bears at places they regularly frequented, relocated them with the help of radiotelemetry, or treated them after a capture event.

In 11 aversive conditioning experiments we used rubber bullets (Eley Ltd./Defender, Eley Ltd., Witton, Birmingham, Great Britain, and SK-GUG, SK Jagd- und Sportmunitions GmbH, Schönebeck/Elbe, Germany, 1 bullet per cartridge; Italcaccia AR 15, 15 small bullets per cartridge), and in total, 21 of 25 shots hit the targeted bear. In 4 experiments we used cracker shells (only once as the sole technique), and in 2 experiments we used fireworks and warning shots. Two free-range darting attempts were also counted as aversive conditioning experiments. In one case the bear was hit but the needle broke, and in the other case we missed the bear. For the rubber bullets and fireworks we used a 12-gauge shotgun, for cracker shells, a gas pistol (Röhm RG3, Röhm RG, Germany), and for free-range darting, an air pressure gun (Dan-Inject Im, Dan-Inject ApS, Børkop, Denmark). All projectiles were shot from a distance of

10–40 m and were aimed at the bear's posterior to avoid accidental injury to the eyes.

We actively approached and sometimes ran after the bear. Only in a few cases did we shout at the bear before or while delivering rubber bullets. During treatments following a capture event, we waited for the bear to regain control over its extremities and then chased it away by yelling, throwing branches and small rocks, and shooting rubber bullets at it.

To evaluate the success of our conditioning experiments on the bears we quantified (1) time until the animal returned to the location of an aversive conditioning experiment and (2) time until the animal was again observed to tolerate human presence. Because of

radio loss, we were only able to estimate time intervals (see below), we were sometimes uncertain about the identity of unmarked bears, and we presume that <100% of unmarked bear observations were reported.

Survey in Europe

We obtained information on aversive conditioning in other European countries through a mail survey of bear managers and scientists in 12 countries. The questionnaire asked the respondents (1) to estimate the frequency of problem bear occurrence during 1991–95 in their country, (2) to describe treatment and its success, (3) to specify which executive body was in charge of handling problem bears, and (4) to explain the legal aspect of problem bear management in the country. We used the term “problem bears” for both nuisance bears (bears that fed on garbage, frightened people, or destroyed property other than livestock) and livestock depredating bears.

Results

Habituated bears in Austria

The annual number of bear observations reported in Austria between 1990 and 1999 ranged from 9 to 194. The annual number of observations of habituated bears ranged from 0 to 40 (Fig. 2). The percentage of habituated bears differed within the decade, increasing from 6% during 1990–92 to 16% during 1993–95 and to 22% during 1996–99 ($\chi^2 = 8.6$, 2 df, $P < 0.025$). Ninety-six percent of observations of habituated bears

Table 1. Response of brown bears to aversive conditioning (AC) in Austria, 1995–98.

Bear ^a	Date	Age ^b (years)	Treatment ^c	Time to return to site of treatment	Time until next observation of habituated behavior
Mariedl	21–22 Mar 1995	2	2 AC experiments, 1 AC attempt	<1 day	3 weeks
	7–11 May 1995	2	Capture + AC experiment, 1 AC attempt	>1 month	3 years
Mona	10–11 Jul 1995	2	Capture + AC attempt	3 weeks	2 weeks
	29 Jul 1995	2	1 AC action, 1 AC attempt	<1 day	1 month
	4–5 Nov 1998	5	Capture, 1 AC experiment	5 months	1 month
Mona, cubs-of-the-year	19 Nov 1998	5	1 AC attempt	<1 day	2 weeks
	2 Dec 1998	5	1 AC attempt	3 months	8 months
Mona's cubs-of-the-year	4 Nov 1998	<1	1 AC experiment	(<1 day) ^c	(>5 months) ^c
	5 Nov 1998	<1	1 AC experiment	(5 months) ^c	(>5 months) ^c
Christl	27 May 1997	2	Capture, + AC experiment	>6 months (<1 day) ^d	2.5 months (<1 day) ^d
	18–21 May 1998	3	Capture, 5 AC experiments, 1 AC attempt	>1 month	1 week
	27 May–3 Jun 1998	3	1 AC experiment, 2 AC attempts	<1 day	1 week
Sibchristl	27–29 May 1997	2	2 AC experiments ^e , 1 AC attempt	<1 week	1 week

^aMona, Mariedl, and Christl were females; the sex of the others was unknown.

^bAt time of treatment.

^cBehavior of the cubs depended on the behavior of the mother until they dispersed in March 1999.

^dChristl returned once again to the capture site before moving away.

^eFree-range darting attempts.

were from the subpopulation in central Austria and 4% from southern Austria. The 3 bears reintroduced into central Austria and the resident male never showed signs of habituation. However, some of the offspring of the reintroduced females behaved in a habituated manner. The origin of 2 problem bears shot in 1994 was not known.

Habituated bears were observed foraging more often than wary bears (habituated bears: 64%, $n = 141$; wary bears: 32%, $n = 648$; $\chi^2 = 50.7$, 1 df, $P < 0.001$). Foraging of wary and habituated bears was observed most at artificial food sources, especially roe deer feeding sites (habituated bears: 80%; wary bears: 62%; $\chi^2 = 9.1$, 1 df, $P < 0.005$). In 97 of the 116 (84%) cases when the reaction of a habituated bear and the observer was documented, the bear remained at the site or eventually retreated, the latter especially when scared away by the observer. In 15 cases (13%) the bear approached the observer, and in 4 cases (3%) it launched a false charge when approached by the observer.

Reaction of individual bears to aversive conditioning

During aversive conditioning none of the bears responded aggressively. Typically, the subject bears rapidly fled a short distance and then continued to move away at a slower pace.

Two bears showed signs of disorientation after treatment. One bear was treated too soon after anesthesia. In the other case, we suspect the target animal (Sibchristl) hesitated before running away because we successfully free-range darted (and thus incapacitated) its sibling Christl.

We considered the treatment of Mariedl successful (Table 1). Following a second round of aversive conditioning in May 1995, she was not observed behaving in a habituated way for approximately 3 years. Exact monitoring was hindered because Mariedl dropped her radiocollar after only 1 month. However, she was not seen again until 1998, when she was observed with cubs and was identified by her ear tag. In 1998, she was observed several times close to people, but in the following years no further observation of habituated behavior were attributed to her.

Our efforts to aversively condition Mona in 1995 were minimal and not effective. She also lost her radiocollar soon after being captured. In 1996 Mona (identified by ear tags) had cubs and continued to show habituation to people. An attempt to recapture her failed but resulted in her becoming more nocturnal. In 1997, Mona, without cubs, was observed rarely. On 1

occasion, she tolerated people approaching within 40 m. When she had a second litter in 1998, she again exhibited habituated behavior. Mona was recaptured in 1998 and aversively conditioned twice before denning. While in the den, she dropped the transmitter and in 1999, without cubs, she was as wary as in 1997. Mona was accompanied by a third litter in 2000, and we presume that all observations of a habituated female with cubs at that time were of her.

Aversive conditioning was conducted twice on Mona's cubs in 1998, once during the capture of their mother and once when they returned alone to the roe deer feeding site the next day. Although the cubs were not marked, we suspected that these experiments together with the aversive conditioning attempts on their mother when they were present were effective. Tracks indicated that the cubs had survived the winter, but, in contrast to 1997 and 2001, no habituated yearlings were reported in spring when yearlings left their mother.

Christl was subjected to only one aversive conditioning action in 1997. After a day she left the area and stayed away from people for 2.5 months. The loss of her ear-tag transmitter prevented further experiments. After recapture in May 1998, she did not alter her habituated behavior despite 6 additional experiments. Christl was probably illegally killed a month later because the signal from the ear-tag and collar transmitters, observations, and damages all stopped at the same time.

The fate of Sibchristl is unknown. Several observations of a habituated bear in 1997 likely were of this bear, but we believe that it did not acquire the same level of habituation as its sister Christl. We do not know if our capture attempts influenced its behavioral development.

Problem bear management in other European countries

The occurrence of problem bears and associated behaviors are widespread throughout brown bear range in Europe (Table 2 and 3). Countries with large bear populations often have a pragmatic approach to problem bears. During the bear hunting season problem bears are harvested within the established quota. Outside the hunting season or in protected areas such as national parks, non-lethal methods are considered in some countries. Hunters primarily conduct these management actions, and treatment is restricted to aversive conditioning. If such measures are unsuccessful, the bears are killed.

In countries with small, protected bear populations each bear is important, especially females. Removing a bear from the population is either not considered or

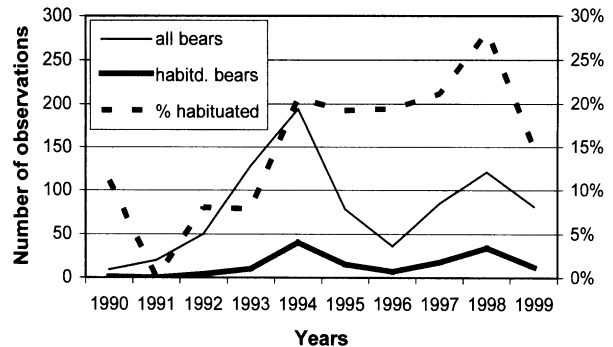


Fig. 2. Number of reported bear observations in Austria 1990–99 (solid lines) and percent of observations of habituated (dashed line) bears (habitd. = habituated).

used only after all other measures have failed. Staff managing problem bears usually have special training. In addition to aversive conditioning, problem bears may be captured and radiocollared for better monitoring or relocation. The outcome of aversive conditioning was mixed and in many cases the effort was considerable (Table 2).

Personnel involved in non-lethal problem bear management were either recruited from hunters' organizations (Estonia, Romania, Slovakia) or were from state agencies and research institutes responsible for wildlife management and research (France, Italy, Norway, Sweden). In Greece, the NGO ARCTUROS is responsible for bear protection and management. In Austria, this function was conducted by 2 NGOs and a university institute.

Discussion

The Austrian experience

Our data show that habituation has become an important problem in the Austrian bear population and will continue to be a prominent management issue. Fluctuations in the natural bear food supply do not seem to be the cause of problem bears because in spring and fall bears largely feed on cereals and corn at roe deer feeding sites (Rauer and Gutleb 1997). In a population of <20 bears, the misbehavior of a single bear may cause considerable fluctuations in the number of observations of habituated bears.

Aversive conditioning of habituated bears is a management tool with a high degree of acceptance among the Austrian public due to its non-lethal character. However,

Table 2. Reports of problem bears and their management in selected European countries, 1967–2000.

Country	Year	Mortality		Relocation			Aversive conditioning			Reference
		n	Type	n	Distance	Outcome	n	Method	Outcome	
Austria	1991–2000	1	legally shot ^a				7	capture rubber bullets cracker shells	mixed, very labor intensive	G. Rauer, P. Kaczynsky, F. Knauer D. Huber ^c M. Kaal ^d
		1	legally shot ^b							
Croatia	1991–96	4	legally shot							
Estonia	1967–90	10	legally shot				250	electric shock noise bird shot	if it did not work, bears were shot	
	1991–95	3	legally shot					repellents chased		
France	1991–96						1	captured but escaped rubber bullets		J.J. Camarra ^e
Greece	1991–97	1	poached	1	more than 100 km	stayed	2	bird shot noise	mixed, very labor intensive	Y. Mertzanis ^f
Italy–Abruzzo	1991–97			1	relocated twice (20 and 30 km)	came back both times	1	electric fencing captured	was a bit shy for a while	M. Posillico ^g
Norway	1991–96	5	legally shot	3	more than 100 km	2 came back 1 died during transport	several	warning shots shouting people chased with dogs	mixed	V. Jaren ^h
Slovenia	1992–96	2–5	legally shot per year				1	with fire crackers (1992)	no success	A. Simonič ⁱ M. Adamič ^j
Spain	1982–96		no problems							J. Naves ^k A. Bjarvall ^l
Sweden	1996						6	rubber bullets electro shocks chased with dogs	good, but considerable effort	

^aShot in self defense.^bShot on order of local authorities.^cDepartment of Biology, Veterinary Faculty, University of Zagreb, Zagreb, Croatia.^dTallinn Zoo, Tallinn, Estonia.^eOffice National de la Chasse, Pau, France.^fARCTUROS Society for Wildlife Conservation, Thessaloniki, Greece.^gState Forest Agency, Castel di Sangro, Italy.^hDirectorate for Nature Management, Trondheim, Norway.ⁱMinistry of Agriculture and Forestry, Ljubljana, Slovenia.^jWildlife Ecology Division, Forestry Institute, University of Ljubljana, Ljubljana, Slovenia.^kInstitute for Natural Resources and Land Management, University of Oviedo, Oviedo, Spain.^lSwedish Environmental Protection Agency, Stockholm, Sweden.

Table 3. Problem bear management in European countries (size and status of bear population from Zedrosser et al. 2001).

Country	Who deals with problem bears	Problem bear treatment	Size of bear population	Status of bear population
Austria	NGO ^a (bear research staff)	aversive conditioning capture	20–30	increasing, protected
Bulgaria	Hunters	shooting	500	decreasing, hunted
Croatia	Hunters	shooting	400	stable, hunted
Estonia	Hunters	aversive conditioning shooting	440–600	stable, hunted
France	GO ^b (Office National de la Chasse–bear research staff)	aversive conditioning capture	10	decreasing, protected
Greece	NGO (bear research staff)	aversive conditioning capture relocation	95–110	decreasing, protected
Italy–Abruzzo	National Park (bear research staff)	capture relocation	40–80	slightly increasing, protected
Norway	GO (bear research staff)	aversive conditioning capture relocation	18–34	increasing, protected
Romania	Hunters	shooting	5,500–6,300	hunted
Slovakia	GO, hunters	shooting	700	increasing, hunted
Slovenia	Hunters, foresters	shooting	300–400	increasing, hunted
Spain		no problems	70–80	decreasing, protected
Sweden	GO (bear research staff) in cooperation with police Livestock owners, police	aversive conditioning capture shooting	1,000	increasing, hunted

^aNon-governmental organization.

^bGovernmental organization.

the results of aversive conditioning activities in Austria were mixed. Aversive conditioning seemed to have had a long term effect for one adult female (Mariedl) and the cubs of another adult female (cubs of Mona). In 2 other females, aversive conditioning, apart from some short-term effects, was not effective. Documentation of aversive conditioning effects was complicated because marked bears lost their transmitters within a few months after capture and ear-tags were small and hard to see.

Our sample size was too small and the history of individual bears was too poorly documented to draw general conclusions or to assess the effectiveness of treatments (such as rubber bullets, fire crackers) or capture on success or failure. Capturing and handling bears may have had an aversive effect comparable to pain-inducing stimuli. We often hazed the bears either immediately after capture or the following days. This made it difficult to separate the effectiveness of the two measures. We also do not know if anesthesia during capture increased or weakened aversive effects.

We note, however, that for both females that resumed habituated behavior, the initial treatment was mild and follow-up reinforcing experiments had to be delayed. Mona was only treated once with cracker shells 2 weeks

after capture, and Christl gave the impression of being dizzy when shot at with rubber bullets and cracker shells shortly after recovering from anesthesia. We believe that these bears' initial (albeit short-lived) avoidance of humans could have been reinforced had immediate subsequent actions been possible. Madel (1996), working on aversive conditioning on the Rocky Mountain Front, Montana, USA since 1986, had no success when a bear had already received many positive experiences with human food sources or when the attractant sites remained accessible. Continued positive reinforcement for nuisance activities also negated the efforts of McCarthy and Seavoy (1994), who attempted to alter the behavior of garbage-feeding bears in Juneau, Alaska, USA, by physical and ingestive aversive conditioning. In our study area, we believe that Christl was an example of a bear whose nuisance behavior was already too fixed through repeated food reinforcement to be altered by a few negative experiences.

The McNeil River sanctuary in Alaska is a rare example where coexistence of man and habituated bears is successful (Aumiller and Matt 1994). The prerequisites for such coexistence (predictable human activities and no food-conditioning) are not possible in the

Austrian bear range. In Austria few people store food or garbage using bear-proofed methods. Also, ungulates are fed foods that are highly attractive for bears. Roe deer feeding sites close to forest roads frequented by people or rape-oil cans improperly stored by forestry workers often were the first stops in the career of an Austrian problem bear (Rauer et al. 2001).

The 2 adult females (Mona and Mariel) exhibited a distinct pattern: observations of habituated behavior came almost exclusively from the years when they had cubs. It is possible that the high energetic demand during cub raising made them more likely to approach human-provided food. In addition, adult females with cubs seem to generally exhibit a more diurnal activity pattern than do adult females without cubs or adult males (Rauer and Gutleb 1997, Kaczensky 2000). In habituated females the higher food demand, plus the change in the activity pattern, might result in a much higher visibility during years of cub raising as compared to years without cubs.

Females with cubs are among the most dangerous classes of bears to people during a close surprise encounter (Swenson et al. 1996, Swenson et al. 1999). However, in Austria the 2 habituated females with cubs never showed any aggression toward people. On the other hand, their cubs did not experience humans to be a threat and might easily become the next generation of habituated bears. The experiences with the habituated yearlings Christl and Sibchristl in 1997 clearly support this view. Therefore, tolerating habituated or food conditioned behavior in females might magnify the problem in the long run. In the end it might become necessary to remove or kill more bears than if the offending female would have been "cured" or removed early in this process (e.g., see Gillin et al. 1994).

Austria compared to other European countries

Information from other European countries indicate that habituated, food conditioned, or livestock-killing bears are common. In large and hunted populations, offending bears are most frequently shot within the regular bear hunting season, while all countries with recovering bear populations have personnel trained to handle bear problems. In Austria, bear advocates and members of the bear emergency team (ET) are recruited from NGOs and a university institute. This implies 2 serious drawbacks for problem bear management. First, the ET lacks official status and is presently perceived by local people as a "private group of bear lovers." Currently, management actions can only be undertaken if the ET can convince the province and district authorities and the owner of the hunting rights that actions are

necessary. Whereas the ET might receive an official request to help with serious bear problems, gaining support for preventative methods has been difficult. Currently, formal consent for such actions depends largely on the goodwill of the responsible authorities. Second, bear advocates and the ET have no long-term funding. The ET consists of professional volunteers, and few have long-term employment. ET members might not be available when needed and may refuse to take part in a specific action.

In Europe, national borders and language barriers hinder the exchange of bear management experiences, material and personnel. European bear managers have considerable experience in problem bear management, particularly in aversive conditioning. Unfortunately, each country has experienced a limited number of cases, and information from these different groups is difficult to obtain. Documentation, especially of failures, is often poor or not centrally located. Although training courses on bear conflict prevention and deterrent techniques are common in North America, they are lacking in Europe, and financial constraints typically keep most European staff from regularly attending such workshops.

Management implications

Experiences from Austria and elsewhere show that although aversive conditioning can be a useful tool in some circumstances, success is far from guaranteed and the procedure can be very time consuming and expensive. We therefore recommend that bear managers concentrate on keeping habituation of bears at a low level by eliminating attractants, educating people, and only in the last resort, by aversive conditioning of bears. Especially in small and threatened populations, it is important to establish a bear emergency group that is experienced in the methods of capture, radiotracking, and aversive conditioning of individual bears. For a bear emergency team to be most effective, the legal, bureaucratic, and financial barriers need to be addressed and working conditions need to be created that guarantee: (1) a long-term commitment from the responsible authorities to support the emergency team, (2) the possibility to operate on a national scale, and (3) that the initiation of actions are the responsibility of the emergency team. To optimize management actions in Europe, it is important to organize a regular exchange of information concerning bear management and research techniques and to establish a standard protocol to document success, and failure of different methods. Agencies, organizations, and groups should work together on the education of field staff

responsible for managing problem bears and institute common goals and actions.

Almost all European countries (except Norway) with small bear populations are members of the European Union (EU), and the brown bear is listed as a priority species in the EU common Fauna-Flora-Habitat Directive. The EU has invested more than 9,000,000 Euros (>\$US10 million, July 2003) during the last 10 years in national bear conservation projects. In the future, international projects should be given preferential treatment to encourage cooperation in brown bear management in Europe.

Acknowledgments

We thank the members of the emergency team and the assisting veterinarians for their efforts and commitment, and the landowners, hunters, and foresters for their help. B. Gutleb added his data for Carinthia. We also thank M. Adamič, A. Bjärvall, J.-J. Camarra, P. Danilov, D. Huber, V. Jaren, M. Kaal, Y. Mertzanis, J. Naves, M. Posillico, and A. Simonič for answering our questionnaire. The work was funded by the Jubiläumsfond der Österreichischen Nationalbank, the provinces of Lower Austria, Styria, and Carinthia, the Ministry of Environment and the Austrian Science Foundation (FWF project: P 11529-BIO).

Literature cited

- AUMILLER, L.D., AND C.A. MATT. 1994. Management of McNeil River State Game Sanctuary for viewing of brown bears. *International Conference on Bear Research and Management* 9(1):51–61.
- GARSHELIS, D.L. 1994. Density-dependent population regulation of black bears. Pages 3–14 in M. Taylor, editor. *Density-dependent population regulation in black, brown, and polar bears*. *International Conference on Bear Research and Management Monograph Series No. 3*.
- GILLIN, C.M., F.M. HAMMOND, AND C.M. PETERSON. 1994. Evaluation of an aversive conditioning technique used on female grizzly bears in the Yellowstone ecosystem. *International Conference on Bear Research and Management* 9(1):503–512.
- GUTLEB, B. 1998. The brown bear in Carinthia: history and status in southern Austria. *Ursus* 10:75–79.
- HUNT, C.L., F.M. HAMMOND, AND C.M. PETERSON. 1987. Aversive conditioning study—1987 progress report. Wyoming Game and Fish Department, Cheyenne, Wyoming, USA.
- INTERAGENCY GRIZZLY BEAR COMMITTEE. 1986. *Interagency grizzly bear guidelines*. USDA Forest Service, Washington, D.C., USA.
- KACZENSKY, P. 1996. *Large carnivore–livestock conflicts in Europe*. Munich Wildlife Society, Ettal, Germany.
- . 2000. *Co-existence of brown bears and men in Slovenia*. Dissertation, Wildlife Research and Management Unit, Technische Universität München, Munich, Germany (<http://tumb1.biblio.tu-muenchen.de/publ/diss/allgemein.html>).
- , F. KNAUER, G. RAUER, AND C. WALZER. 1997. *Handbuch für die Eingreiftruppe–Vergrämen, Fangen, Narkotisieren und Überwachen von Bären*. Manual of the Arbeitsgemeinschaft Braunbär Life, Institute of Wildlife Biology and Game Management in Vienna, Austria. Munich Wildlife Society, Ettal, Germany and World Wide Fund for Nature Austria, Vienna, Austria. (In German.)
- , ———, M. JONOZOVIC, C. WALZER, AND T. HUBER. 2002. Experiences with trapping, chemical immobilization, and radiotagging of brown bears in Slovenia. *Ursus* 13:347–356.
- LINNELL, J.D.C., M.E. SMITH, J. ODDEN, J.E. SWENSON, AND P. KACZENSKY. 1996. *Carnivores and sheep farming in Norway*. 4. Strategies for the reduction of carnivore–livestock conflicts: a review. *Oppdragsmelding 443*. Norwegian Institute for Nature Research, Trondheim, Norway.
- MADEL, M.J. 1996. *Rocky Mountain Front grizzly bear management program*. Four-year progress report 1991–1994. Montana Fish, Wildlife and Parks, Great Falls, Montana, USA.
- MATTSON, D.J. 1990. Human impacts on bear habitat use. *International Conference on Bear Research and Management* 8:33–56.
- MCCARTHY, T.M., AND R.J. SEAVOY. 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(1):75–84.
- MCLELLAN, B.C. 1994. Density-dependent population regulation of brown bears. Pages 15–24 in M. Taylor, editor. *Density-dependent population regulation in black, brown, and polar bears*. *International Conference on Bear Research and Management Monograph Series No. 3*.
- PAQUET, M., EDITOR. 1995. *Conservation of grizzly bears in British Columbia*. Background report. Ministry of Environment, Lands and Parks, Victoria, British Columbia, Canada.
- RAUER, G. 1997. First experiences with the release of 2 female brown bears in the Alps of eastern Austria. *International Conference on Bear Research and Management* 9(2): 91–95.
- , AND B. GUTLEB. 1997. *Der Braunbär in Österreich*. Federal Environment Agency–Austria, Monograph Series No. 88. Vienna, Austria. (In German.)

- , P. AUBRECHT, B. GUTLEB, P. KACZENSKY, F. KNAUER, C. PLUTZAR, L. SLOTTA-BACHMAYR, C. WALZER, AND A. ZEDROSSER. 2001. Der Braunbär in Österreich II. Federal Environment Agency–Austria, Monograph Series No.110. Vienna, Austria. (In German.)
- SÆTHER, B.E., S. ENGEN, J.E. SWENSON, O. BAKKE, AND F. SANDEGREN. 1998. Assessing the viability of Scandinavian brown bear, *Ursus arctos*, populations: the effect of uncertain parameter. *Oikos* 83:403–406.
- SERVHEEN, C. 1989. The status and conservation of the bears of the world. International Conference on Bear Research and Management Monograph Series No. 2.
- SWENSON, J. 1999. Does hunting affect the behavior of brown bears in Eurasia? *Ursus* 11:175–162.
- , F. SANDEGREN, M. HEIM, S. BRUNBERG, O.J. SØRENSEN, A. SÖDERBERG, A. BJÄRVALL, R. FRANZÉN, S. WIKAN, P. WABAKKEN, AND K. OVERSKAUG. 1996. Er den skandinaviske bjørnen farlig? [Is the Scandinavian brown bear dangerous?] Oppdragsmelding 404, Norwegian Institute for Nature Research, Trondheim, Norway. (In Norwegian with English summary.)
- , ———, A. SÖDERBERG, M. HEIM, O.J. SØRENSEN, A. BJÄRVALL, R. FRANZEN, S. WIKAN, AND P. WABAKKEN. 1999. Interactions between brown bears and humans in Scandinavia. *Biosphere Conservation* 2(1):1–9.
- , N. GERSTL, B. DAHLE, AND A. ZEDROSSER. 2000. Action plan for conservation of the brown bear in Europe (*Ursus arctos*). Council of Europe, Nature and Environment No.114. Strasbourg, France.
- WOOLRIDGE, D.R. 1980. Chemical aversion conditioning of polar and black bears. *International Conference on Bear Research and Management* 4:167–173.
- ZEDROSSER, A., N. GERSTL, AND G. RAUER. 1999. Brown bears in Austria. Federal Environment Agency–Austria, Monograph Series No. 117. Vienna, Austria.
- , B. DAHLE, J.E. SWENSON, AND N. GERSTL. 2001. Status and management of the brown bear in Europe. *Ursus* 12: 9–20.

Received: 28 May 2001

Accepted: 3 March 2003

Associate Editor: R.T. Shideler