

**Interventions targeting human fear of large carnivores
– many ideas but scarce data**



Besøkende i et rovtiltsenter
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Interventions targeting human fear of large carnivores – many ideas but scarce data

By: Maria Johansson¹, Inês A. Ferreira¹, Ole-Gunnar Støen², Jens Frank³ and Anders Flykt⁴

¹Environmental Psychology, Department of Architecture and Built Environment, Lund University, SE-22100, Lund, Sweden

²Department of Natural Resources and Management, Norwegian University of Life Sciences, NO-1432 Ås, Norway

³Wildlife Damage Centre, Department of Ecology, Swedish University of Agricultural Sciences, SE-730 91 Ridderhyttan, Sweden.

⁴Department of Psychology, Mid Sweden University, SE-831 25 Östersund, Sweden

Abstract

This report reviews the peer-reviewed scientific literature on interventions discussed to address peoples' fear of large carnivores in human-large carnivore conflicts. Based on psychological theories a wide definition of fear was adopted including fear as an emotion, and as a component in (risk) perception or attitude. The systematic literature search in international databases yielded 31 relevant hits whereof 20 articles proposed and 11 articles evaluated interventions. Four major categories of interventions were identified: information and education, exposure to animal and habitat, collaboration and participation, and financial incentives. Each one of these categories may have a potential to reduce fear related variables. The present scientific evidence of the effect of these interventions on fear of large carnivores is, however, scarce and partly contradicting. This makes it difficult to rely on present findings in the design of appropriate interventions.

Sammendrag

Denne rapporten gjennomgår vitenskapelig fagfelleurdert litteratur om tiltak rettet mot folks frykt for store rovdyr i konflikter mellom mennesker og store rovdyr. Basert på psykologiske teorier ble det benyttet en bred definisjon av frykt. Dette inkluderte frykt som en følelse, og frykt som en komponent i (risiko) oppfatning eller holdning. Et systematisk litteratursøk i internasjonale databaser ga 31 relevante treff hvorav 20 artikler foreslo tiltak og 11 artikler evaluerte tiltak. Fire hovedkategorier av tiltak ble identifisert: informasjon og utdanning, eksponering for dyr og habitat, samarbeid og deltakelse, og økonomiske insentiver. Hver og en av disse kategoriene kan ha et potensiale for å redusere fryktrelaterte variabler. De nåværende vitenskapelige bevisene for effekten av disse tiltakene på frykt for store rovdyr er imidlertid knappe og delvis motstridende. Dette gjør det vanskelig å stole på nåværende resultater fra forskningen i utformingen av hensiktsmessige tiltak.

Introduction

Large carnivore populations, such as brown bear (*Ursus arctos*), wolf (*Canis lupus*), lynx (*Lynx lynx*) and wolverine (*Gulo gulo*), have increased in the last decades in Scandinavia (Chapron et al. 2014). This has intensified the debate about the presence of the large carnivores as well as about large carnivore policy and management (Sandström, Ericsson, Dressel, Eriksson & Kvastegård, 2014). To some people large carnivores are associated with positive feelings such as interest and joy (Jacobs, Vaske, Dubois & Fehres, 2014). To others the presence of large carnivores is stressful (Manfredo, 2008), and a concern for the perceived safety (Ericsson, Sandström, Kindberg & Støen, 2010). People differ however to what extent they fear attacks on humans, pets or livestock, and the expression of fear varies in strength between people as well as situations (Frank, Johansson & Flykt, in press). Despite these individual differences, fear reactions always reduce capacity to some extent for tasks not directly related to handle the threat (Flykt & Bjärtå, 2008). In this sense, to people who fear large carnivores, the presence of these animals in their vicinity constitute an environmental stressor that may affect quality of life (Moser, 2009), and well-being (WHO, 2014).

A range of potential management measures aiming to reduce the number of interactions between humans and large carnivores exists, e.g. fencing livestock, attractant removal and hunting (Shivik 2014). Despite several evaluations of the effectiveness of management measures, the social or human aspects are seldom addressed (Treves, Wallace, & White, 2009; Maheshwari, Midha, & Cherukupalli, 2014; Frank et al., in press). The literature frequently suggest interventions to address negative attitudes, perceptions, or emotions towards large carnivores, but few studies have assessed the impact of these measures on fear-related variables (Gore, Knuth, Curtis, & Shanahan, 2006; Gusset et. al, 2008). In this paper we systematically review the scientific literature on interventions put forward to address human fear of large carnivores with the aim to summarize the current state of knowledge. The specific objectives are to i) identify the interventions proposed and evaluated, ii) describe the impact of these interventions on human fear responses, and iii) discuss the suitability of the interventions for the management of large carnivores in Scandinavia.

Central concepts: emotion, perception and attitude

In the literature on wildlife management, human fear of animals is inconsistently theoretically defined and operationalized. Therefore we have chosen a broad and inclusive view of the concept of fear in this review as outlined below.

In human-large carnivore interactions, fear is considered as:

- an emotion towards large carnivores (e.g. Jacobs, Vaske & Roemer, 2012a; Johansson, Karlsson, Pedersen & Flykt, 2012; Flykt, Johansson, Karlsson, Lindeberg & Lipp, 2013),
- a component in the (risk) perception of large carnivores (e.g. Gore et al., 2009; Thornton & Quinn, 2009; Zajac, Bruskotter, Wilson, & Prange, 2012)
- a component of attitudes towards large carnivores (e.g. Ericsson & Heberlein, 2003; Espinosa & Jacobson, 2012).

Moreover, from a psychological view, fear of animals that is out of proportion and handicapping is defined as a specific phobia (American Psychiatric Association, 1994).

Fear as an emotion: There is no consensus on the definition of emotion, but three components are commonly accepted by most emotion psychologists, namely the subjective experience (i.e. feeling), physiological reactions, and behavioural expression (Lang, 1997). Some psychologists also include other components for example appraisal (Scherer, 2000; Kappas, 2006) and action readiness/tendencies (Frijda, Kuipers, & ter Schure, 1989; Flykt, 2006). The feeling of fear in studies involving large carnivores are most commonly captured by self-reports as either a general affective experience, valence, or as a discrete emotion of fear (Jacobs, Fehres & Campbell, 2012b). The focus on valence is based on the idea that the unspecific arousal evaluated is dependent on the environmental context, basically claiming that emotions are mental constructs. The idea of discrete emotions presumes dedicated neural programmes for some (basic) emotions. Emotions can be measured as physiological, central nervous, and behavioural changes (see Jacobs et al., 2012 for an overview), where fear is for example expressed as reduced precision in motoric movements (Buetti, Juan, Rinck, & Kerzel, 2012), delayed response times (Lipp & Waters, 2007; Flykt, et al., 2012), and decreased accuracy in decision-making (Flykt & Bjärtå, 2008) in tasks not related to the handling of the threat itself.

Fear and perception: Perception of a large carnivore species is defined in at least two ways in the wildlife management literature: As a general or global concept, encompassing people's relation to large carnivores (Goldman, de Pinho, Perry, 2010; Lescureux et al., 2011). Or, more specifically, to denote a risk perception related to the perceived consequences of an interaction with large carnivores on human health, safety, property, or economy (Gore et al., 2009). The latter concept is theoretically founded in risk psychology, and can be described as the subjective assessment of the probability of a specified type of accident happening and how concerned we are with the consequences (Sjöberg, Moen & Rundberg, 2004). Lay people's perceptions of risk, as opposed to large carnivore experts in the present context, are often heightened for hazards that are perceived as uncontrollable, involve fatal consequences, result from involuntary exposure, not easily reduced or are new or relatively unknown to science (Slovic, 1987). Emotions play a role in risk perception because feelings have an influence on how people perceive a certain risk (Slovic & Peters, 2006), e.g. fear seems to amplify the perceived risk (Lerner & Keltner, 2001). This emotional component is a prominent factor in risk perception, because it serves as a simple decision rule, which is supposed to enhance survival among people (Visschers & Siegrist, 2008). Operationalisations of this concept in studies involving wildlife include self-report questions on fear (e.g. Zajac et al., 2012).

Fear and attitude: Attitudes towards large carnivores are one of the most frequently reported social aspects in human-large carnivore interactions (Manfredo, 2008; Decker, Riley & Siemer, 2012). In social psychology, attitude is defined as a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour (Eagly & Chaiken, 1993). This entity could be a person, object, or action, and the attitude could be explicit, formed from deliberate thought and processing, or implicit, formed more automatically and not necessary conscious. In wildlife research the focus has so far been on explicit attitudes captured by self-reports (Decker et al., 2012). Cognitive, affective, and behavioural processes are involved in the formation of attitudes (Ajzen, 1991). Attitudes towards large carnivores may consequently be inferred from i) *cognitions, beliefs*, about the animals based on direct, or indirect experience with the animals, ii) *affective or emotional experiences* of the animal, the pleasant or unpleasant feeling associated with situations involving the animal, and iii) *past behaviour* – how you

previously have acted in response to the animal. As an example, the emotion of fear, elicited by a potential threat, has been shown to have an impact also outside the time frame of the actual fear responses (e.g. Suinn, Jorgensen, Stewart, & McQuirk, 1971; Huijding, Muris, Lester, Field, & Joosse, 2011), and will thus influence attitude formation.

Animal fear as a specific phobia: In psychology the vast majority of studies on fear of animals concerns snakes and spiders. These are animals with a high prevalence of phobic fear responses (Fredrikson, Annas, Fischer, & Wik, 1996; Gadermann, Alonso, Vilagut, Zaslavsky, & Kessler, 2012). To fulfill the criteria for DSM-IV diagnosis Specific phobia, one should regularly get strong fear reactions to a specific stimulus category which is incapacitating for the daily life (American Psychiatric Association, 1994). Our previous research suggests that fear responses towards large carnivores are commonly not so strong and that the term phobia should not regularly be used for people having fear responses towards large carnivores (Johansson et al., 2012; Flykt et al., 2013; Frank et al., in press). In this review we have excluded interventions developed to address fear or phobia of snakes, spiders, and birds, but have been open towards interventions that address dogs and other animal species (real or imaginary) that are not necessarily large carnivores.

Method

The search protocol

The review process was defined by a literature search protocol developed by an interdisciplinary research group including psychologists and biologists (Pittel, Corcoran & Pillai, 2008). The protocol stated:

- the scope of the literature review: a) internationally available peer-reviewed scientific papers b) in English language c) that suggests and/or evaluates interventions for human-carnivore conflict directly regarding fear or indirectly regarding fear as part of emotion, perception or attitude.
- the purpose of the literature review: to identify the effect of interventions (any action to mitigate human-carnivore conflict); on human (any individual who may be exposed to large carnivores); fear response (self-reported, physiological or behavioural); in relation to large carnivores (any species of large carnivore that attack or threaten humans, with special regards to those present in Scandinavian countries).
- search strategies: Preliminary and thorough searches were made in electronic databases, Web of science (ISI), Scopus, EBSCO (PsycInfo and SocINDEX with Full Text) and Google Scholar. Reference lists of relevant publications were explored in order to find additional relevant literature and in the end of the search period a confirmatory search was made also including private databases.
- eligibility criteria: The focus should be on “fear” of large carnivores and an intervention in response to fear or human-carnivore conflict (with fear components) should be addressed.
- key search terms: The search terms were defined broadly, in four groups – carnivore (e.g. *carnivor**, *wolf*), human (e.g. *people*, *hunter*), fear response (e.g. *emotion*, *fear*), and intervention (e.g. *management*, *information*) (Table 1). The search term *attitude* was not used, since the concept although commonly employed, frequently lack theoretical underpinning in studies on human-large carnivore interactions (Manfredo, 2008; Decker et al., 2012). We therefore chose to focus on those studies on attitudes that specifically reported an emotional or a fear component and hence was identified via these search terms.

Table 1. Search terms and Boolean search strings employed.

Large Carnivore	Fear response	Intervention for human response	Human
Included			
Carnivor* Predator Wolf / Canis lupus Brown bear/Ursus arctos Eurasian lynx/Lynx lynx Wolverine/Gulo gulo	Emotion ¹ Fear ¹ Perception ²	Intervention Mitigation Action Information Management Participation Coexistence Interaction Education Legislation	Human People Person Hunter Farmer Local Community Shepherd Resident Native Stakeholder
Final Boolean search string [template]			
<p>¹(human OR people OR person OR hunter OR farmer OR local OR community OR shepherd OR resident OR native OR stakeholder) AND (carnivor* OR predator OR wolf OR "canis lupus" OR "brown bear" OR "ursus arctos" OR "eurasian lynx" OR "lynx lynx" OR wolverine OR "gulo gulo") AND (fear OR emotion) AND (intervention OR mitigation OR management OR interaction OR action OR information OR participation OR coexistence OR education OR legislation)</p>			
<p>²(human OR people OR person OR hunter OR farmer OR local OR community OR shepherd OR resident OR native OR stakeholder) AND (carnivor* OR predator OR wolf OR "canis lupus" OR "brown bear" OR "ursus arctos" OR "eurasian lynx" OR "lynx lynx" OR wolverine OR "gulo gulo") AND perception AND (intervention OR mitigation OR management OR interaction OR action OR information OR participation OR coexistence OR education OR legislation)</p>			

The search process

Preliminary scope searches were run by combining the search terms in different ways, defining a preliminary Boolean search string. After several scope searches, which yielded relevant hits in several data bases, a final Boolean string was defined (Table 1). The final search string was used in the thorough literature search carried out in February 2014 using the five identified databases (Booth, Papioannou & Sutton, 2012) (see Table 1). The search resulted in 136 relevant hits.

Screening and selection for eligibility of relevant references

The abstracts of the identified papers were read by two researchers. Articles that did not clearly proposed or evaluated an intervention were excluded at this stage. Also articles not written in English, articles only assessing human perceptions of general risks posed by wildlife and articles dealing with general attitudes without including a fear or emotion component (e.g. “general opinion of presence of bears in Norway”) and articles suggesting interventions related to herbivores, were excluded. Full-text of the remaining articles were retrieved and read. Four additional articles were during reading identified in the reference lists, retrieved and assessed for eligibility by full-text. Resulting in a total of 26 references included in the list of eligible articles.

Confirmatory literature search

A confirmatory literature search was run in May 2014. The same Boolean string, slightly modified, was used in this new search (terms fear OR emotion OR perception taken together), with the “human” terms (e.g. people) searched in full text and those within the “carnivore” (e.g. wolf) and “intervention” (e.g. management) dimensions searched in title. The search was run in all five databases previously used, and in a private/restricted database of human-carnivore studies, from The Swedish University of Agricultural Sciences. Fifteen new references were retrieved from the databases and another fourteen from reference lists and related records. These articles were screened in full, but only five of them were found relevant for the review. This gave us the final set of 31 articles for further thematic analysis.

Results

Articles included in the review

The 31 articles were dated from 2001 to 2014, and included two literature reviews and 29 articles published in peer-reviewed international scientific journals, primarily within the fields of psychology, conservation, and human dimensions of wildlife. The majority of studies are based on research in Europe (N=12), and North America (N=10), others are based on research in Africa (N=5), Asia (N=3) and South America (N=2) (Table 2).

Two major groups of articles can be identified. The first group includes articles that describe fear as a factor in human-large carnivore interactions and propose, but does not evaluate interventions. The second group includes studies that evaluate interventions to address human fear/phobia, negative emotion, perception or attitude towards large carnivores (or in some cases other animals).

Group 1: Studies that proposed interventions

The articles in Group 1 propose interventions based on descriptions of human-large carnivore interactions. The articles can serve to identify relevant interventions, but little can be concluded regarding effects of the interventions. The approach, to a varying degree, departs from a management perspective, i.e. fear of large carnivores (or other animals) should be addressed primarily to overcome conflicts between people and large carnivores. The empirical studies are largely based on cross-sectional research designs and correlational analyses in real world contexts. The articles can be further divided into two sub-groups, those that explicitly focus on the concept of fear, *interventions proposed to address fear* (N = 6) (Group 1A, Table 2) and articles that address fear indirectly as an component of perception, attitude and in some cases also behaviour, towards large carnivores, *interventions proposed to address negative perceptions and attitudes* (N = 14) (Group 1B, Table 2).

Interventions proposed to address fear (Group 1A): These studies explicitly assess the public's self-reported fear of large carnivores (brown bears, wolves, lynx and wolverines), mostly in a Scandinavian context. The studies analyze possible antecedents of fear including socio-demographics and personal experience of large carnivores or of living in areas with presence of large carnivores (Røskaft, Bjerke, Kaltenborn, Linnell, 2003; Zimmermann, Wabakken &

Dötterer, 2001), perceived physical condition (Prokop & Fancovicová, 2010) and psychological variables, e.g. appraisal of a potential encounter with the species in terms of the perceived danger, unpredictability of the animal's behaviour and the uncontrollability of the personal reaction (see the Cognitive Vulnerability Model, Armfield, 2006) and social trust in authorities (Cvetkovich & Winter, 2003) (Johansson & Karlsson, 2011; Johansson et al., 2012). Based on the variables explaining variance in self-reported these studies suggest that education (through information campaigns) and experience of the animal species (through exposure activities) would reduce fear of large carnivores among the public (Røskaft et. al, 2003; Johansson & Karlsson 2011, Prokop & Fancovicová, 2010). The study by (Prokop, Usak, & Erdogan, 2011) showed that school children who more frequently watched natural history films and walked in nature were less fearful of wolves. These researchers also suggest educational activities including nature visits for children. Outreach projects involving public and local authorities in an effort to increase social trust is proposed to be a useful tool in reducing people's fear of wolves (Johansson et. al, 2012). Moreover, information and exposure combined with local participation in livestock loss prevention actions and compensation schemes have also been suggested (Zimmerman et. al, 2001).

Interventions proposed to address perceptions and attitudes (Group 1B): The interventions proposed in Group 1B may apply to change perceptions, attitudes or even behaviour rather than specifically address fear. Most of the studies concerns local people in areas with presence of the investigated species. Stakeholder groups are commonly identified and contrasted (e.g. Bisi, Kurki, Svensberg & Liukkonen , 2007; Gusset et al., 2008), and two studies include students (Drahei, Patterson, Rockwood, Guagnano, & Parsons 2013; Hermann & Menzel, 2013). Several different species are considered but approximately half of the studies deal with human interaction with wolves and/or bears, in different parts of the world (Finland: Bisi et al., 2007; Germany: Hermann & Menzel, 2013; U.S: Treves, Naughton-Treves, & Shelley., 2013; Norway: Røskaft et al., 2007; Japan: Sakurai & Jacobson, 2011, Brazil: Sakurai, Jacobson, & Ueda, 2013, U. S: Zajac et al., 2012).

Among the studies that focus upon a general perception of large carnivores a few have applied anthropological or other qualitative approaches, and identified danger and fear as one aspect reflected in local peoples' perception of for example lions and lynx (Goldman et al., 2010;

Lescureux et al., 2011). Other studies have used quantitative approaches and considered the fear, threat or danger associated with the animal as a risk perception (Thornton & Quinn, 2009) also integrating fear-related variables in models of wildlife acceptance (Zajac et al., 2012). Yet other studies have primarily aimed at understanding public attitudes towards large carnivores. Here fear has been conceptualized as the emotional or evaluative component of an attitude referring to Ajzen and Fishbein's (1980; 1991) Theory of Reasoned Action and Theory of Planned Behaviour (Sakurai & Jacobson, 2011; Sakurai et al., 2013; Treves et al., 2013). Fear has also been integrated as an additional part of Protection Motivation Theory (Gardner & Stern, 1996) aiming to understand people's pro-environmental behaviour (Hermann & Menzel, 2013). However fear as part of a perception or attitude has sometimes been introduced without any clear reference to social science theoretical basis (Bisi et al., 2007; Draheim et al., 2013; Sponarski, Semeniuk, Glikman, Bath, & Musiani, 2013; Bhattacharjee & Parthasarathy, 2014).

Educational efforts, such as campaigns and outreach projects providing information and training to increase people's knowledge of the species' biology, behavior, habitat and potential benefits, as well as behavioral strategies for humans to avoid conflict, are by far the most commonly proposed interventions. A few studies propose education as a universal intervention to prevent human-large carnivore conflict and consequently also to reduce perceived risk and feelings of fear (Røskoft, Händel, Bjerke, & Kaltenborn, 2007; Zajac et al., 2012). Røskoft et al. (2007) suggests that education including information about benefits of carnivores as well as loss prevention may reduce fear but also argues that education should be combined with other interventions if attitudes should be successfully addressed.

Some authors propose collaboration between authorities and locals (e.g. villagers, hunters or farmers) and local participation in management as means to develop trust and prevent conflict (Bisi et al., 2007; Goldman et al., 2010; Lescureux et al., 2011; Sakurai et al., 2013; Draheim et al., 2012; Bhattacharjee & Parthasarathy, 2014). In a Masaai community in Kenya, Goldman and colleagues (2010) suggested collaborative interactions, based on Masaai's narratives about the problem, between community and conservationists in participatory projects to solve human-lion conflicts. Financial incentives or loss compensation are also proposed as measures complementing education and collaboration to support favourable attitudes or acceptance of large carnivores (Bisi et al., 2007; Thornton & Quinn, 2009; Sakurai & Jacobson, 2011). Financial schemes are however also criticized for being ineffective (Røskoft et al., 2007) since

negative attitudes towards wild predators may have other reasons than purely financial (Lescureux et. al, 2011; Goldman et. al, 2010). A recent study in India emphasizes the use of financial compensation as a short-term measure in combination with livestock protection and education to increase awareness, as tools to reduce human-leopard conflicts (Bhattacharjee & Parthasarathy, 2014).

Group 2: Studies that evaluates interventions

The second group of articles includes studies that evaluate interventions to directly or indirectly address human fear. These articles can also be further divided into two sub-groups: *studies that evaluate the impact of an intervention on fear* (N=4) (Group 2A, Table 2) and *studies that evaluate the impact of an intervention on perception or attitude* (N=7) (Group 2B, Table 2) and in some cases also behaviour towards large carnivores. These two groups largely differ in their point of departure, theoretical approach, research design, and species investigated.

The effect of interventions on fear (Group 2A): We found no articles specifically evaluating the effect of interventions directly addressing human fear of large carnivores. Instead the articles in Group 2A depart from a therapeutic perspective and aim to understand and change human fear responses towards dogs or hypothetical creatures/beasts. Theoretically the studies take a behavioural learning approach amongst others referring to Rachman (1977) who distinguishes between three different etiological pathways for phobias: i) having been attacked or directly exposed to an animal (direct conditioning), ii) having observed another person being attacked/harmed (vicarious acquisition), and/or iii) having been informed by a credible source that specific animals are dangerous in some respect (i.e. instruction). These studies use experimental research designs in laboratory environments (Field, Argyris & Knowles, 2001; Hoffman & Odendaal, 2001; Hoffmann & Human, 2003) or school settings (Muris, Bodden, Merckelbach, Ollendick, & King, 2003). Field et al. (2001) found that among children positive and negative information about novel stimuli (a monster doll) changed their fear beliefs about the doll. Positive information had little effect on self-reported fear beliefs, the fairly neutral initial fear beliefs were only slightly lowered after positive information, whereas negative information had a substantial effect in increasing fear beliefs. Direct verbal information from an adult was more efficient than observational learning, i.e. vicarious acquisition (watching a film of a woman

interacting positively or negatively with the doll). Similarly Muris et al. (2003) assessing children's fear of an unknown (doglike) imaginary creature before, immediately after, and one week after positive or negative information had been presented, found that negative information increased self-reported fear of the beast, as well as fear of dogs and predators, and positive information decreased the fear, immediately and one week after.

Hoffman and Odendaal (2001) evaluated systematic desensitization (exposure to sequence of phobia stimulus, e.g. dogs) and instructional learning (pictures of fighter dogs and explanation on how to act in an encounter) among women with dog phobia. The evaluation included physiological, observational and self-report measures of fear. The participants in the treatment group could walk closer to dogs and reported less anxiety after the intervention, whereas no effect could be identified for the physiological measure. No significant changes were reported in the control group. A follow-up eight months later indicated a significant improvement in interactions with dogs for 75% of the participants in the treatment group (Hoffman & Human, 2003).

The effect of interventions on perception and attitude (Group 2B): In this group all articles have a management perspective, they show a high diversity in theoretical and conceptual approaches, but all the interventions are evaluated in field settings. Most studies are carried out in the US with a focus upon black bears (Dunn, Elwell & Tunberg, 2008; Gore Knuth, Scherer & Curtis, 2008; Gusset et al., 2008; Baruch-Mordo, Breck, Eilson, & Broderick, 2011; Slagle, Zajac, Bruskotter, Wilson, & Prange, 2013). The exceptions are Espinosa and Jacobson (2012) who evaluate interventions in relation to Andean bear in Ecuador and the study by Meguro & Inoue (2011) that concerns a wildlife program in Kenya.

Gore et al (2008) departing from the Elaboration Likelihood Model (Petty & Cacioppo 1981) found in a quasi-experimental study that various types of written information about behaviour that can reduce human-black bear interactions, (e.g. risk-reducing behaviour) could change risk perceptions via peripheral processing of information, but were not likely to change behaviour. Dunn et al. (2008) referring to Theory of Planned Behaviour (Ajzen, 1980) found that written information; brochures, posters, and signs, providing knowledge about bear safety including black bear attractants and appropriate behaviour when encountering a black bear, contributed to increased knowledge, i.e. changed beliefs. In a study of the effects of different

information packages on black bears in an area with a recently established bear population, Ohio (USA), participants who were informed by a written online message on how to avoid bear problems (by for example bringing birdfeeders or garbage cans inside during the night) reported 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 (Slagle et al., 2013).

Baruch-Mordo et al. (2011) evaluated the BeAware campaign including a combination of written educational material (signs at dumpsters informing about bears feeding from garbage) and personal contact with verbal information about how to reduce black bear attractants and conflict, and proactive enforcement (i.e. daily patrolling and application of further measures in areas with dumpsters). No significant effect could be identified of the educational part despite the presence of factual, emotional, moral and nonverbal elements in the information, but the proactive enforcement was efficient in changing people's preventive behaviours (Baruch-Mordo et al., 2011). Espinosa and Jacobson (2011) evaluated a long-term educational program aimed to increase knowledge, change attitudes and strengthen behavioural intentions towards conserving the Andean bear (*Tremarctos ornatus*) habitat. Face to face surveys and group discussions suggested that the local people's knowledge somewhat increased, behavioural intention became more positive, but attitudes towards the presence of bears became more negative.

Gusset and colleagues (2008) surveyed the effect of an educational program on wild dogs in South Africa. The program was found successful in changing people's opinion of wild dogs. However negative attitudes towards the dogs increased and their perceived value for local ecotourism decreased from the end of the one-year program to three years later. Meguro and Inoue (2011) analysed the impact of efforts of a community-based conservation project in Kenya aiming to increase the understanding of the value of wildlife to the local ecosystem and thereby more favourable attitudes towards wildlife conservation. The evaluation suggested that awareness of the economic benefits of wildlife conservation had increased.

Table 2. List of articles included in the review presented in chronological order of publication year. Articles in bold have evaluated the intervention/s discussed.

Year	Author/s	Title	Journal	Intervention	Group
2001	Field et al.	<i>Who's afraid of the big bad wolf: a prospective paradigm to test Rachman's indirect pathways in children.</i>	Behaviour Research and Therapy	Information about animal Modelling of behaviour	2A
2001	Hoffman & Odendaal	<i>The effect of behavioral therapy on dog phobia response patterns</i>	Anthrozoös	Behavioural therapy, including animal exposure Modelling of behaviour	2A
2001	Zimmermann et al. <i>review</i>	<i>Human-carnivore interactions in Norway: How does the re-appearance of large carnivore affect people's attitudes and levels of fear?</i>	Forest, Snow, Landscape Research	Information campaign Exposure via presence of animal in vicinities Local participation in monitoring Livestock loss prevention Financial compensation	1A
2003	Conforti & de Azevedo	<i>Local perceptions of jaguars (panthera onca) and pumas (puma concolor) in the Iguacu National Park area, south Brazil.</i>	Biological Conservation	Long-term education for children Local participation and economic profit via ecotourism Participation in planning and implementation Financial compensations for prevention of predation	1B
2003	Hoffman & Human	<i>Experiences, characteristics and treatment of women suffering from dog phobia.</i>	Anthrozoös	Behavioral therapy, including animal exposure Modelling of appropriate behaviour	2A
2003	Muris et al.	<i>Fear of the beast: a prospective study on the effects of negative information on childhood fear</i>	Behaviour Research and Therapy	Information about animal Animal exposure	2A
2003	Røskaft et al.	<i>Patterns of self-reported fear towards large carnivores among the Norwegian public</i>	Evolution and Human Behavior	Education Exposure via close contact with carnivore habitat	1A
2007	Bisi et al.	<i>Human dimensions of wolf (canis lupus) conflicts in Finland</i>	European Journal of Wildlife Research	Information Power to local authorities & NGO's Improvement of compensation system Damage prevention actions Hunting	1B
2007	Røskaft et al.	<i>Human attitudes towards large carnivores in Norway</i>	Wildlife Biology	Education on benefits of having large carnivore nearby (relevance, number and distribution and prevention to loss).	1B



2008	Dunn et. al	<i>Safety education in bear country: Are people getting the message?</i>	Ursus	Information by brochures, posters adhesive signs with messages about how to be safe around animal.	2B
2008	Gore et al	<i>Evaluating a conservation investment designed to reduce human-wildlife conflict</i>	Conservation Letters	Information -Peripheral communication material: posters, magnets, billboard information, lawn signs -Centrally oriented communication material magazine, article, brochure	2B
2008	Gusset et al.	<i>Conflicting human interests over the re-introduction of endangered wild dogs in South Africa</i>	Biodiversity Conservation	Education Co-management Financial incentive schemes	2B
2009	Thornton & Quinn	<i>Coexisting with cougars: public perceptions, attitudes and awareness of cougars on the urban-rural fringe of Calgary, Alberta, Canada</i>	Human Dimensions of Wildlife	Proactive education Compensation programs	1B
2010	Goldman et al.	<i>Maintaining complex relations with large cats: Maasai and lions in Kenya and Tanzania</i>	Human Dimensions of Wildlife	Collaborative interactions between conservationists and community	1B
2010	Prokop & Fancovicová	<i>Perceived body condition is associated with fear of a large carnivore predator in humans</i>	Annales Zoologici Fennici	Information about animal's role in ecosystem Exposure by visits to habitat	1A
2011	Baruch-Mordo et. al	<i>The Carrot or the Stick? Evaluation of education and enforcement as management tools for human-wildlife conflicts.</i>	PLOSone	Education Signs on site + website link Personal home visits + educational material Law enforcement Daily patrolling Patrolling with notice application	2B
2011	Johansson & Karlsson	<i>Subjective experience of fear and the cognitive interpretation of large carnivores</i>	Human Dimensions of Wildlife	Communication based on awareness of the cognitive interpretation of the animal Exposure to animal to enable people to learn more about own reactions.	1A
2011	Lescureux et al.	<i>Fear of the unknown: local knowledge and perceptions of the Eurasian lynx Lynx lynx in western Macedonia</i>	Fauna & Flora International, Oryx	Education Local involvement in cooperative research program	1B
2011	Meguro & Inoue)	<i>Conservation goals betrayed by the uses of wildlife benefits in community-based conservation: the case of Kimana Sanctuary in Southern Kenya.</i>	Human Dimensions of Wildlife	Community-based conservation program	2B
2011	Prokop et al.	<i>Good predators in bad stories: cross-cultural comparison of children's attitudes towards wolves</i>	Journal of Baltic Science Education	Information natural history films Exposure by nature walks in habitat	1A



2011	Sakurai & Jacobson <i>review</i>	<i>Public perceptions of bears and management interventions in Japan</i>	Human–Wildlife Interactions	Education and outreach programs Compensation programs	1B
2012	Espinosa & Jacobson	<i>Human-wildlife conflict and environmental education: evaluating a community program to protect the Andean Bear in Ecuador</i>	Journal of Environmental Education	Five year educational and collaborative program Workshops Radioprograms Newsletter Teacher training Training of community members as para-biologists	2B
2012	Johansson et al.	<i>Factors governing human fear of brown bear and wolf</i>	Human Dimensions of Wildlife	Trust building actions authorities-locals Exposure under controlled conditions and guidance.	1A
2012	Zajac et al.	<i>Learning to live with black bears: A psychological model of acceptance</i>	Journal of Wildlife Management	Information focusing on building trust Increasing personal control over human-carnivore conflict	1B
2013	Draheim et al.	<i>Attitudes of college undergraduates towards coyotes (canis latrans) in an urban landscape: management and public outreach implications</i>	Animals	Outreach program and education focusing on what to do when encountering the animal	1B
2013	Hermann & Menzel	<i>Predicting the intention to support the return of wolves: a quantitative study with teenagers</i>	Journal of Environmental Psychology	Education that include affective views in socio-scientific issues	1B
2013	Sakurai et al.	<i>Public perceptions of risk and government performance regarding bear management in Japan</i>	Ursus	Education Participation in reducing conflicts to increase perceived control,	1B
2013	Slagle et. al	<i>Building tolerance for Bears: A communications experiment</i>	Journal of Wildlife Management	Information and outreach material about benefits of animal and on how to avoid conflict	2B
2013	Sponarski et al.	<i>Heterogeneity among rural resident attitudes toward wolves</i>	Human Dimensions of Wildlife	Education dispelling myths about the animal and clarify policy	1B
2013	Treves, Naughton-Treves & Shelley	<i>Longitudinal analysis of attitudes toward wolves</i>	Conservation Biology	Regulated hunting	1B
2014	Bhattacharjee & Parthasarathy (2014)	<i>Coexisting with large carnivores: A case study from western Duars, India</i>	Human Dimensions of Wildlife	Awareness program on understanding human-animal conflict Compensation Translocation Habitat restoration Livestock protection.	1B

Discussion

This systematic review shows that the internationally available scientific peer-reviewed literature provides many ideas for interventions to target the human dimension of human-large carnivore conflicts. However the data on the effects on fear of such interventions are scarce. Most of the interventions suggested or evaluated by the studies in the review included information and education, and mixed interventions combining information and education with exposure to species in the wild or in a laboratory, public participation and collaboration in species management and conservation, and/or financial schemes. Our perspective was on the individual level focusing on fear responses to large carnivores using a very broad definition also including fear as a component of perception and attitude. Still few studies, in total 11, that scientifically evaluated interventions relevant to human fear of large carnivores could be identified. None of the studies specifically tested the effect of an intervention on fear of large carnivores. This result is quite surprising considering the public concern about the presence of large carnivores in their vicinity (Ericsson et al., 2010). It might be that our search strings were not efficient enough, but we searched several databases, covered reference lists, and deliberately made the search string broader than first intended in the confirmatory search. Our results are however in line with previous studies concluding that evaluations of interventions addressing human – large carnivore interactions are scarce (Dunn et al., 2008; Sakuri & Jacobson, 2011), and that the existing studies often do not capture relevant outcome measures for human dimensions factors (Gore et al., 2006). We can only but agree that evidenced based knowledge is lacking and urgently needed (Ericsson & Heberlein, 2003; Baruch-Mordo et al., 2011). Below, the different types of interventions are discussed in relation to possible effects on human fear.

Information and education

Information and education is relatively easy to develop and implement and is also the universally most frequently suggested and tested intervention to change individuals' emotions, perception or attitudes towards large carnivores (Decker et al., 2012). The experimental studies in this review suggest that verbal information may have an impact both in positive and negative direction on children's emotions (Field et al., 2001; Muris et al., 2003). Studies on dog phobia show similar findings, i.e. providing phobic individuals with accurate information about the animal and

training them how to react to the dog through direct contact reduced fear and increased coping with dog encounters (Hoffman & Odendaal, 2001; Hoffmann & Human, 2003).

In field studies, information and education about the biology and the habitat of the animal, as well as strategies to deal with and avoid conflict (e.g. remove food attractants), have also been successful in changing people's risk perception (Gore et al., 2008), increasing knowledge and improving conflict avoidance behaviours (Dunn et al., 2008; Espinosa & Jacobson, 2011; Slagle et al., 2012), but the effect on attitudes seems less evident (Gusset et al., 2008; Espinosa & Jacobson, 2011). The experiment by Slagle et al. (2012) stressed the importance of providing information on benefits to humans of wolves to increase an accepting attitude, but it is difficult to infer what the specific effect on fear responses would be. There is a large variation in theoretical departures to fear as well as design and distribution, context, and time frame of the interventions. Several information channels are sometimes simultaneously introduced and evaluated. Moreover information/education are often combined with other interventions. This lends many questions with regard to the set-up of the intervention. Taken together, a tentative conclusion is that information might have a potential to change fear responses. One should however be aware that information and education might go in both directions and must therefore be highly context specific (Field et al., 2001). Verbal information about non-harmfulness of evolutionary fear-relevant feared animals such as snakes and spiders is not expected to have any impact on phobic responses. The reason for this is that this kind of processing would not be compatible with the information processing system maintaining the fear reactions (LeDoux, 1996). One relevant question will then be if information about non-harmfulness can be efficient in reducing fear for large carnivores with a shorter common evolutionary history with humans. Another remaining question is to what extent the efficiency of information and education is dependent on the combination with exposure, i.e. personal direct experiences and role modelling of relevant behavioural strategies when exposed to large carnivores.

Animal and habitat exposure

Proposals of education programs sometimes suggest the use of animal or habitat exposure to increase predictability of animal behaviour and decrease uncontrollability of human reaction during an encounter (Røskaft et al., 2003; Johansson et al., 2011; Prokop & Fancovicová, 2010),

but no studies testing the effect of exposure to large carnivores were found. In an experimental study, Randler et al (2012) showed that fear of mice, snails and wood lice decreased among school children who were exposed to these animals in class. Exposure is also the key to treatment of animal phobia. The treatment of specific phobia that has proved efficient is exposure in vivo together with modelling (Öst, 1988; Hellström & Öst, 1995). In explicit, exposure to the actual object of fear and using behaviours provided by a model to get a behaviour repertoire to use when confronted with the feared object. The modelling aspect seems to be an important part not only for the modelling itself, but also because the presence of other individuals might be a social support (Hellström & Öst, 1995). Much of this research on interventions is concerned with snake and spider fear. Studies on dog phobia may have shown similar findings, i.e. providing phobic individuals with accurate information about the animal and training them how to react to the dog through direct contact reduced fear and increased coping with situations of dog encounter (Hoffman & Odendaal, 2001; Hoffmann & Human, 2003). Habitat exposure has not been sufficiently evaluated to draw any further conclusions. Further studies on exposure to large carnivores and their habitats also testing for the combined effect with modelling of appropriate behaviour close to large carnivores would be needed.

Collaboration and participation

The large carnivore management literature mostly stress mixed interventions combining education-information and public participation and/or financial schemes. Stimulating public participation (i.e. co-participation) is increasingly referred to as a complement to education also specifically in relation to fear (Zimmerman et. al, 2001; Johansson et. al, 2012). This may be especially relevant in situations where lack of trust in managing authorities is associated with fear responses (Johansson et. al, 2012; Zajac et al., 2012; Slovic & Peters, 2006). Participation and collaboration is however in the Scandinavian context primarily introduced to address conflicts between locals and authorities or between stakeholder groups (Matti & Lundmark, in press). In other parts of the world educational programs have integrated collaboration and participation (i.e. authorities/associations and public working together in management/conservation actions). For example the program developed to conserve an Andean bear habitat also included participatory components, recruitment and training of community members to work as para-biologists to assist in the research. Expected effects were obtained for

knowledge and intention, but not attitudes (Espinosa & Jacobson, 2011). Another example is the community-based conservation project evaluated by Meguro and Inoue (2011) showing that people's opinions about wildlife were more positive after the project's implementation for other reasons than conservation itself, mainly economic benefits resulting from the project's existence.

Financial incentives

Financial incentives can aim at compensating for direct costs or overcompensate to provide benefits of large carnivore presence (Zabel & Holm Muller 2008). In terms of human fear, the result may be a potential for exposure and desensitization that had otherwise not been possible. Financial incentives in this sense have the potential of an indirect effect on human fear on a large scale, temporally and spatially. However, the feature of exposure under controlled condition is in reality lacking. Despite the short time span of the analysed studies (13 years), there is a decreasing tendency in using financial schemes (e.g. compensation, incentives) as a short-term measure, combined with long-term education-information (e.g. campaigns, information signs), to overcome people's fear and change negative perceptions of large carnivore. Whether the main reason for this is that scientists believe that there is not much left to investigate regarding the effect of financial incentives or because of other interventions gaining popularity is unknown. The most recent studies have emphasized the importance of combining education with co-participation, and the few who still rely on compensation as a complementary short-term measure suggest it to be integrated with public participation in a conflict mitigation process. Interestingly, compensation and other financial schemes (e.g. incentives for species conservation) as a complement to information campaigns are used in Asia (Sakurai & Jacobson, 2011; Bhattacharjee & Parthasarathy, 2014), whereas in South America and Africa these are supplemented or replaced by collaborative actions in which public and authorities work together to mitigate conflicts (Conforti & de Azevedo, 2003; Gusset et al., 2008). A recent study on human-leopard coexistence in rural India proposed the use of financial compensation to affected areas and animal translocation as short-term measures to end the conflict, but only if combined with long-term strategies such as accurate education on preventive actions in order to increase awareness of the conflict and how to cope with it (Bhattacharjee & Parthasarathy, 2014). Zimmerman et al (2001) proposed compensation schemes in the Scandinavian context, but no evaluations with regard to the effect on fear related variables are available.

Conclusions

At present there seems to be two separate research lines discussing interventions directed towards human fear of large carnivores. One line departs from the human individual and applies psychological perspectives. These studies use well-founded theoretical frameworks from social psychology, risk psychology, environmental psychology, emotion psychology and analogous operationalization of fear making it possible to grasp the effect of the intervention. Sometimes these studies lack validity, both with regard to the setting and the animal, thereby reducing the generalizability to the context of large carnivores in the wild. The second line has a clear management approach departing from conservation or management goals for the large carnivores. These studies rely on real cases of human –large carnivore interactions and provide thorough contextual descriptions and regardless of the suggested interventions, suggest that each is specific to the context in which it is applied, the people (e.g. villagers, farmers or hunters) and animal species involved (e.g. bears, wolves, wild dogs). The theoretical foundation is however often limited to a brief reference to perception or attitude, and fear is generally not specifically addressed. Jacobs et al, (2012) also noted that a majority of studies on human emotion towards large carnivores have gaps in the conceptualization and operationalization of emotion. The interventions proposed and evaluated may be well designed for the context, but it is hard to draw conclusions regarding its' effect on human fear or what possible antecedent of fear could be expected to change. In further research evaluating interventions to address human fear of large carnivores it would be desirable to design studies that use a strong theoretical approach to study ecologically valid cases (see for example Gore et al., 2008; Espinosa & Jacobson, 2012; Slagle et al., 2013), but preferably also integrate conceptualizations and assessment that directly focus on fear (Johansson et al., 2012; Jacobs et al., 2012; Flykt et al., 2013), as well as the use of control or reference groups (e.g. Hoffman & Odendaal, 2001; Muris et al., 2003; Slagle et al., 2013). This review shows that research on interventions aiming at reducing human fear of large carnivores is scarce, based on limited or diverging theoretical foundations and often conducted in a way that does not allow conclusions about the effects.

Implications for management

The review highlights four major categories of interventions. Each one of these might have a potential to reduce fear related variables, but the present evidence of the effect of these interventions on fear of large carnivores is scarce and as described above partly contradicting.

Information/education has the advantage of being easily implemented, practically feasible, relatively cheap, and can reach a large number of people. Information and education are commonly proposed and used and would therefore benefit from more knowledge about the actual effects. Managers should be aware that the effects of interventions based on information/education can go in both directions i.e. positive information may reduce fear and negative information may increase fear. Interventions must therefore be highly context specific and designed according to communication strategies appropriate for the target group and the conflict it is supposed to mitigate. That is, information intended to reduce fear might have the opposite effect if not being carefully considered. However, introduction of interventions based on providing information seems to be appreciated most people (Frank et al. in press).

Experiences from studies on fear and phobia of other animals support that exposure might be a relevant intervention to address fear of large carnivores. Exposure in vivo as an intervention for large carnivores might not be easy, but is possible. Exposure under controlled conditions combined with modelling of appropriate behaviour in a situation perceived as threatening in a laboratory environment should not be considered similar to exposure by random encounters that may occur when there are large carnivores in the vicinity of people. Moreover frequent encounters with the feared carnivore without any aversive consequence would be needed. Animal exposure has practical limitations and may be costly and not suitable for reaching large numbers of people. In addition animal exposure can have animal welfare and ethical implications, if the exposure influence or disturbs the large carnivores. Present technology such as virtual reality also opens for new possibilities to explore the potential of exposure. The effect of habitat exposure is not yet established, but it would have less practical limitations because it does not involve the large carnivore and therefore should be further explored.

Participation and collaboration may take many different forms. It is usually directed towards a group of people rather than the individual and the examples included in the review do not directly include assessments of fear related variables. Collaboration and participation is

commonly applied and practically feasible, but can be expensive to implement and seems most suitable for specific target groups. Projects that could foster trust and/or offer opportunities for exposure together with role-modelling of appropriate human behaviour close to large carnivores (see above), could possibly contribute to reduced fear beyond information and exposure, but so far no evidence are available.

Also the examples of financial incentives in the review lack evaluations on fear related variables and no conclusions can be drawn. It is practically feasible, but may be associated with high costs if directed towards larger groups of people. Financial incentives are currently used in Scandinavia as a way of facilitating living in an area with large carnivores, and thus increasing the potential for the public to be exposed to large carnivores and their habitat. However this approach is as described above not comparable with exposure under controlled conditions.

The limited number of evaluations makes it difficult to rely on the present scientific findings when designing appropriate interventions to address human fear of large carnivores. It would be advisable that any further large scale interventions launched to meet the public's fear of large carnivores go hand in hand with a thorough evaluation based on appropriate theoretical approach and relevant outcome variables. These evaluations should preferably be part of an adaptive wildlife management scheme where managers and researchers in close cooperation design the evaluation of an intervention before it is launched, evaluate the effect and if necessary accordingly adjust the intervention.

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