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Predators, stewards, or sportsmen – how do Norwegian hunters perceive their role in carnivore management?

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Hunting is increasingly seen as a management strategy in regulating large carnivore populations and reducing conflicts with human interests. A central theme in the carnivore debate is the role of the hunter in simulating natural predation and structuring of ecosystems. We surveyed a sample of Norwegian hunters to examine how they see their role in the ecosystem and to what extent environmental attitudes affect their perceptions of key functions of hunting. The hunters share a positive perception of themselves as responsible and law-abiding actors and important stewards of the ecosystem of great importance to wildlife management. Factor analysis revealed four underlying dimensions of the hunters' perceptions of salient functions of hunting related to management, recreation, predation, and poaching. Environmental orientation was shown to affect perceptions of recreational and experiential functions of hunting, views on poaching, and perceptions of the stewardship role of hunters. Data on the multifaceted role of hunters can be important in the development of a socially legitimate hunting ethic in the increasingly complex sociopolitical landscape of carnivore management.

Keywords: hunters; hunting functions; carnivore management; ecosystem stewardship

1. Introduction

Many wildlife populations in Europe, and especially large carnivores (Musiani & Paquet 2004; Linnell & Boitani 2012; Slagle et al. 2012), are increasing as a response to protection and other management practices. This challenges policy-makers and managers to develop socially acceptable ways of regulating controversial species. Understanding the functions of hunting and how hunters perceive their role as ecosystem agents is becoming increasingly important as hunting more strongly emerges as a strategy in the sociopolitical landscape of carnivore management (Stedman et al. 2004; Nilsen et al. 2007; Karanth & Chellam 2009). Achieving a successful hunting ethic is a question of developing an ethic shared by a sufficiently large part of the public that elicits cultural, political, and economic support for wildlife management (Peterson 2004). It must also be logical in the sense that it fits sensibly into the current wildlife management models balancing diverse hunter motivations with other ecosystem management goals. Hunters interact in a number of ways with the environment, and can take the roles of predators, stewards, sportsmen or harvesters or any combination of these, and their self-perceptions have implications for how they exercise hunting and their attitudes toward wildlife management. However, their roles and actions will always be subject to interpretation by the public at large in the context of current hunting ethics. For instance, if we want public acceptance for a management strategy that supplants declining carnivore numbers with human hunters for the purpose of structuring ecosystems, human hunters must prioritize harvest strategies that fulfill these ecologically motivated management goals even if they conflict with their own hunting preferences. Furthermore, carnivores are interpreted as negative as well as positive symbols of desired landscapes (Treves & Karanth 2003; Treves et al. 2004; Treves 2009). Hence, hunting carnivores may be perceived as a 'right' as well as a 'wrong' thing to do, depending on whether carnivores are seen as legitimate and appropriate elements in contemporary environments. This implies that it is just as important to consider how hunters and non-hunters perceive their role as how their role is actually played from an ecological viewpoint (Berger 2005; Andersen et al. 2007).

Large predators and human hunters have different reasons for hunting and can structure ecosystems differently (Sergio et al. 2008). Human hunters tend to exploit large proportions of prey populations, and target large, reproductive–aged adults. Historically, this has at times led to wildlife harvests far exceeding sustainable yield and frequent episodes of extinction, also among indigenous human populations (Webster & Webster 1984; Hay 1994). Hence, human hunter harvest selection may be quite different from large predator harvest selection which is not directed by human needs or interests, but regulated by ecological functions (Darimont et al. 2009, Mysterud & Bischof 2010).

In a strictly functional sense, human hunters are top predators with the capability of devising an array of strategies and techniques for harvesting wildlife prey. They are also potentially capable through research-based

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information and policy of estimating carrying capacities, sustainable yield, and predictable impacts of hunting on prey populations (Treves 2009; Treves & Martin 2011). Human hunters and their constituencies also have the prerogative of deciding and prioritizing what should be the justification for hunting so that it is deemed publicly acceptable. In other words, the ultimate power to decide the relative importance of justifications such as maintaining some kind of ecological balance between species, harvesting meat and food sources, recreational enjoyment, and/or reducing conflict between livestock and wild game.

However, little if any research has looked into hunters' self-perceptions. In this paper, we focus on how human hunters perceive their role in the ecosystem, and to what extent environmental attitudes affect their perceptions of the key functions of hunting (Fischer et al. 2013). The novelty of this study is that we more systematically identify hunters' self-perceptions, evaluate key dimensions of hunter functions, and discuss how this can inform carnivore management. We assume that hunters, like most other groups of recreationists hold a diversity of environmental attitudes, and we envision that concern for the environment may affect how they perceive different aspects of hunting and the role hunting plays in wildlife management and environmental stewardship. We specifically ask (1) what the hunters consider to be salient reasons and functions for hunting, (2) what is their degree of environmental orientation in terms of general environmental beliefs, and (3) to what extent does environmental orientation affect the perception of key hunter functions.

1.1 Literature review

Humans have been hunter-gatherers for most of human history (Hill 1982; Gat 2000; Kruuk 2002), and hunting has been key to human development and survival (Hawkes et al. 1997). However, while humans today hunt for a variety of reasons, if excluding indigenous populations, most of it is carried out in some kind of recreational context (Ericsson & Stedman 2005; Wynveen et al. 2005; Radder & Bech-Larsen 2008; Shresta et al. 2012) and only smaller groups of people depend directly on hunting for sustenance. Modern day hunters are motivated by such diverse reasons as nature experience, thrills and skills, social bonding with peers, acquiring food, and identifying with primeval history (Kruuk 2002). Earlier research has investigated the human dimensions of hunters such as segments, opportunity preferences and attitudes toward management (e.g. Floyd & Gramann 1997; Daigle et al. 2002; Ericsson & Heberlein 2003; Stedman et al. 2004; Needham et al. 2007; Ward et al. 2008; Kaltenborn et al. 2012). Studies also show that hunting is motivated by a range of incentives such as social bonding with peers, nature experience, skill development and sportsmanship, and subsistence (Hrubes et al. 2001; Radder & Bech-Larsen 2008; Reis 2009). Research on hunter motivations has also provided knowledge about outcomes and willingness to comply with management actions so that hunters are sufficiently satisfied with their opportunities (Cornicelli & Grund 2011; Shresta et al. 2012).

Hunters have a complex relationship with carnivores compared to other stakeholder groups with a non-consumptive connection to wildlife (Ericsson et al. 2004; Musiani & Paquet 2004; Kaczensky et al. 2004). Some studies suggest that hunters are in strong opposition to carnivore conservation, especially since they kill hunting dogs, and they are seen as competitors for shared game (Skogen & Krange 2003; Bisi et al. 2010). However, other studies show that hunters also respect the large carnivores and see them as powerful symbols of wilderness and an important connection with the landscape (Kruuk 2002; Heberlein & Ericsson 2008; Reis 2009).

Historically, the acceptance of hunting is linked to how hunters and non-hunters have shared common symbolic views of hunting (Dizard 2003). The view of hunters held by society at large has diversified considerably over the last few decades, and traditional hunting ethics have been challenged. One dominant idea in the hunting discourse has indeed been that hunters are predators and that hunting is the only way for them to enter nature as an interactive participant and not just as a spectator, leading to the view that hunting is a 'right' thing since it is a natural human role (King 1991; Swan 1995; Dizard 2003). Controversies around the morality of hunting generally focus on the sporting values of hunting, but as List (1998, 2004) point out, sport hunting is not a morally distinct type of hunting unless there is a reference to the goods hunting produces, and also that its largely futile and historically suspect to draw a moral distinction between sport hunting and subsistence hunting. This view is also reflected in Leopold's much cited 'land ethic' (Leopold 1949; Naess 1973; Callicott 1980) where hunting is construed as 'right' to the extent that it contributes to preserving the 'integrity, stability and beauty' of the biotic community. The power and the weakness of this perspective are that it allows for personal meanings and interpretations, but defies universally accepted definitions of terms (Peterson 2004).

2. Methods and data collection

2.1 Sample

The hunter population for this study was the register of the Norwegian National Hunting and Fishermen's Association which contains all persons that have completed the mandatory hunting education program. This organization currently has around 120,000 members (anglers and hunters combined). Not knowing exact what response rate we could expect, we roughly estimated that we would need approximately 2000 potential respondents in order to have a sufficiently large net sample that was also representative of the hunter population. A total of 2117 persons were randomly recruited by telephone, and then sent an e-mail with a link to an Internet-based survey. Two reminders produced only 635 completed surveys. The relatively low response rate may partly be explained by a delay between the

recruitment phase and the survey. However, the response rate is more or less in line with average figures for currently mail- and Internet-based surveys (Dillman et al. 2009; Lindhjem & Naverud 2011). Using an Internet-based survey, we expected older age groups to be underrepresented since older people use computers and Internet services to a lesser extent. Consequently, we mailed a printed version of the questionnaire to a random sample of 200 persons (considered to be a sufficient number to allow age-corrected subsampling) that were 65 years or older from the same register. This yielded 105 completed questionnaires. In order to achieve a sample that was representative of the age structure in the national register, we then randomly sampled 37 of these respondents and added them to the main sample which then totaled 672 respondents.

2.2 Survey, constructs, and analysis

Hunter roles and functions were measured using a battery of 21 items tapping different aspects of hunting behavior, outcomes, and image (Table 1). The items were developed from a combination of informal talks with hunters, various pieces of research on hunter characteristics (e.g. Hrubes et al. 2001; Needham et al. 2007; Norton 2007) and research on ecological functions and conservation aspects of carnivores (e.g. Sergio et al. 2008; Treves 2009; Ritchie et al. 2012). The respondents were asked to rate to what extent they disagreed or agreed with each item on a five-item scale, and the list of items were introduced by the question; 'There can be many reasons for participating in hunting and the hunter can play different roles in terms of resource conditions and management. What is your opinion about the following statements?'

Environmental orientation was measured using a shortened version of the New Ecological Paradigm (NEP) scale which is a well-tested instrument for examining environmental attitudes on an anthropocentric–ecocentric scale (Dunlap & Van Liere 1978; Dunlap et al. 2002). Environmental orientation is a relatively stable attitude or expression of how people evaluate the environment in general with some degree of favor or disfavor (Fransson & Gärling 1999; Milfont & Duckitt 2010; Heberlein 2012). The NEP scale was originally developed with 15 items, but subsequent testing and a number of studies have revealed that a shorter scale with fewer items also produces satisfactory inter-item reliability and validity (Edgell & Nowell 1989; Bjerke et al. 2006; Dunlap 2008; Kaltenborn et al. 2009). In general, six to seven items have been shown to be adequate (Kaltenborn & Andersen 2009; Kaltenborn et al. 2008, 2011) based on testing of each item's contribution to scale reliability. In this study, we used a seven-item scale (Table 2). Each respondent is then assigned a score of environmental orientation. This index is computed as the mean value of the scores on the NEP items, and the sample is divided into three approximately equally large groups using a percentile calculation in SPSS (Version 20, IBM SPSS Statistics, New York, NY, USA) which constructs three groups we labeled low, medium, and high ecocentrics reflecting their degree of environmental concern (Table 2).

Table 1. Hunters' perception on their function and the function of hunting in general (mean scores, $N = 571$).

	Means	Standard error
Most hunters behave responsibly in terms of rules and regulations.	4.16	0.027
The hunter plays an important role in sustaining valuable land use traditions.	4.02	0.030
Modern wildlife management depends entirely on hunting in order to regulate wildlife populations.	3.90	0.034
Hunting is required in order to maintain the balance in nature.	3.89	0.038
Hunting is a nice way to provide healthy food.	3.88	0.035
Norwegian hunters have a good reputation among the general public.	3.77	0.031
The main function of hunting is to provide recreation and outdoor experiences.	3.67	0.040
Hunting plays a part in nurturing good wildlife populations so that the hunter can harvest from a predictable surplus.	3.63	0.034
The hunter plays an important role as a steward of wildlife by taking out older and sick specimens through well-targeted harvesting.	3.58	0.042
In many ways, the hunter is a 'predator' like other large carnivores.	3.54	0.042
In reality, hunters protect animals because wildlife populations are kept under control so that fewer animals starve, get sick or hit on the roads,	3.52	0.039
Hunters are mostly concerned about environmental needs and not over-harvesting wildlife populations.	3.49	0.039
Hunting is mostly about harvesting sustainable yield and taking out high quality wildlife.	3.40	0.040
Hunting is a threatened activity in contemporary society.	3.13	0.046
Increasing illegal hunting is beginning to give Norwegian hunters a bad reputation among the general public.	3.11	0.046
It is understandable that some carnivores are shot when they cause large conflicts.	3.01	0.055
The modern hunter has replaced the large carnivores.	2.94	0.044
The main purpose of hunting should be to satisfy hunters' demand for harvest and recreation.	2.85	0.045
Strictly speaking we do not need to hunt wildlife, nature will regulate this itself in a long-term perspective.	2.48	0.049
Hunting has no ecological function of importance compared to other factors that affect wildlife populations.	2.41	0.039
Traditional trapping is an outdated way of hunting that should not be maintained.	2.04	0.039

Note: Response format: 1, Completely disagree; 2, Disagree; 3, Neutral; 4, Agree; 5, Completely agree.

Table 2. Environmental orientation of hunters (NEP segments and items).

NEP groups	Mean	*N*	Standard deviation
Low ecocentrics	2.85	201	0.307
Medium ecocentrics	3.50	182	0.157
High ecocentrics	4.15	188	0.279
Total	3.48	571	0.596
NEP items			
The balance of nature is very delicate and easily upset	3.79	672	1.109
Humans are severely abusing the environment	3.52	672	1.207
The so-called 'ecological crisis' facing humankind has been greatly exaggerated	2.51	672	1.317
Plants and animals have as much right as humans to exist	3.78	672	1.156
The balance of nature is strong enough to cope with the impacts of modern industrial nations	2.17	672	1.137
If things continue on their present course, we will soon experience a major ecological catastrophe	2.99	672	1.482
Human ingenuity will insure that we do not make the earth unlivable	2.60	672	1.463

Hunter roles and functions are reported descriptively as mean scores. Underlying dimensions were explored by the factor analysis of the 21 items, using principal components analysis and oblique rotation for extracting and retaining factors with Eigen values above 1.0. Since this was largely an exploratory study, we also supplemented this with a principal axis factoring and promax rotation to see which approach provides the best solution. Reliability analysis was used to test the scale coherence. Effects of environmental orientation on hunter roles and functions were tested with analysis of variance with the three NEP groups as independent variables and the 21 function/role items and the dimensions identified with the factor analysis as dependent variables. Effects of environmental orientation on hunting functions were examined using analysis of variance (ONEWAY).

3. Results

3.1 Hunter characteristics and environmental orientation

The mean age of the hunters in this sample is relatively high with 40 years for men and 47 for women. Gender wise the sample is heavily skewed with 83% men and 17% women. In terms of education, a little more than one-half (55%) have completed college- or university level training, slightly less than one-third (29%) have completed vocational training, and more than two-thirds (70%) are fully employed. The sample contains different types of hunters, roughly one-half (58%) hunt only small game, 23% hunt only big game, and 20% spends approximately equal amounts of time on small and big game hunting. On average, the hunters in this sample had 19 years of experience. The hunters report a considerable range in environmental orientation with a mean value for the sample of 3.48 which is slightly above neutral (on a five-point scale), i.e. on the ecocentric part of the scale. The low ecocentrics have a mean value of 2.85, the medium ecocentrics 3.50, and the high ecocentrics 4.15 (Table 2). Regression analysis showed a relationship between the NEP scores and the level of education, i.e. increasing ecocentrism was positively correlated with higher levels of education ($F = 19.152$, $p < 0.001$, $R = 0.180$). However, there was no significant interaction between the NEP scores and age and gender.

3.2 Hunter functions and self-perceptions

In general, the respondents agreed most with the statements that in different ways postulated that hunters have stewardship roles, that hunters play important roles in maintaining sustainable wildlife populations, and that hunting is required to regulate wildlife populations and keeping a balance in nature (Table 1). There is little support for the view that hunting does not have any significant ecological functions, or that nature can regulate itself in a long-term perspective, and that hunting is not needed to control wildlife populations.

There is also a fairly high level of agreement that Norwegian hunters enjoy a positive reputation among the general public and that hunting can serve multiple functions like recreation and outdoor experiences, provide healthy food, and serve as a management strategy. The hunters have an overall positive self-perception of their own role and image with an emphasis on responsible behavior and stewardship. It is worth noting that the statement 'the main function of hunting is to provide recreation and outdoor experiences' elicits a fair level of agreement, but the statement that 'the main purpose of hunting should be to satisfy hunters' demand for harvest and recreation' receives less support, i.e. some hunters may feel that they need another justification beyond having fun. There is some, but not very strong support for viewing the human hunter as a predator like other large carnivores, and limited support for the statement that the modern hunter has replaced the large carnivores. Overall the hunters express a fairly anthropocentric perspective in the sense that they see self-enjoyment, recreation, and acquiring quality game meat as key purposes of hunting along with a strong belief in the importance of hunting as a management strategy in maintaining sustainable wildlife populations (Table 1).

3.3 Dimensions of hunter functions

The data reduction through factor analysis identified four underlying dimensions in the hunters' perception of hunting functions: 'Management', 'Recreation', 'Predation', and 'Poaching' (Tables 3 and 4). Since the items used to tap into the hunters' perception of the functions of hunting represented an a priori defined list put together based on the practical experience and summaries from literature; we explored a range of factor models to identify the best solution in terms of underlying dimensions. As suspected, several of the items did not fit well into a data reduction model. The best result was a four-factor model including 13 of the 21 original items explaining 54.2% of the variance (Table 3). The strongest factor was labeled 'Management' (seven items, 26.7% of the variance) and addressed the role of hunters and hunting in sustainable wildlife management. The second factor 'Recreation' (two items, 9.7% of the variance) covers outdoor recreation functions of hunting. The third factor 'Predation' (two items, 9.4% of the variance) addresses the human hunter as a predator. The fourth factor 'Poaching' (two items, 8.4% of the variance) deals with the public consent around illegal hunting and hunter reputation (Table 3). Reliability analysis was used to test the internal consistency of the subdimensions, i.e. how well the items in each factor actually measure the same construct. The alpha values of the four subscales are acceptable for the factors; responsible management, predation, and poaching. For 'recreation' however, the alpha value is below the usual cut-off alpha value of 0.5 (Table 3).

3.4 Effects of environmental orientation on hunter functions

We first tested the effect of environmental orientation on all of the 21 hunting function items. Significantly different effects of environmental orientation were identified for only four out of the 21 items, and the effect of environmental orientation shows some variance for these items on a scale from 1 (completely disagree) to 5 (completely agree).

- 'The main function of hunting is to provide recreation and outdoor experiences' ($F = 8.73$,

Table 3. Principal component analysis of hunter functions (oblique rotation).

	Eigen value	Percentage of variance	Cumulative (%)	Scale mean	Range	Alpha
Management	4.006	26.7	26.7	3.70	0.67	0.78
Recreation	1.461	9.7	36.4	3.24	0.85	0.37
Predation	1.407	9.4	45.8	3.20	0.59	0.53
Poaching	1.256	8.4	54.2	3.04	0.15	−0.69

Table 4. Dimensions of hunter functions (factor analysis).

		Factor loadings			
Factors	Items	Factor 1	Factor 2	Factor 3	Factor 4
Management	In reality, hunters protect animals because wildlife populations are kept under control so that fewer animals starve, get sick or hit on the roads.	**0.734**	−0.196	0.346	0.118
	The hunter plays an important role in sustaining valuable land use traditions.	**0.717**	0.137	0.312	0.028
	Norwegian hunters have a good reputation among the general public.	**0.700**	0.210	0.111	0.248
	Most hunters behave responsibly in terms of rules and regulations.	**0.697**	0.134	−0.001	0.065
	Hunting plays a part in nurturing good wildlife populations so that the hunter can harvest from a predictable surplus.	**0.665**	−0.137	0.328	0.180
	Hunters are mostly concerned about environmental needs and not harvesting wildlife populations too much.	**0.650**	0.039	−0.035	0.085
	Hunting is required in order to maintain the balance in nature.	**0.542**	−0.343	0.394	0.199
Recreation	The main function of hunting is to provide recreation and outdoor experiences.	−0.066	**0.757**	−0.004	−0.223
	The main purpose of hunting should be to satisfy hunters' demand for harvest and recreation.	0.217	**0.686**	0.113	0.224
Predation	The modern hunter has replaced the large carnivores.	0.120	0.006	**0.809**	0.081
	In many ways, the hunter is a 'predator' like other large carnivores.	0.181	0.051	**0.761**	−0.057
Poaching	Increasing illegal hunting is beginning to give Norwegian hunters a bad reputation among the general public.	0.052	0.218	0.059	**−0.786**
	It is understandable that some carnivores are shot when they cause large conflicts.	0.300	0.222	0.100	**0.758**

Note: Factor loadings above 0.5 that contribute to valid factor structure in bold.

$p = 0.000$). Medium ecocentrics agree more (mean 3.81) than high ecocentrics (mean 3.77), which again agree more than low ecocentrics (mean 3.44).

- 'It is understandable that some carnivores are shot when they cause large conflicts' ($F = 19.35$, $p = 0.000$). Low ecocentrics (mean 3.42) agree more than medium (mean 2.97) and high ecocentrics (mean 2.61).
- Hunters are mostly concerned about environmental needs and not over-harvesting populations ($F = 3.07$, $p = 0.047$). Low ecocentrics (mean 3.60) agree more than medium ecocentrics (3.48) and high ecocentrics (3.37).
- 'Increasing illegal hunting is beginning to give Norwegian hunters a bad reputation among the general public' ($F = 15.89, p = 0.000$). Low ecocentrics (2.79) agree less than medium ecocentrics (3.16) and high ecocentrics (3.40).

Although the degree of environmental orientation discriminated significantly among only four out of 21 items, the pattern is interesting. Environmental orientation has some bearing on the perception of the main objective of hunting, where those hunters who express a moderate environmental orientation to a greater extent than other hunters, see recreation as the main function. In light of the responses to the other items, low ecocentrics presumably are more concerned with harvest than the other two groups, and the high ecocentrics probably emphasize management aspects more. Interestingly, there is an inverse relationship between hunters' general environmental orientation and the perception of hunters as environmental stewards. Those hunters who express a lower level of environmental orientation to a greater extent think that hunters are environmentally aware and concerned. The view of illegal hunting is clearly related to the degree of environmental orientation. Increasing ecocentrism is positively correlated with a negative view on poaching.

The effect of environmental orientation and the importance of illegal hunting as a key issue were confirmed by the analysis of the effect of the NEP scores on the four-factor solution. Here, we found significant associations for the poaching factor ($F = 31.17$, $p = 0.000$). The degree of environmental orientation discriminates significantly in the views on illegal hunting, but not for management functions, recreation functions, or predation functions of hunting.

4. Discussion

Norwegian hunters to a great extent share a positive self-perception. All statements included in our study that tapped into some aspect of hunters' positive contribution to wildlife and ecosystem management received some level of agreement with the statements. Likewise statements downplaying the stewardship and management roles of hunters received little support. There is a strong consensus among the hunters that they behave responsibly and comply with rules and regulations. There also seems to be a widely shared perception that modern wildlife management cannot do without hunting. Overall the dominant self-perception is that hunters (1) are law-abiding and responsible actors, and (2) play a salient role as ecosystem stewards.

The stewardship and management role or function of hunters comes out more strongly in this study than other aspects of hunting such as sportsmanship, predation, or communion with nature. The hunters to some extent acknowledge that humans can act and function like large predators, but they do not agree that they have replaced the large carnivores. Outdoor recreation and non-consumptive experiences are key reasons for engaging in hunting, but hunting opportunities and outdoor experiences entail more than just harvesting meat, and this is supported by several previous studies assessing the importance of different hunting outcomes (Sanyal & McLaughlin 1993; Hrubes et al. 2001; Daigle et al. 2002; Hunt et al. 2005; Wam et al. 2013).

The hunters in this sample report a considerable range in environmental orientation. Earlier research has suggested that hunters tend to belong more to the consumptive than the appreciative category of outdoor recreationists (Zinn 2003; Kaltenborn & Andersen 2009) and that they, at least in more general terms, often are relatively anthropocentric and use oriented in their environmental outlook (Bujis et al. 2006). Research on the relationship between outdoor recreation and environmental orientation has shown that people who prefer appreciative, i.e. non-consumptive uses of nature also express more biocentric attitudes toward nature (Van Liere & Noe 1981; Jackson 1989; Peterson et al. 2008). In Norway, big game hunting was shown to correlate with a low degree of environmental orientation. However, other forms of consumptive activities such as fly fishing and berry picking and various appreciative, non-consumptive forms of recreation correlated positively with a higher degree of environmental orientation, which is an ecocentric perspective on nature (Bjerke et al. 2006). The findings in this study that the hunters express a range and diversity of environmental orientation suggest along with other research that 'hunter' may not be a homogeneous category when it comes to environmental attitudes (Kaltenborn et al. 2012). Furthermore, most types of hunting are probably motivated by appreciative as well as consumptive aspects. In this study, we did not segment the hunters into categories, and it is plausible that even more differences in environmental orientation exist between small game and big game hunters. However, we can generally ascertain that the degree of environmental orientation does affect perceptions of the sensitive issue of illegal hunting, attitudes toward large carnivores, the perception of hunters as environmentally responsible actors and the role of the kill in fulfilling experience preferences.

4.1 Management implications and research needs

Large carnivore management needs to balance the various interests in the sociopolitical landscape advocating the range from total extermination to major increases in carnivore populations, and hunters will likely play increasingly important roles in future management strategies. At the moment, the four large carnivores are subject to somewhat different management systems. Lynx are harvested as a game species up to a given quota for a region, meaning that all hunting stops when the total quota is reached. Wolverine hunting is managed much the same way, except hunters are also required to be registered in a central database. Wolf and bear hunting is subject to a license system similar to wolverine hunting, but the annual quotas are very small. Norwegian hunters have a high self-regard suggesting they can play an active role in the carnivore management. But self-reports on the perception do not necessarily reflect the knowledge level of hunters about the ecosystem functioning or their willingness to adapt to harvesting strategies that have specific targets. If public hunting is to be used more actively in regulating carnivore populations, recruitment of hunters need to target persons who have a baseline understanding of predator functions in ecosystems, who are experienced and highly motivated, i.e. willing to put in the time and efforts, and who are willing to take out the specific animals that are targeted by management be it for conflict reduction purposes or population dynamics, even though they may be less attractive from a sport hunting perspective.

The attitudes of hunters are shaped by many factors such as the individual's expectations and preferences, the views of peers, and the different social groups of hunters, the level of experience, the available hunting opportunities, and the general ecological context and how it is managed (Ericsson & Heberlein 2003; Ericsson et al. 2004). There is a huge difference between the highly manipulated ecosystems of Scandinavia, where large carnivores have been more or less extinct for decades and are only recently gaining some ground, and ecosystems like those found in Alaska and northern Canada which are much more intact with stable and resilient populations of large carnivores. In Scandinavia, in the absence of functional predator populations, hunting is considered essential to maintaining healthy populations of large ungulates such as moose and reindeer. In Alaskan and northern Canadian ecosystems, large carnivores have maintained an important regulatory function. These ecosystems are much less impacted by anthropogenic factors and are more bounded by energy cycles. Here hunting also plays a role, but does not substitute for ecologically functional carnivore populations in the way it does in Scandinavia (Linnell et al. 2005).

The emphasis on management roles and stewardship found among hunters in this study reflect the context of highly manipulated ecosystems in Scandinavia and the philosophy of the Norwegian hunter education. The latter focuses strongly on the need for the hunters to behave in such a way that the general public perceives the modern hunter as a responsible and conscientious user of nature. This suggests that hunters can be receptive to new knowledge and engage in more active cooperation with managers if new strategies are developed in the carnivore management. This study also shows that hunters comprise a diverse group in terms of environmental orientation and that some groups are likely to be more conservation oriented and more accommodating to being management partners than other hunter segments.

At any point in time, a socially legitimate hunting ethic will need to resonate with the dominant value orientations in contemporary society (Peterson 2004). Norwegian hunting has, like fishing, traditionally advocated a balance between sportsmanship and subsistence. The relatively high and stable support for hunting in the general public over the last decades owes much to the historical role of subsistence harvesting in Scandinavia. Although good time series data are lacking, there are some indications that hunting enjoys relatively wide support among the Norwegian public. In a representative study, Stokke (2004) showed that 54% of the public-supported hunting, and that a mere 14% directly opposed hunting. The study also identified a slight increase in positive attitudes during the past 10 years, as well as recognition of a wide range of motives for hunting. Interestingly, more than three quarters of the public agreed that hunting contributes to maintaining a balance in nature. A study from Sweden (Ericsson & Heberlein 2002) showed that the public's acceptance of hunting was reduced if the hunters' motives switched from utilitarian to seeking challenge and excitement.

The sportsman aspect of hunting has to some extent piggybacked on subsistence and cultural tradition arguments and is currently vulnerable to the sentiments of an increasingly urbanized society and changing public values on animal welfare (Bye 2003). An obvious implication is that hunters and their interest organizations would benefit from efforts to better communicate their stewardship role and environmental functions to the general public. This is particularly important in light of the steady decline in hunter recruitment and retention across many Western countries (Heberlein 2007; Andersen et al. 2010; Aiken & Harris 2011). Renewed interest in hunting will require a focus on functions that are readily acceptable by the broader public.

Hunting opportunities are currently strictly regulated by management goals in Scandinavia. Yet, to demonstrate their commitment to ecosystem management and a socially legitimate hunting ethic, hunters may in some cases also need to modify their own hunting preferences even more in favor of ecosystem sustainability. An example in point is wolf hunting. A recent study (Liberg et al. 2011) documented widespread poaching of the species throughout Scandinavia, and that without illegal hunting the wolf population would probably have been four times as high as the current one. As of 2013, a small number of wolves can now be hunted legally in Norway, and this is an opportunity for the hunting community and its organizations to show their

commitment to responsible management by publicly supporting the new policy and denounce poachers within their own ranks. However, this may be difficult as hunters in Scandinavia have demonstrated dramatic declines in support for wolf conservation as wolf numbers have increased (Heberlein & Ericsson 2008).

The willingness of hunters to adapt to, and cooperate with, changes in policy and management regulations are areas ripe for more research. In this study, we used a scale and set of items on hunting functions that were drawn largely from practical experience. This was an exploratory study, and we recommend further development of instruments that tap into motives, knowledge, environmental attitudes, and experience preferences among hunters and how these are linked to ecosystem management goals. Further research should also consider specific hunter subgroups and treat hunters as a heterogeneous population.

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