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Authors: Johansson, Maria, and Frank, Jens

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The impact of access to an ultrasonic scaring device on human fear of wolves

Maria Johansson and Jens Frank

M. Johansson (maria.johansson@mpe.lth.se), Environmental Psychology, Dept of Architecture and the Built Environment, Lund University, SE-221 00, Lund, Sweden. – J. Frank, Wildlife Damage Centre, Dept of Ecology, Swedish University of Agricultural Sciences, SE-730 91 Riddarhyttan, Sweden

The increase of wolves in Scandinavia is associated with socio-ecological conflicts, and the conservation and management of this species is as much a political and socio-cultural challenge as a biological matter. One component in this conflict is people's feeling of fear, but there have been very few evaluations of management interventions aimed at addressing human fear of wolves. Based on the theory of human–environment interaction, this paper presents a first attempt to evaluate the effect of introducing a hand-held ultrasonic scaring device. A total of 27 persons living in wolf territories had access to the device for six months. No significant effect on participants' appraisal of wolves, trust in managing authorities, or self-reported fear could be identified. The investigated psychological variables were stable over time in a reference sample of people in the large-carnivore counties (n = 202). The introduction of the device was largely rejected by the public. In-depth interviews with 10 persons who declined the invitation to have access to the device revealed that the device was considered an irrelevant solution to the conflict between humans and wolves, and that people lacked trust in the technology. It is concluded that the potential in using an ultrasonic device to reduce fear of wolves seems very limited in the present context. Further interventions to address human fear must be identified in dialogue with the people affected, and should preferably be based on psychological principles.

The increase in large-carnivore populations in Europe is associated with socio-ecological conflicts. This is in particular evident in the case of the recovery of the wolf populations, where attitudes has become more negative whereas the attitude towards brown bears has become more positive (Dressel et al. 2015). The Nordic countries presents one example of how the conservation and management of wolves is as much a political and socio-cultural challenge as a biological matter (Figari and Skogen 2011, Pohja-Mykrä and Kurki 2014, Sjölander-Lindqvist et al. 2015). One component in the conflicts over large carnivores in general as well as in the case of wolves *Canis lupus* is people's feeling of fear of these animals (Røskaft et al. 2003, Bisi et al. 2007, Ericsson et al. 2010, Pohja-Mykrä and Kurki 2014). This fear may negatively influence everyday life and wellbeing, especially among people in the countryside (Sjölander-Lindqvist et al. 2008).

Shivik (2006) argues that decision-makers and wildlife managers need a toolbox of different management actions when working to reduce negative effects of large carnivores. Such tools should also be evaluated according to theoretical frameworks that address relevant human outcomes (Gore et al. 2006). Information and education are commonly suggested, but evaluations of the effects have so far yielded mixed results (Johansson et al. 2015a). In practice, this means that wildlife managers are largely left to address the public's fear with interventions that are based on the manager's intuition rather than scientific evidence. This paper presents a first attempt to evaluate the effect of introducing a hand-held ultrasonic scaring device to people who experience fear of wolves.

Tools to handle large carnivores close to human settlements

According to Bangs and Shivik (2001), two broad animal behavioural modification approaches have been widely used, confused and misused for depredation management; primary repellents and secondary repellents. Primary repellents use disruptive stimuli, which are stimuli that disrupt predatory behaviours by causing a 'fright' or 'startle' response. One of the oldest disruptive stimulus techniques is a scarecrow. The concept can be extended to almost anything out of the ordinary that is placed in a pasture or area and that startles or frightens predators away. A flashing light, a vehicle or some other large object in a pasture may discourage some predators from entering, at least for a short time, but animals quickly become accustomed and habituated to passive disruptive stimuli (Shivik et al. 2003b). Moving the object or light around intermittently and randomly may slow the habituation process (Shivik and Martin 2001). As with visual

disruptive stimuli, sounds can frighten or startle a predator and limit access to an area. Radios, ultrasonic devices, and other noises placed in a pasture or pen and played loudly during the night will probably frighten intruding predators for a limited time (Blackshaw et al. 1990, Bomford and O'Brien 1990, Koehler et al. 1990). Secondary repellents use aversive stimuli, which are paired with a behaviour in order to condition a predator against the behaviour. This is difficult to achieve with free-living wildlife, and although regularely aimed at, few studies have been performed that show effective use in practice (Gehring et al. 2006). Pepper spray has been shown to deter large carnivores attacking or approaching humans, and is frequently used in, for example, North America (Herrero 2002). However, in some areas (such as Sweden), pepper spray is regarded as a weapon and thereby surrounded by restrictive legislation, making it very hard or even impossible for hikers to carry, so alternatives are needed. Sonic deterrents have the advantage of being cheap, easy to carry, and not restricted by any current legislation. Furthermore they have no proven potential to harm the user or the carnivore involved. Although sonic deterrents have many advantages they suffer from one serious drawback; there is little evidence that they are actually effective in deterring animals (Bomford and O'Brien 1990). This is something they share with many of the management interventions currently used (Shivik et al. 2003a).

This feature of the ultrasonic device raises questions regarding the reliability of the technology. From this perspective, it is important to understand how people form their opinions on new technology, and why people adopt or reject technology; this provides insight regarding design, implementation and communication (Huijts et al. 2012). So far, empirical research has neglected the nature and drivers of rejection compared with adoption of new technology (Johansson et al. 2015b, Kleijnen et al. 2009). In order to assess the potential usefulness of a hand-held ultrasonic scaring device, first we need to know whether the device would be useful or not to offer people who fear wolves, bearing in mind the current lack of knowledge about its deterring effects. We address this question in two empirical studies. Study 1 aimed to evaluate access to the ultrasonic device as a tool to address public fear of wolf, using a fixed, quasi-experimental design and quantitative method. Study 2 aimed to understand people's reasons for declining an invitation to evaluate the ultrasonic device, using a flexible research design and a qualitative method (Robson 2011). The research procedure was submitted to the regional ethical review board at Lund University, which declared that the study required no further ethical review (dnr 2012/9).

Theoretical framework

Our starting point is the FearSEM model of antecedents of self-reported fear of brown bear and wolf (Johansson et al. 2012). The model is based on the Human–environment interaction model (HEI model, Küller 1991), which focuses on the continuous interaction between humans and the surrounding environment. In line with the appraisal theory on emotion, the HEI model assumes that emotional processes are affected by different levels of appraisal of stimuli in the external natural and social environment (Leventhal and Scherer 1987).

In a series of experimental studies, Flykt et al. (2013) concluded that self-reported fear of wolf probably results from appraisal at a conceptual level, meaning that the appraisal process is highly dependent on cognitive elaboration of stimuli. For stimuli that are handled by elaborated cognitive processes, people's emotional response varies with the activity at hand, the perception of the environmental and social contexts, as well as individual factors (e.g. sociodemographic background, experiences, personality). Self-reported emotional responses to environmental stimuli such as the presence of wolves have been shown to be experienced along two dimensions: valence, varying along a scale of unpleasantness–pleasantness, and arousal, varying along deactivation–activation (Küller 1991, Mehrabian and Russell 1974), as well as specific emotions such as interest, joy, anger and fear (Jacobs et al. 2014). Self-reports on fear and valence generally discriminates between fearful and non-fearful participants, whereas no such difference has been seen in ratings of arousal (Johansson et al. 2012, Flykt et al. 2013).

In applications of the FearSEM model, structural equation modelling has confirmed that self-reported fear of wolves includes appraisal of both environmental and social contexts. Appraisal of the social context seems however to be somewhat more important to fear of wolves than for fear of brown bears (Johansson et al. 2012). In line with the Cognitive vulnerability model of animal fear, appraisal of the environmental context includes dimensions of the animal species wolf (CVM model, Armfield 2006, 2007). A relatively high degree of the three CVM variables 'perceived danger' of the animal, 'unpredictability' of the animal's movement (i.e. uncertainty about the animal approaching or attempting to attack the person), and 'uncontrollability '(i.e. the person's lack of control when responding to an encounter with an animal) is associated with fear (Johansson and Karlsson 2011, Johansson et al. 2012). As for the appraisal of the social context, high ratings on these CVM variables were associated with low ratings on social trust, which in turn was strongly associated with higher self-reported fear of wolves. There are numerous definitions of trust. In the FearSEM model trust was conceptualised and operationalised according to the Salient-value-similarity model as the willingness to rely on those who are formally responsible for developing policies and taking measures, in our case wildlife managers (Cvetkovich and Winter 2003). Hence in our case social trust is comparable with the term institutional trust commonly used in research on management of natural resources (Peters et al. 2007, Höppner et al. 2008, Mouro and Castro 2010).

Study 1. Evaluation of access to an ultrasonic device

Objectives

The specific objectives of study 1 were to evaluate the effect of six months with free access to an ultrasonic device on:

1) The appraisal of potential wolf encounters as dangerous, unpredictable and uncontrollable, as captured by the CVM variables. We expected that access to the device

would change the appraisal of a potential encounter. As the sound of the device is designed to surprise and startle the wolf, we predicted a decrease in the CVM ratings.
2) Social trust in managing authorities. The free access to the device can be seen as an attempt from managing authorities to address the public's fear, and we expected that social trust would increase.
3) The experienced feeling of fear of wolves. In line with the expected changes in the antecedents of fear, we also expected a decrease in self-reported valence as well as in the specific feeling of fear. No change was expected in arousal.

The mere personal access to an ultrasonic device could provide an additional way of thinking about i.e. coping with threatening situations with wolves regardless if one actually uses the device or not. However we expected that the effect on CVM, social trust and valence would be moderated by the participants' use of the device. A reference sample of people living in areas with wolf presence was used in order to identify any general trends in relation to the investigated main concepts.

Method

Sample

A total of 27 persons participated in the study, 13 females and 14 males (25–83 years, mean = 55 years, standard deviation = 14). Sixty-three per cent of the sample had a university education, 59% were employed, 26% were retired, and the remaining participants were studying or on parental or sick leave. Almost all, 93%, lived in detached houses. In 22% of the households there were children below 15 years. Fifty-six per cent of the households had a dog, 13% had livestock, and in 55% of the households there was at least one hunter. Most of the participants had personal experience of wolves: 89% had seen wolf tracks, 40% had heard wolves howling, and 40% had seen a wolf in the area where they live.

The reference sample involved 202 persons, 45% females and 55% males (20–83 years, M = 57 years SD = 14 years). In this sample, 44% had university education, 40% were employed, and 40% were retired. Seventy-two per cent lived in detached houses and 8.5% of the households had children below 15 years. In 30% of the households there was a dog, 7% had livestock, and 28% had a hunter in the household. Many persons had personal experience of wolves: 40% had seen wolf tracks, 28% had heard wolves, and 16% had seen wolves in the area where they live.

Procedure

The participants were recruited at public information meetings, 'Wolves Close to Human Settlements', arranged by the County Administrative Board and the Swedish Wildlife Damage Centre. The meetings were advertised in the local daily newspapers, and were held during the period February–May 2013 in villages inside wolf territories where resident wolves had been present for 5 + years.

These meetings were evaluated with regard to impact on the fear of wolves, and the participants were asked to complete questionnaires before and after the information. In the final questionnaire, respondents could indicate their willingness to participate in further studies. It should be noted that these meetings in general had a significant positive impact on antecedents of fear and self-fear among people who found the information to be credible (Johansson et al. unpubl.).

Twelve per cent agreed to evaluate the ultrasonic device after receiving written information about the project, and signing an informed consent form. These participants' responses after the information meetings were retrieved and, for the present purpose, used as a pre-test measure. The device was sent by post, together with an information sheet, to the participants' home address in July–August 2013. The post-test questionnaire and a postage-paid reply envelope were sent to the participants after which the participants had access to the device for six months, i.e. in February 2014.

Data from the reference sample was collected by means of an online survey administered by a professional field-work agency (Norstat, < www.norstat.se/ >). The panel was recruited from the same counties as the participants who attended the information meetings. The first data collection, including two reminders, was carried out in April/May 2013 and the second data collection in February/March 2014.

The ultrasonic device

The ultrasonic device used was a Dazer II, manufactured by Dazer Int., UK. The device is battery operated, measures 11.5 × 3.5 cm and weighs 122 g. The manufacturer states that the device emits a sound on 25 kHz (2 kHz) with 115 dB at a distance of 0.5 m. Participants were offered use of a device for six months. They also received the following information:

- The ultrasonic device emits a sound audible to wolves and dogs. The sound may surprise and startle a wolf or dog, for example in a close encounter. You can, for example, carry the device when outside hiking, picking berries, or walking the dog.
- If you are worried about your dog's reaction to the sound, we advise you to test the reaction at home, starting at a distance of 10 m.
- Also, when using the device, you are advised to follow general recommendations on how to behave when encountering wolves (see for example < www.viltskadecenter.se >).

Participants were also advised to read an enclosed leaflet from the Swedish Wildlife Damage Centre providing the following advice: Make the wolf aware of human presence (you) if you perceive the encounter to be unpleasant. If the wolf still does not leave, you should do so, making a noise. If the wolf follows, you are advised to make yourself large, for example by holding out your arms and backpack. If the wolf continues to approach and gets closer to you than 10 metres, direct the device towards the wolf and press the button. In the unlikely event of a wolf actually attacking you, fight back with arms and legs. This information was also presented at the information meetings.

The questionnaires

The CVM variables were measured using a six-item version of the instrument used in previous research (italics indicate reversed coding): I believe that if I came close to a wolf I would be harmed; *I do not believe wolves could be dangerous*

to me; *I believe that I would be able to deal effectively with a wolf by myself if encountered*; If a wolf came nearby I would probably not feel in control; I think that the movement of wolves is impossible to understand in advance; *I find a wolf to be predictable in their movements*; (Armfield and Mattiske 1996, Johansson et al. 2012). The responses were given on a 5-point scale (1 = completely disagree to 5 = completely agree). The item was analysed as a composite measure (pre-test Cronbach's $\alpha = 0.88$, post-test Cronbach's $\alpha = 0.81$). Social trust was measured by four items presented as statements: I trust that (a) the County Administration Board (CAB), (b) the Wildlife Damage Centre (c) the Swedish Environmental Protection Agency "manage problematic wolf situations with consideration to people who live in wolf areas" (d), the Government "manages the wolf population with consideration to people who live in wolf areas" (Winter and Knap 2001, Johansson et al. 2012). The responses were given on a 5-point scale (1 = completely disagree to 5 = completely agree). These items were also analysed as a composite measure (pre-test Cronbach's $\alpha = 0.86$, post-test Cronbach's $\alpha = 0.82$).

The affective quality in the experienced fear in terms of arousal and valence was assessed by the short version of the Swedish Core Affect Scale. In this instrument, participants were asked to indicate how they feel about encountering a wolf near where they live on two five-point scales ranging from low valence (sad, depressed, displeased) to high valence (glad, happy, pleased) and from low arousal (dull, passive, sleepy) to high arousal (peppy, active, awake) (Västfjäll and Gärling 2007). They were also asked to give their response in a grid providing five steps, capturing the relative strength of the two dimensions of unpleasantness-pleasantness (1 = unpleasant and 5 = pleasant; in the analyses reversed to 1 = pleasant and 5 = unpleasant) and non-arousal-arousal (1 = not aroused to 5 = aroused) (Russell et al. 1989, Johansson et al. 2012). The responses from the two instruments were highly correlated (valence: pre-test Pearson $r = 0.90$, post-test Pearson $r = 0.93$; arousal: pre-test Pearson $r = 0.74$, post-test Pearson $r = 0.52$), and so were treated as indices.

A complementary measure of the specific feeling of fear of wolves was included. In this measure, respondents rated their fear of wolves from 0 = not at all to 6 = very much (Jacobs et al. 2014). At the beginning of the initial information meeting, and at the end of the study, we also included questions about the object of fear and asked about worry and anxiety about attacks of wolf on dogs, livestock, children and themselves (Frank et al. 2015). The post-test questionnaire included additional items capturing the participants' experience of the ultrasonic device.

The online questionnaire included basically the same items and response format as the paper and pencil versions. One exception was that we excluded the part of the questionnaire measuring specific feelings towards wolves. All data was analysed in IBM SPSS statistics version 22. The very few missing values were not replaced. The distribution of all the dependent variables was examined with regard to skewness, kurtosis, and the Kolmogorov–Smirnov test of normality. Most variables were normally distributed and were further analysed by analysis of variance (one-way ANOVA and repeated measures ANOVA). The variables valence, arousal, and specific feeling of fear significantly deviated from a normal distribution and were treated with non-parametric tests (Mann–Whitney U-test and Wilcoxon signed-rank test). The level of significance was set to $p = 0.05$.

Results

Attitude towards using the ultrasonic device

Among the 27 participants, 70% reported that they had carried the device at some point during the six-month test period. The participants, in their own words, described that the most frequent situations in which they carried the device was when walking in the forest after dark. Some participants deliberately carried it when walking with their dog, whereas others especially avoided the device when having the dog because of concern about the effect of the sound on their dog. Fifteen per cent of those who had carried the device had triggered it in situations when they believed there was a wolf near them. Those participants who reported that they never carried the device (30%), in their own words, mentioned concern about the effects on dogs, lack of trust in the device functioning properly, and that there had been no wolf nearby during the test period. A lack of trust in the technology was also noticed among those who carried the device. For example, respondents stated it was difficult to know if the device was working or not. Forty percent would use the device in the future and 51% would recommend the device to someone else.

Access to the ultrasonic device and fear of wolves

The participants reported an intermediate level of cognitive vulnerability in a potential wolf encounter, and their social trust was rather low. The measure of experienced fear shows that the thought of meeting a wolf close to where the participants live elicits low valence combined with high arousal. This is consistent with their ratings of the specific feeling of fear. The Mann–Whitney U-test showed that participants who reported that they had carried the device initially had a strong tendency to score higher on the feeling of fear than those who did not (carriers: $Mdn = 6.00$; non-carriers: $Mdn = 3.00$, $U = 101$ $z = 2.05$, $p = 0.057$ $r = 0.39$). Carriers also tended to score lower on valence than did non-carriers (carriers: $Mdn = 1.50$; non-carriers: $Mdn = 3.00$, $U = 37$, $z = -1.85$, $p = 0.097$, $r = 0.36$).

Contrary to our expectations, the participants' ratings of the CVM variables tended to increase from pre-test to post-test ($F_{1,25} = 4.08$, $p = 0.054$, $\eta_p^2 = 0.14$). Nevertheless, the CVM rating after the intervention was significantly lower than the rating before the preceding information meeting ($F_{1,25} = 4.38$, $p = 0.05$, $\eta_p^2 = 0.15$). No significant changes between pre-test and post-test could be identified in social trust, valence, arousal or the specific feeling of fear of wolves. Measures of the participants' self-reported fear of attacks by wolves on dogs, livestock, children and oneself were available before the information meeting and at the post-test (Table 1). No significant changes in the fear of attacks could be identified. In order to further test if access to the device had influenced carriers and non-carriers differently repeated measures ANOVAs with carrier/non-carriers as a grouping

Table 1. Participants' assessment of CVM variables, social trust and the various fear variables as a reference at the beginning of the information meeting, after the information meeting (pre-test), and after six months access to the device (post-test). SD = standard deviation.

Variable n = 27	Before information meeting		Pre-test spring 2013		Post-test winter 2014		Change pre-post test
	mean	SD	mean	SD	mean	SD	ANOVA[a]/Wilcoxon[b]
CVM	3.28	0.90	2.73	1.02	3.00	0.85	[a]$p = 0.054$, $\eta_p^2 = 0.14$, increase
Social trust	2.32	0.95	2.67	1.06	2.49	0.96	[a]ns
Valence	2.78	1.70	2.90	1.79	2.82	1.96	[b]ns
Arousal	4.30	0.83	4.38	0.82	4.46	0.72	[b]ns
Specific feeling: fear	4.31	1.98	4.24	2.05	4.27	1.61	[b]ns
Fear of attacks	6.61	2.49	–	–	6.18	2.58	[a]ns

factor were also calculated, but did not change the results. Hence no significant interaction effects were observed. Also complementary non-parametric analyses (Wilcoxon signed-rank test) of the 19 participants who had carried the device were calculated showing a similar effect on CVM, but no significant changes in the other variables.

Trends in the reference sample

In the reference sample, the assessments of CVM, social trust, valence, and arousal were very stable and no significant differences could be identified between the first and the second survey. Self-reported fear of attacks slightly but significantly decreased over time, but the effect size was rather low (Table 2).

Study 2. Reasons to decline participation in the evaluation of the ultrasonic device

Objective

The objective of study 2 was to obtain a nuanced understanding of why people were reluctant to test and use the ultrasonic device. We were able to address this question in a group of respondents at the preceding information meeting, who accepted to participate in further studies but declined to test the device.

Method

In-depth interviews were carried out with 10 persons (2 females and 8 males, 47–74 years, mean = 60 years, background data given by nine persons only). Sixty-seven per cent of the informants had a university education, 33% were employed, 56% were retired, and the remaining informants were studying or on parental or sick leave. Eighty-nine per cent lived in detached houses. In 20% of the households there were children below 15 years. Twenty-two per cent of the households had a dog, 22% had livestock and in 67% of the households there was at least one hunter. Most of the informants had personal experience of wolves: 78% had seen wolf tracks, 44% had heard wolf, and 74% had seen a wolf in the area where they live.

Table 2. The reference sample's assessment of CVM variables, Social trust, Valence, Arousal and Fear of attacks at the time of the information meetings, spring 2013 (pre-test), and the time of the post-tests, winter 2014. SD = standard deviation.

Variable n = 202	Spring 2013		Winter 2014		Change pre-post test
	mean	SD	mean	SD	ANOVA
CVM	3.05	0.85	3.06	0.88	ns
Social trust	2.69	1.21	2.80	1.19	ns
Valence	2.81	1.37	2.83	1.26	ns
Arousal	3.81	0.97	3.82	0.97	ns
Fear of attacks	4.51	3.11	3.93	2.92	$F_{1,201} = 18.21$, $p < 0.001$, $\eta_p^2 = 0.08$

The interviews were organised according to a semi-structured guide that allowed the informants to expand on themes that they considered of particular interest. The guide covered the following overarching topics: experiences of the public information meetings, view of wolves and managing authorities, and the view of mitigation measures, including the offer to test the ultrasonic device. The interviews were held by telephone and lasted approximately one hour each. The interviewer took notes during the conversation and all informants consented to the conversation being recorded.

A thematic analysis across the interviews was carried out (Braun and Clarke 2008). In the analysis an inductive approach was employed that identified semantic themes. The focus was on field-specific concepts and understandings revealed in the interviews (Patton 1990). Immediately after the interviews, a rough analytical frame was constructed based on key concepts in the written notes. This frame was further elaborated in more fine-grained coding based on an iterated process of re-reading the notes and transcripts of the recorded interviews.

Findings

The analysis revealed that the informants represented a very diverse group with regard to their general view on the impact of wolves and the managing authorities. In most cases, this was obvious from the very beginning of the conversation (Table 3). The reasons for declining to test the ultrasonic device can be described by four overarching categories as outlined below.

Category 1. Irrelevant solution to the human–large carnivore conflict

The first category of reason is linked to an ideological conviction that wolves should be managed differently. It is argued that wolves should be managed with consideration

Table 3. Informants' views on wolves and wolf management.

		Negative	Ambivalent	Positive
View on managing authorities	Negative	no. 1 male, no. 7 male, no. 8 male	no. 3 male, no. 9 male	
	Ambivalent	no. 4 male	no. 2 female	no. 6 male
	Positive			no. 5 female

for countryside lifestyle, based on farming and hunting, and the associated financial and recreational outcomes. This view is connected with lack of trust in managing authorities and seems to reflect the divide between regional centres and periphery previously identified in fear of large carnivores (Johansson et al. unpubl.). Informants stated that representatives for the managing authorities lack personal experiences and therefore a thorough understanding of countryside life, as well as the damage caused by large carnivores to this lifestyle. This is considered to be exacerbated by the representatives' communicative style, including one-way communication and academic language.

Some people felt that the wolf population should be reduced or even made extinct. The ultrasonic device (or any other conflict-reducing tool) is therefore seen as an absolutely irrelevant solution to human–carnivore conflict, including human fear, since the problem is considered to be based on complex and multifaceted problems relating to bad politics, bad management, and bad communication with the local population.

"No, it's selective measures that you could imagine, but not some form of solution to the problem, just eases someone's conscience. If it's to be anything, it must be something that animal-owners in general could use and benefit from, not just work hard for the sake of making it work. It's a completely different view from the powers-that-be (that's needed). It's the local population or the landowner who should administer." No. 1, male

Category 2. Lack of trust in (the) technology

A second category of reasons focuses more on the technology. These reasons also reflect a lack of trust, but in this case directed towards the technology rather than the managing authorities. It is argued that the ultrasonic device has not been properly tested for the effects on the animals, and it is therefore questionable if the device is at all useful. One informant stated that humans should not be used as guinea pigs by the managing authorities. These considerations are similar to the reasons stated by the participants who agreed to evaluate the device, but then never carried it. Others were less concerned about how well the device works, but simply felt that they should be forced to carry around a lot of technology to go out in nature, since this goes against the true nature experience.

"Don't know if it works, but I don't believe in it because nature's forces are stronger if you end up in a flock of wolves, if it works it would be very good but I'm not going to be a guinea pig is my argument." No. 7, male

Category 3. Present living conditions

A third perspective is that the ultrasonic device might be relevant to the participant, but not in the present phase of life or living conditions. This perspective corresponds to a view that wolves should exist in Sweden and so humans may need to make certain sacrifices with regard to their use of nature. Participants who put forward these reasons seem to trust technology, and state that we should use all tools that may help reduce human–carnivore conflicts, including those that may have the potential to reduce human fear, on condition that the tools do not interfere too much with nature. Consequently, any intervention that is less definitive than lethal management is to be favoured.

"I think it (different technologies) is good. We must try to find a way… The wolf has been gone too long… It's the 2000s, there must be technology, we can go to the moon and galaxies, it's not difficult technology. It's really good we must test new things. Someone must be given time to solve this, there are loads of engineers and consulting firms who solved it in a few weeks, but there must be time and money. Sooner or later solutions will come. The latest I heard about are the electric dog blankets… it's really good… those dogs haven't had any problems." No. 6, male

Category 4. Did not pay attention – no fear

Category four includes reasons that are rather neutral and can briefly be described as that the participants did not fear wolves and did not consider participation in the evaluation because it was irrelevant, because of the lack of fear of wolf. Some of the participants did not even remember the request.

"I'm not afraid of going out in the forest to meet a wolf and don't think I need any transmitter for that. I feel absolutely no need for it." No. 4, male

Discussion

Based on the theory on human–environment interaction and associated methodology, this exploratory study should be considered a first attempt to scientifically evaluate the introduction of technology put forward to address human fear of wolves, an ultrasonic device (Gore et al. 2008). The outcomes of the study indicate a strong resistance towards this type of tool among people who live in wolf territories. This was shown by the low interest in participating in the evaluation of the device, the informants' reasons for declining participation, and that 30% of the participants actually never carried the device. The reluctance seems to be founded in the larger socio-political conflicts around large carnivores, including negative views on managing authorities (i.e. those who offered the tool), lack of trust in the technology, as well as personal individual reasons. Consequently, even if sufficient resources were spent on testing the effectiveness of the device in disrupting the behaviour of an approaching, or even attacking, wolf, it is unlikely that large segments of the population in wolf territories would be motivated to adopt the device as a tool to reduce fear of wolves.

However, participants who were relatively more fearful of wolves tended to have a stronger motivation to use the device. They more frequently carried the device during the test period and the device was considered useful, particularly when they were walking in the forest. Almost half of the

total group of participants was willing to continue to use the device and even recommend it to other persons. However, access to the device for six months did not have any significant effects beyond the preceding information meeting on the appraisal of a wolf encounter, social trust or self-reported fear. Just as importantly, access to the device in no way increased fear above the participants initial level (e.g. when they first came to the information meetings). The motivation to use the device among participants relatively fearful of wolves might be explained by other perceived benefits of access to the device, such as the mere attention given to this aspect of human-large carnivore conflicts by the managing authorities.

It could be argued that the result could be due to shortcomings in instruments and lack of statistical power in the analyses. However, the study was based on a theoretical framework, including some of the key psychological concepts in fear of wolves and corresponding measures with satisfactory reliability successfully used in previous research (Johansson et al. 2012, Frank et al. 2015). In parallel studies on interventions aimed to reduce fear of brown bear, significant effects have been identified with the same measures and corresponding sample sizes (Johansson et al. unpubl.).

In the reference group, the ratings for fear-related variables were stable, suggesting that external conditions potentially influencing feelings of fear did not change very much during the study period. The only rating that significantly changed was fear of attacks, but the effect size was rather low, and a similar pattern could be seen among the participants in the evaluation. This result could be explained by the fact that the first survey was carried out during the spring (due to an unfortunate delay), when attacks on livestock are more likely, and the second survey was carried out during the winter season, when the likelihood of attacks on livestock is very low.

Although access to the ultrasonic device did not seem to make any difference to the carriers, the interviews indicated strong secondary negative effects of introducing the device as a tool to address the public's fear of wolves. At least two of the categories of reasons for declining to evaluate the device, i.e. "Irrelevant solution to the human-large carnivore conflict" and "Lack of trust in (the) technology", correspond with the view that such measures taken by the managing authorities are little more than window dressing. Previous research suggest that these views may reflect different social representations of the impact of wolves on the local landscape and its associated consequences, between the public, stakeholder groups and authorities (Figari and Skogen 2011, Buijs et al. 2012). The public and the authorities may therefore make different meanings of the introduction of a device.

Large-scale implementation would probably fuel rather than reduce lack of trust between locals and authorities. This argument was also common in local media, as well as critical phone calls and letters to the project co-ordinator when the research project was launched. Such negative effects on social trust may indirectly contribute to increased fear.

Kleijnen et al. (2009) proposed a three-level resistance hierarchy to new technology, with the mildest resistance being postponing adoption of the technology, followed by rejecting the technology and, thirdly, and overtly opposing the technology. The ultrasonic device faced all three levels of resistance in our study. In order to prevent our study jeopardising trust in authorities, we decided not to proceed with large-scale data collection. However, in further evaluations of interventions to address fear of large carnivores, it would be advisable to use a larger sample, as well as randomisation to intervention and control groups.

Conclusion

The potential for using access to an ultrasonic device in order to reduce fear of wolves seems very limited in the present context. As the arguments for declining to use the device (e.g. no evidence of effect on wolves), prevalent among both participants and non-participants, are applicable to most other primary repellents (bear spray being a unique exception), we suggest that the results are not unique for this device, but can probably be widely applied. The initiative seemed appreciated by some of the participants but, to avoid negative secondary effects in other groups, interventions to address the public's fear of wolves should be developed and chosen in close dialogue with those who express fear. In this dialogue it seems important to acknowledge the presence of diverse attitudes towards wolves as well as different social representations of the impact of wolves on local people. Managing authorities may benefit from using a bottom–up perspective to identify possible management measures.

Our study shows the importance of evaluating management interventions. One lesson learned is that the effectiveness (in this case the response of wolves when exposed to the sound) of an intervention should be extensively tested in practice and reported before assessing people's response to the intervention. This may seem obvious, but our experience of wildlife management in practice is that this is often not the case. Our study also stresses the importance of working with long-term initiatives that include dialogue, collaboration and participation rather than ad hoc solutions (Decker et al. 2012). We are aware that in some acute situations complementary management measures might be needed. The potential of technology in such situations would probably be greater in contexts where there is a strong initial trust between the players involved. One should however not disregard the complex interplay between appreciation of nature, trust and assimilation of technical innovations in relation to management of natural resources (Peters et al. 2007). Moreover, interventions based on psychological principles for addressing fear of animals, rather than available technology, should be considered and evaluated in parallel.

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