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Authors: Frank, Jens, Johansson, Maria, and Flykt, Anders

Source: Wildlife Biology, 21(3) : 122-130

Published By: Nordic Board for Wildlife Research

URL: <https://doi.org/10.2981/wlb.13116>

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Public attitude towards the implementation of management actions aimed at reducing human fear of brown bears and wolves

Jens Frank, Maria Johansson and Anders Flykt

J. Frank (jens.frank@slu.se), Grimsö Wildlife Research Station, Department of Ecology, Swedish University of Agricultural Sciences, SE-730 91 Riddarhyttan, Sweden. – M. Johansson, Environmental Psychology, Dept of Architecture and Built Environment, Lund Univ., Box 118, SE-221 00 Lund, Sweden. – A. Flykt, Academy of Health and Occupational Studies, Dept of Social Work and Psychology, Univ. of Gävle, SE-801 76 Gävle, Sweden

Previous research on human fear of large carnivores has mainly been based on self-reports in which individual survey items and the objects of fear are measured, so whether a person fears attacks on humans or livestock and pets has not been identified. The objectives of this study were to differentiate between the objects of fear as well as capturing attitudes towards implementation of management actions and the potential for conflict index (PCI). These concern the implementation of a limited number of management actions currently used or discussed in Sweden that are aimed at reducing human fear of brown bears/wolves. 391 persons living in areas with either brown bear ($n = 198$) or wolf ($n = 193$) in Sweden responded to a questionnaire. The degree of self-reported fear varied between residents in brown bear areas and residents in wolf areas. The fear of attacks on livestock and pets was stronger than fear of attacks on humans in both brown bear and wolf areas. In brown bear areas, fear was strongest for livestock, while in wolf areas fear was strongest for pets. The fear of attacks on livestock and pets was significantly stronger in wolf areas, while the fear of attacks on humans was strongest in brown bear areas. In both brown bear and wolf areas, there was little acceptance of implementation of management actions that would allow people to carry pepper spray or a gun outdoors. Management actions aimed at setting a population cap for bear/wolf populations, information on how to act when encountering a bear/wolf, and providing information on local presence of bear/wolf had relatively high acceptability. This was especially true for respondents expressing high fear of attacks on humans.

Management of ‘species that occur in low numbers’ is a challenge, as relatively minor management actions may have a large impact on the population. Management of ‘controversial species’ is also a challenge, because management actions may trigger public responses that affect support for political goals that go beyond the specific management action (Feral 1995, Okwemba 2004, Vaske et al. 2004).

Large-carnivore management involves species that may be both rare and controversial. Public response to large carnivores and the management of these species should be met by long-term initiatives to increase public involvement and trust by enhancing collaboration and participation (Decker et al. 2012). However, specific conflict situations often require rapid decisions and actions, which may have long-term consequences. In these situations it is important to have access to knowledge about the effects that could be expected from various actions and how the actions may be received by various stakeholder groups and the public. It is well known that the legitimacy of specific management actions is affected by who puts the actions into practice (Vaske et al. 2004). Specific management actions and decisions are also known to affect political legitimacy, as well as trust in government, and thereby limit or allow future

decisions and policies (Matti 2009). In this context, the effects can be studied, including attitudes towards implementation of proposed management actions before they are implemented. The results may ultimately be used to guide selection of actions (Treves et al. 2009).

In Sweden, fear of brown bear and wolf is commonly reported by people who live in large-carnivore areas (Ericsson et al. 2010, Johansson et al. 2012). This fear may negatively influence everyday life and wellbeing (Sjölander-Lindqvist 2009), and may be associated with people’s acceptability of policy measures (Woodroffe et al. 2005, Slagle et al. 2012). For example, people who are fearful of large carnivores are less willing to pay for policies that support large carnivores (Johansson et al. 2011), and are more likely to advocate lethal management (Bradley et al. 2005, Prokop and Fančovičová 2010). Depending on current aims and policies, this may increase demand for management actions aimed at reducing the experienced fear (Decker and Chase 1997, Nyhus et al. 2003). Researchers such as Vaske et al. (2010) have recognized that management actions with a high degree of acceptability are generally preferable to actions with a low degree of acceptability, as they are less likely to cause conflicts.

In order for wildlife management to be successful in reaching policy goals, 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 and to influence attitudes towards implementation of other management actions. Several studies have examined the effectiveness of various management actions aimed at mitigating depredation on livestock, e.g. removal of carnivores and fencing of livestock (reviewed by Linnell et al. 1996). However, few studies have evaluated or compared the effects of management actions aimed at reducing human fear of wolves and brown bears. Lethal methods have been used extensively in the past, but there is growing public demand to apply non-lethal methods (Shivik et al. 2003), which may exacerbate the already heated debate. It is widely believed that enhancing knowledge in rural communities through information is essential for the sustainable management of natural resources (Baland and Platteau 1996). Consequently, information programs aimed at reducing fear and influencing attitudes towards conservation measures relating to large carnivores and addressing human safety concerns have been called for (Treves and Karanth 2003, Røskaft et al. 2003, Nyhus et al. 2003). However, several studies have identified a complexity of interacting socio-cultural (Skogen and Thrane 2008) and psychological factors (Manfredo 2008) behind human responses to wildlife, including the perception of control of the carnivore situation (Lescureux and Linnell 2010), the relation to, and the trust in, management authorities (Ericsson and Heberlein 2003, Linnell et al. 2003, Sjölander-Lindqvist 2009, Skogen and Thrane 2008), personal values and value orientation (Bjerke and Kaltenborn 1999, Bisi et al. 2007), and the general attitude towards carnivores (Williams et al. 2002). Moreover, the role of experience has been discussed (Karlsson and Sjöström 2007). All these results suggest that it is very hard to predict how single management interventions will be received by the public and what effect they might have (Hazzah et al. 2009). Previous research has shown that the appraisal of the carnivore species (Prokop and Fančovičová 2010, Johansson and Karlsson 2011, Johansson et al. 2012) and social trust in managing authorities (Johansson et al. 2012) are strongly associated with the experience of fear. This implies that management actions that may alter these factors would be more likely to succeed in reducing fear.

A large number of diverse management actions have potential to reduce the number of interactions between humans and large carnivores, and thereby influence human fear of large carnivores. When selecting management actions it may however be of use to know what the object of fear is. If the main fear concerns attacks on children, actions targeting fear for attacks on hunting dogs may seem irrelevant to the general public. However, it is not certain that people who are fearful of large carnivores, and who potentially also show low levels of trust in authorities (Johansson et al. 2012), wish for the authorities to take any management actions at all. Consequently, public response to management actions may differ greatly between stakeholder groups as well as between individuals.

The public response to the anticipated environmental change, including the introduction of management actions, has been discussed in terms of resistance, opposition, tolerance,

acceptability, acceptance and support. In the psychological literature, “acceptability” refers to people’s attitude towards policy measures that may be introduced in the future (Nilsson and Martinsson 2012, Gyllin et al. unpubl.), whereas “acceptance” has been referred to as an attitude, a behavioral intention and/or overt behavior (Huijts et al. 2012). The continuum of opposition – support has been described as a behavioral intention (Johansson and Laike 2007, Slagle et al. 2012). This intention can be expressed in a passive or an active way, although the public debate is often limited to the active ends of the scale (Waldo et al. 2013). In the present study we focus on the attitudinal level, and consider actions that are currently used in practice and those that are discussed for future use. In this context we have chosen to use the more neutral term ‘attitude towards implementation’ in reference to whether or not people report that a certain management action should be introduced in the area where they live.

The presence of large carnivores has been shown to elicit strong positive as well as strong negative affective responses (i.e. feelings, Karlsson et al. 1999, Ericsson and Heberlein 2003, Johansson et al. 2012). Consequently, it has been argued that affective aspects must be considered if we are to fully understand public reactions to management actions (Røskaft et al. 2003, Kaltenborn et al. 2006, Manfredo 2008, Johansson and Karlsson 2011, Jacobs et al. 2012, Slagle et al. 2012). In previous research, human fear of large carnivores has commonly been based on self-reports measured by single (survey) items (Jacobs et al. 2012). Consequently the objects of fear, i.e. whether a person fears attacks on humans or attacks on animals, have not been differentiated. However, this information may be essential to public attitudes towards implementation of management actions, as well as to the authorities’ choice of actions.

When the correct object of fear has been distinguished, the potential for conflict index (PCI) can be a methodological approach to facilitate the use of human dimensions research in wildlife management (Manfredo et al. 2003) in general, and possibly for fear in particular, as the PCI provides a quantitative direction for management decisions (Thornton and Quinn 2009). Vaske et al. (2010) increased the complexity of the analysis to include additional factors in the context, i.e. the behavior of the wolf, its location, and the conservation status of the species. Needham et al. (2004) used PCI to neatly describe how the reduction of deer herds in several American states would have been more controversial and less accepted by hunters if the reduction had been undertaken by agency staff instead of local hunters. PCI has also been used to study interactions between humans and cougars *Puma concolor* (Thornton and Quinn 2009), acceptance for alien species management (Sharp et al. 2011), and suburban deer management (Urbanek et al. 2012). A main advantage of PCI is that it presents information about the central tendency, dispersion, and form of a distribution in a single graphic representation that may include multiple management actions simultaneously. The visual presentation can be discussed in relation to attitudes towards implementation of a given management action in different sub-groups (e.g. persons who are fearful and persons who are not fearful of large carnivores).

The objectives of the present study were:

1. To assess the relative fear of brown bear/wolf attacks on humans compared to fear of attacks on livestock and pets among people living in brown bear/wolf areas.
2. To test whether residents who report that they are fearful of brown bears/wolves have different attitudes towards the implementation of management actions compared to those who report that they are not fearful of brown bears/wolves.
3. To discuss which of a limited number of management actions for addressing human fear of brown bears/wolves have the lowest potential for conflict in brown bears and wolf areas respectively.

Method

A questionnaire was sent to a sample of 733 persons between 18 and 75 years of age, who were randomly selected from the local online telephone directory (including numbers to cell phones), in November 2009. Approximately two weeks later, 524 persons who had not yet returned the questionnaire were telephoned, and 36% were reached. In January 2010 a reminder with a new questionnaire was sent by post. The final response rate was 53%. The questionnaire also contained questions that are not analysed or reported here, but can be found in Johansson et al. 2012.

The respondents were sampled from two areas in south-central Sweden with well-documented presence of wolf territories (Wabakken et al. 2009) and two areas somewhat more to the north, with well-documented resident brown bear populations (Schneider 2006). The respondents were 391 persons living in areas with either presence of brown bears ($n = 198$) or wolves ($n = 193$) in Sweden. Ages of respondents ranged from 18 to 75 years (mean age 53 years); 47% were males and 53% females. In 17% of the households, there were children under 12 years, 23% households included a dog, and 8% owned livestock.

Instruments

The instrument used was a six-page questionnaire. The questions analysed for this study consisted of three background questions regarding personal experience of brown bear/wolf: "Have you ever seen a brown bear/wolf close to the area where you live?" "Have you ever seen the tracks of a brown bear/wolf close the area where you live?" The response scale was "no, never", "yes, a few times", "yes, several times". "Have you ever had pets or livestock attacked by brown bear/wolf?" The response alternatives were "yes" or "no". In addition there was an open-ended question: "When was the last time you heard about presence of brown bear/wolf in the area where you live?". Fear of brown bears/wolves was measured by asking: "To what extent do you experience fear or worries of attacks by brown bears/wolves on: 1) livestock, 2) pets, 3) children, and 4) yourself?" The experienced fear was to be marked on continuous scales ranging from no fear (0) to very strong fear (10). Worry (i.e. cognitive interpretations and anticipation of potential future threatening encounters,

Table 1. List of proposed management actions and the numbers representing the different management actions in Fig. 1 and 2.

No. in Fig. 1 and 2	Management action	Type of action
1	Information on local presence of carnivores	information
2	Information on how brown bears/wolves react when encountered by humans	Information
3	Information on the frequency of attacks on humans by brown bears/wolves	information
4	Information on how to act when encountering brown bears/wolves	information
5	Setting a cap for brown bear/wolf populations	policy
6	Make it illegal to dispose of livestock carcasses within 3 km of human dwellings	policy
7	Allow pepper spray to be carried for personal protection when in areas with brown bear/wolf presence	direct
8	Allow firearms to be carried for personal protection when in areas with brown bear/wolf presence	direct
9	Distribution of an ultrasonic scaring device for dogs that may also deter wolves	direct

Castaneda and Segerstrom 2004), does on one hand seem to play an important role in fear acquisition (Joos et al. 2012; see also McLaughlin et al. 2007) and on the other hand worry might contribute to the maintenance of fear (Castaneda and Segerstrom 2004). Therefore we formulated our questionnaire items in a way to capture affective responses labelled both fear and worry.

Attitudes towards the implementation of different management actions were captured by the question: "What is your opinion on the authorities implementing the following management actions in the county where you live?" followed by nine proposals of management actions, each of which was to be rated on a 5-point Likert scale (1 = Should not be implemented and 5 = Should absolutely be implemented) (Table 1). The management actions were either in use (actions 1–4) or being discussed with regard to their future usefulness (actions 5–9) in Swedish brown bear/wolf management. Actions 1–4 involve information from authorities, actions 5 and 6 concern policy decisions, actions 7–9 are direct actions aimed at reducing the risk of an actual confrontation with a brown bear or wolf. The questionnaire also included a few socio-demographic questions.

Data processing

Responses to the open-ended question were subjected to a qualitative content analysis and categorized into different sub-themes. The respondents' self-reported fear of attacks on livestock, pets, children and themselves as marked on the continuous lines tended to have a bimodal distribution, so this data was processed with non-parametric statistics (Mann–Whitney U-test and Wilcoxon signed rank test). The statistical analyses were carried out in IBM SPSS statistics 19. In the analysis of attitude, responses on the 5-point

Likert scale were transformed to range from -2 (should not be implemented) to +2 (should absolutely be implemented) in order to illustrate the attitudes towards implementation of different management actions by means of the PCI (Vaske et al. 2010). The model for PCI assumes that the greatest potential for conflict would occur when there is a bimodal distribution between the two extreme values of the response scale (in our case, 50% of respondents stating that a management action should absolutely be implemented and the other 50% stating that the same management actions should absolutely not be implemented). In this case, PCI attains a highest possible value of 1. On the other hand, a distribution with 100% on the same value would yield no potential for conflict and a PCI of 0. In the analysis of attitudes towards implementation of management actions, each sub-sample was divided into two groups according to their self-reported fear of attacks on children and fear of attacks on themselves. Participants who obtained an averaged value on these two scales above 5 (the visual middle point on the continuous line) were categorised as fearful (brown bear areas 30% and wolf areas 34%) and respondents with a value of 5 or below were categorized as non-fearful (brown bear areas 67% and wolf areas 65%). Differences between these two groups were tested by Pearson χ^2 - and t-test. This division also formed the groups compared in the PCI analyses.

Results

Personal experience of brown bear/wolf

Sixty percent of the respondents in brown bear areas report that they have observed brown bears on some occasion, and 82% have seen brown bear tracks. The corresponding figures among respondents in wolf areas are 32% who have observed wolves, and 59% who have seen wolf tracks (Table 2).

Respondents also encounter the large carnivores, or tracks of them, during recreational activities such as walking the dog, running and picking berries, hunting activities and when driving. Five percent had experienced pets or livestock attacked by brown bear and four percent had experienced pets or livestock attacked by wolf.

Self-reported level of fear for different objects of fear

The self-reported level of fear as marked on the continuous scales involving different objects of fear (i.e. attacks on livestock, pets, children, oneself) varied considerably between

Table 2. Proportion of respondents who report they have observed brown bear/wolves and/or tracks from brown bear/wolves in the area where they live.

Brown bear	Have seen animal	Have seen tracks	Wolf	Have seen animal	Have seen tracks
Several times	24%	60%	several times	8%	30%
A few times	36%	32%	a few times	24%	29%
Never	39%	7%	never	64%	38%
Missing	1%	1%	missing	4%	3%

respondents fearful of brown bear and respondents fearful of wolves (Table 4).

Respondents in wolf areas reported that they were significantly more fearful of attacks on livestock and pets than were respondents in brown bear areas. However, respondents in brown bear areas were more worried about attacks on themselves than were the respondents in wolf areas. There was a strong tendency ($p = 0.064$) towards respondents in wolf areas being more worried about attacks on children (Table 4).

The level of self-reported fear of brown bears/wolves also varied considerably between objects of fear. The level of fear was significantly different for attacks on livestock, pets, children and the respondents themselves (Table 3). In both the brown bear and wolf areas, respondents reported higher level of fear of attacks on livestock and pets than on people. Respondents in brown bear areas reported a higher level of fear of attacks on livestock than attacks on pets, and more fear of attacks on livestock and pets than attacks on children and themselves. However, there was no difference in reported fear of attacks on children compared to attacks on the respondents themselves (Table 4).

Respondents in wolf areas reported that they feared attacks on pets to a higher degree than attacks on livestock. They reported more fear of attacks on pets and livestock than on children, but were more concerned about attacks on children than attacks on themselves (Table 4).

Attitude towards implementation among respondents fearful and non-fearful of attacks on humans

In the brown bear areas, the respondents categorized as fearful of attacks on humans (had an averaged value above 5 the visual middle point on the continuous line for fear of attacks on children and fear of attacks on themselves) were more likely to be women than men ($\chi^2 = 4.97$, $DF = 1$, $p = 0.026$, Cramer's $V = 0.16$), and to have children under 18 years old in the household ($\chi^2 = 6.76$, $DF = 1$, $p = 0.009$, Cramer's $V = 0.19$), than respondents categorized as non-fearful (obtained an averaged value of 5 or below). No significant differences were found between fearful and non-fearful respondents with regard to the respondents' age or experience of brown bear. In the wolf areas, the respondents categorized as fearful of attacks from wolves on humans were more likely to have seen tracks of wolf than were non-fearful respondents ($\chi^2 = 14.78$, $DF = 2$, $p = 0.002$, Cramer's $V = 0.09$).

Regardless of whether the respondents were categorized as fearful of attacks on humans by brown bear or by wolf, fearful respondents reported more positive overall attitudes towards implementation of the management actions than non-fearful respondents in both brown bear areas at an aggregated level (index based on eight management actions, fearful: $M = 0.053$, $SE = 0.07$, non-fearful $M = 1.10$, $SE = 0.09$). This difference was significant $t(183) = -4.63$, $p < 0.001$, but it represented a medium-sized effect ($r = 0.35$) in wolf areas (index based on nine management actions; fearful: $M = 0.35$, $SE = 0.06$, non-fearful $M = 0.91$, $SE = 0.10$). This difference was statistically significant; $t(185) = -4.83$, $p < 0.001$, $r = 0.36$. There were also statistically significant differences in attitudes towards implementation of management

Table 3. Median values of different objects of fear in the two sub-samples (brown bear and wolf).

	Brown bear Median	Wolf Median	Test of differences Mann–Whitney U-test
Livestock	4.5 (n = 195)	7.0 (n = 193)	$U = 14711.5, z = -3.73, p < 0.001, r = 0.19$
Pets	3.5 (n = 195)	8.0 (n = 193)	$U = 12715.5, z = -5.55, p < 0.001, r = 0.28$
Children	2.5 (n = 194)	3.5 (n = 193)	n.s
Themselves	2.0 (n = 193)	1.0 (n = 191)	$U = 15580.5, z = -2.64, p < 0.01, r = 0.13$

Sample size, n, varies between 191 and 195 for each, with test of differences between the two sub-samples. All ranges 0–10, with 0 indicating no fear and 10 indicating high fear.

actions between fearful and non-fearful respondents for a majority of the single management actions (Table 5 for brown bear and Table 6 for wolf). The exception for brown bear was action number 4 “Information on how to act in order to avoid an attack when encountering brown bears”, and the exceptions for wolf were action number 7 “Allow pepper spray to be carried for personal protection when in areas with brown bear/wolf presence” and action number 8 “Allow firearms to be carried for personal protection when in areas with brown bear/wolf presence”.

The values of the potential for conflict index (PCI) were relatively high for management actions aimed at direct personal protection, such as allowing firearms or pepper spray when in areas with presence of brown bears or wolves. Management actions based on factual information about various species-specific topics generally had lower PCI values than other management actions, especially in the group of fearful respondents (Fig. 1, 2).

No statistically significant differences regarding gender or age were found between the two sub-samples. However, it was more common that someone in the household was a hunter ($Z_{MWU} = -2.80, p < 0.01$), and the household more likely to contain a dog ($Z_{MWU} = -3.55, p < 0.01$), in the brown bear sample.

Discussion

This study, directed towards people living in areas with resident populations of brown bears or wolves, shows that the object of fear matters in the self-reported fear of large carnivores. Moreover, individuals who are fearful of attacks on humans express more positive attitudes towards implementation of various management actions.

In both brown bear and wolf areas, respondents express stronger fear of attacks on livestock and pets than fear of

attacks on children or themselves. This corresponds well to the likelihood of attacks. For brown bears, there is a greater fear of attacks on livestock than attacks on pets, which reflects the actual numbers of brown bear attacks on livestock in Sweden (around 20 per year), while brown bear attacks on pets (dogs) are well below 5 (Swedish Wildlife Damage Centre 2012). Each year, 1–2 humans are injured (and more seldom killed) by brown bears. The fact that respondents in brown bear areas still express less fear of attacks on humans than attacks on livestock and pets strongly indicates that they perceive the risk of attacks on humans as lower.

Respondents in wolf areas express more fear of attacks on pets than attacks on livestock. Livestock owners are in the minority among respondents from both wolf and brown bear areas, so the small proportion of livestock owners among the respondents is not likely to be the main mechanism behind this pattern. However, in contrast to brown bears, wolves do attack dogs regularly. In Sweden, 25–40 dogs are injured or killed by wolves each year (Swedish Wildlife Damage Centre 2012). Domestic cats are also killed by wolves each year (J. Frank pers. comm.). Respondents in wolf areas also expressed more fear of attacks on children than attacks on adults; in brown bear areas there was no difference. This is interesting, since in Sweden there have been no documented attacks on children or adult humans for almost 200 years by wild wolves (Linnell et al. 2003). However, studies of documented wolf attacks on humans from other parts of the world clearly show that children are at greater risk of being attacked than human adults (Linnell et al. 2003). The higher level of fear of attacks on children than attacks on adult humans therefore corresponds to factual data. These results point to the necessity of differentiating the object of fear in further studies of fear of brown bear and wolf. Differentiated data would allow implementation of management actions that can more specifically target the public’s concerns.

Table 4. Median values of different objects of fears in the two sub-samples (brown bear and wolf) with test of differences between the two sub-samples.

	Brown bear Test of differences (Wilcoxon signed ranks test)	Wolf Test of differences (Wilcoxon signed ranks test)
Livestock vs Pets	$Z_{Wilcoxon} = -2.59, p < 0.01, r = 0.13$	$Z_{Wilcoxon} = -2.65, p < 0.01, r = 0.13$
Livestock vs Children	$Z_{Wilcoxon} = -4.57, p < 0.001, r = 0.23$	$Z_{Wilcoxon} = -6.69, p < 0.001, r = 0.34$
Livestock vs Yourself	$Z_{Wilcoxon} = -5.71, p < 0.001, r = 0.29$	$Z_{Wilcoxon} = -9.87, p < 0.001, r = 0.50$
Pets vs Children	$Z_{Wilcoxon} = -2.17, p < 0.05, r = 0.11$	$Z_{Wilcoxon} = -7.96, p < 0.001, r = 0.41$
Pets vs Themselves	$Z_{Wilcoxon} = -2.93, p < 0.01, r = 0.15$	$Z_{Wilcoxon} = -9.97, p < 0.001, r = 0.51$
Children vs Themselves	$Z_{Wilcoxon} = -0.71, p = 0.426, r = 0.04$	$Z_{Wilcoxon} = -8.20, p < 0.001, r = 0.42$

Table 5. Attitudes towards implementation of brown bear management actions.

Number in Fig. 1 and 2	Management actions	Brown bear area Low fear	Brown bear area High fear	Test of differences Mann–Whitney U-test
1	Information on local presence of carnivores	0.12	1.07	$U = 2326.0, z = -4.23, p < 0.001, r = 0.31$
2	Information on how brown bears react when encountered by humans	1.18	1.74	$U = 3301.0, z = -1.43, p = 0.15, r = 0.10$
3	Information on the frequency of attacks on humans by brown bears	0.88	1.29	$U = 3142.0, z = -2.02, p = 0.043, r = 0.15$
4	Information on how to act when encountering brown bears	1.23	1.6	$U = 3111.0, z = -2.43, p = 0.015, r = 0.18$
5	Setting a cap for the brown bear population	1.01	1.33	$U = 3128.0, z = -2.04, p = 0.041, r = 0.15$
6	Make it illegal to dispose of livestock carcasses within 3 km of human dwellings	0.97	1.17	$U = 2831.0, z = -3.35, p = 0.001, r = 0.24$
7	Allow pepper spray to be carried for personal protection when in areas with brown bear/wolf presence	-0.33	0.5	$U = 2697.5, z = -3.39, p = 0.001, r = 0.25$
8	Allow firearms to be carried for personal protection when in areas with brown bear/wolf presence	-0.77	-0.06	$U = 2922.5, z = -2.84, p = 0.004, r = 0.21$

Numbers in the column to the left correspond to the various management actions shown in Fig. 1 and 2. Numbers in the columns to the right show the respondents' opinion on whether the specific management actions should/should not be implemented in the area where the respondent lives, among respondents in brown bear and wolf areas who report low or high fear of brown bears. Values were transformed from a 5-point Likert scale to range between -2 and 2.

In our sample, the level of self-reported fear of attacks on humans differentiated between respondents' attitude toward the implementation of management actions in their county, further substantiating the importance of affective aspects on attitudes towards implementation of management actions (Prokov and Fančovičová 2010). In both brown bear and wolf areas, those respondents that expressed a high level of fear of attacks on humans were more positive towards the proposed management actions than respondents from the same areas who expressed low fear. This result was consistent for very different management actions. This is particularly interesting as fear has previously been shown to negatively correlate with social trust (Johansson et al. 2012). It is not obvious that people with low social trust would have

favorable attitudes towards the implementation of management measures that are taken by regional or national authorities.

It should be noted that the present paper does neither test nor claim that people who fear attacks on humans would hold a different attitude toward the implementation of the management actions investigated than people who fear attacks on pets or livestock. We believe however that it is important to acknowledge that different persons may be fearful of brown bear and wolf for different reasons. Thus, discussions on specific management actions should take nuances as for example, the object of fear into account. We chose to focus on fear of attacks on humans since management actions in use today primarily are designed to address fear of attacks on pets and livestock.

Table 6. Attitudes towards implementation of wolf management actions.

No. in Fig. 1 and 2	Management actions	Wolf area Low fear	Wolf area High fear	Test of differences Mann–Whitney U-test
1	Information on local presence of carnivores	0.33	1.39	$U = 2272.0, z = -5.31, p < 0.001, r = 0.39$
2	Information on how wolves react when encountered by humans	0.93	0.19	$U = 3216.0, z = -2.71, p < 0.007, r = 0.20$
3	Information on the frequency of attacks on humans by wolves	0.82	1.28	$U = 3289.0, z = -2.51, p < 0.012, r = 0.18$
4	Information on how to act when encountering wolves	1.06	1.09	$U = 3891.0, z = -0.71, p = 0.480, r = 0.05$
5	Setting a cap for the wolf population	0.75	1.48	$U = 2594.0, z = -4.51, p < 0.001, r = 0.33$
6	Make it illegal to dispose livestock carcasses within 3 km of human dwellings	0.93	0.41	$U = 4056.5, z = -0.21, p = 0.84, r = 0.01$
7	Allow pepper spray to be carried for personal protection when in areas with brown bear/wolf presence	-0.43	0.46	$U = 2922.5, z = -3.35, p = 0.001, r = 0.24$
8	Allow firearms to be carried for personal protection when in areas with brown bear/wolf presence	-1.08	0.2	$U = 2396.0, z = -4.99, p < 0.001, r = 0.36$
9	Distribution of an ultrasonic scaring device for dogs that may also deter wolves	-0.21	0.4	$U = 3098.0, z = -2.83, p = 0.005, r = 0.21$

Numbers in the column to the left correspond to the various management actions shown management actions in Fig. 1 and 2. Numbers in the columns to the right represents the respondents' opinion on whether the specific management actions should/should not be implemented in the area where the respondent lives, among respondents in brown bear and wolf areas who report low or high fear of wolves. Values were transformed from a 5-point Likert scale to range between -2 and 2.

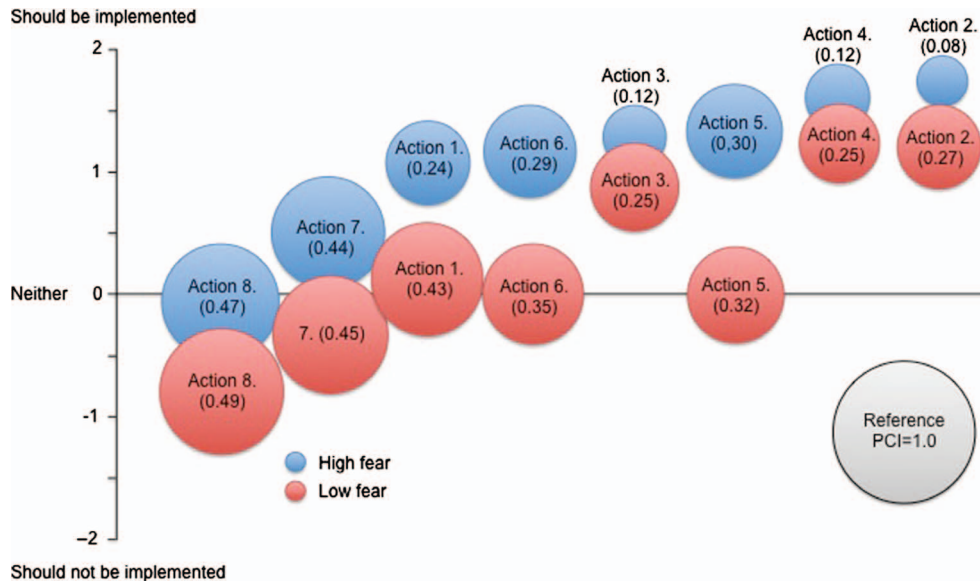


Figure 1. PCI values for brown bear management actions. PCI value for management actions in the brown bear area is presented graphically by the size of each bubble and numerically inside each bubble. The value on the y-axis represents the respondents' attitude towards implementation of the specific brown bear management actions in the area where the respondent lives. Values were transformed from a 5-point Likert scale to range between -2 and 2.

In both brown bear and wolf areas, management actions targeting personal protection, such as allowing people to carry pepper spray or a gun when outdoors in brown bear/wolf areas, were less often considered to be actions that should be implemented. Management actions aimed at setting a population cap for brown bear/wolf populations, or information on how to act when encountering a brown bear/wolf, as well as information on local presence of brown bear/wolf, were the most preferred management actions. This was especially true for respondents expressing high fear of attacks on humans. It should be noted that no perfect correlation can be expected between people's attitude toward implementation and their overt reaction once an action

is implemented. Nevertheless, the attitude, as long as it is measured at the same level of contextual specificity as the behavior to be targeted, is the most accurate picture we can get before a specific action is introduced (Fishbein and Ajzen 2010).

Information on local presence of carnivores was rated significantly higher as a management action that should be implemented in wolf areas than in brown bear areas. Important reasons for this may be that 1) wolves are more often involved in attacks on livestock and pets than brown bears, 2) wolves occur in lower densities than brown bears, and 3) wolves are strictly territorial. Good knowledge about the extent of a wolf territory enables people to know when they

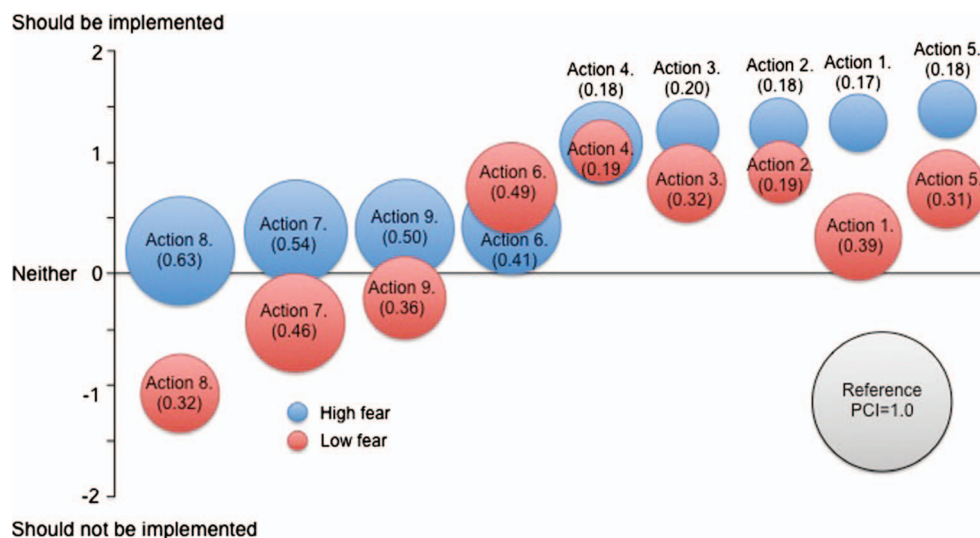


Figure 2. PCI values for wolf management actions. PCI value for management actions in the wolf area is presented graphically by the size of each bubble and numerically inside each bubble. The value on the y-axis represents the respondents' attitude towards implementation of specific wolf management actions in the area where the respondent lives. Values were transformed from a 5-point Likert scale to range between -2 and 2.

are in an area with resident wolves, and allows them to take precautions to prevent attacks by wolves on their livestock, their dogs or themselves. "Information on how to avoid an attack when encountering a large carnivore" and "Making it illegal to dispose of carcasses within 3 km of the nearest human dwelling" were rated significantly higher as desirable management actions in brown bear areas. This difference may also be explained by a wide recognition of brown bears more often being involved than wolves in attacks on humans. Especially during spring, carcasses and other food resources attract bears and may increase the likelihood of encounters between brown bears and humans if the food source is close to human activity.

Considering the proportions of respondents that have observed brown bears/wolves and/or their tracks, we are confident that the survey successfully targeted people that are affected by the presence of brown bears/wolves and/or management of these species. This is further supported by the responses to the open-ended question on when the respondent last heard about wolf/bear observations. There are several plausible reasons why more respondents in brown bear areas have observed brown bears or bear tracks than the number of respondents in wolf areas that have observed wolves or wolf tracks. The two most important reasons may be that 1) wolves are present in lower densities than brown bears, partly because wolves are strictly territorial and brown bears have overlapping home ranges, and 2) brown bear tracks are easy to recognize while wolf tracks are similar to tracks from dogs. The response rate is comparable to other Swedish surveys on public attitudes towards large carnivores (Ericsson et al. 2010). As in other studies on controversial issues, people with a neutral opinion tend to be underrepresented. However, the present analyses primarily aimed to compare sub-groups of people in large carnivore areas who report a low or high level of fear of the species. Therefore, the biased sample is not likely to confound the results of the present study.

Until the effects of actions to mitigate human fear of large carnivores have been rigorously assessed, it may, in everyday application, be rational to refrain from certain actions or implement management actions that have the lowest potential for conflict. The management actions that had the highest potential for conflict among high-fear respondents were those involving permission to carry guns and pepper spray. This may be both due to a lack of trust in the efficiency of the actions, but also because of fear of misuse of guns and pepper spray for criminal purposes. Management actions aimed at spreading information on both carnivore and human behavior had the lowest potential for conflict index among respondents reporting high fear of bears/wolves. For respondents fearing wolves, setting a cap for the wolf population also had a relatively low potential for conflict.

Management actions must be implemented with caution since there is a dependency between social trust on the one hand, and risk perception (Needham and Vaske 2008), fear (Johansson et al. 2011), and successful implementation of management actions (Stern 2008) on the other. Vlek and Cvetkovich (1989) conclude that existing attributions of trust are preserved because they affect the interpretations and meanings of new information. The double-asymmetry principle suggests that bad news from mistrusted individuals and good news from trusted individuals is expected to be more

likely than the reverse (Cvetkovich and Winter 2007). Given the controversies surrounding large carnivores, information concerning attacks on humans may not decrease human fear at all. The information therefore needs to be carefully balanced in order to avoid at least major unexpected and unwanted effects. The findings from Vlek and Cvetkovich (1989) also lead to the view that trusted managers have greater flexibility in which to act. Since the use of almost all management actions can be interpreted from a negative point of view, it is important that the authority or person responsible is highly trusted. However, it should be noted that the type of information given will also affect the outcome. In a study of the effects of different information on black bears in an area with a recently established bear population, Ohio (USA), persons that were informed on how to avoid bear problems (for example, by bringing in birdfeeders or garbage cans at night) gained a lower acceptance for bears compared to persons that were informed on both how to avoid bear problems and the potential benefits of having bears (R. Wilson pers. comm.). However, the results may be different in an area with well-established attitudes towards bears. Before applying large-scale management actions involving information on brown bears/wolves, it would be wise to use small-scale trials that are evaluated with regard to the type information provided.

Acknowledgements – The authors would especially like to thank Henrike Hensel and Eja Pedersen for help with data collection and treatment, and Simon Matti and Serena Cinque for valuable comments on previous version of the manuscript. The research was funded by grants from the Swedish Wildlife Foundation and the Swedish Research Council Formas.

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