The different sides of the fence: household land-use preference in the case of livestock-carnivore conflict

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Abstract

This study, based on a household survey in Norway, examined land use preferences in the presence of livestock-carnivore conflicts, particularly focusing on free-range grazing, which benefits sheep but poses risk due to predation. About 12000 lambs are killed every year by large predators that are endangered and protected. Survey respondents were presented with two management programs: one favoring more large carnivores and fewer free-range grazing sheep, and the other favoring fewer carnivores and more free-range grazing sheep. Preferences were influenced by sociodemographic factors, including age, gender, education, and residence. The findings suggest that attitudes toward carnivores and sheep are shaped by complex social factors, not just economic self-interest. Drawing on Amartya Sen's theory of welfare economics, the study highlights how sympathy and commitment to others in the community—such as knowing someone who has lost livestock to predators—can influence preferences. This underscores the idea that people's choices are often guided by a sense of social responsibility and concern for collective welfare, rather than purely by self-interest. The results demonstrate that while positive attitudes toward conservation exist, they do not always translate into straightforward policy preferences, reflecting the overlooked role of identity, sympathy, and commitment in decision-making processes.

Keywords: Carnivore conflict management; Attitude; Welfare; Sympathy; Commitment

JEL Classification: D60; Q18; Q24; Q57

1. Introduction

According to Norwegian law, sheep must graze on pasture for at least 16 weeks each year, provided the weather permits it (Lovdata, 2005). Year-round indoor animal housing is associated with increased environmental costs and poorer animal welfare. In contrast, access to pasture benefits livestock by improving their health, reducing antisocial behavior, and lowering the risk of health issues such as mastitis (Armbrecht et al., 2018; Goldberg et al., 1992; Krohn & Munksgaard, 1993; Miller & Wood-Gush, 1991; van den Pol et al., 2008). Pasturing allows livestock to engage in natural behaviors like foraging, exploration, and movement, and depending on its intensity and management, grazing can support biodiversity and provide important ecosystem services (D'Ottavio et al., 2018; Slade et al., 2014).

Grazing offers additional benefits, including improved landscape aesthetics, the preservation of biodiversity, healthier livestock, and the production of high-quality pasture-raised products like lamb and mutton. Under suitable conditions, pasture-based production systems can be as economically efficient as, or even more efficient than, confinement-based systems (Knaus, 2016; van den Pol et al., 2010; Schulte et al., 2018). There is also evidence of greater consumer demand for grazing-based products (Ellis et al., 2009; Gassler et al., 2018; Weinrich et al., 2014). However, outdoor grazing also has its risks, particularly when animals graze without supervision. Unsupervised livestock are vulnerable to accidents, collisions, drowning, plant poisoning, diseases, predator attacks, and other hazards. Current regulations mandate that sheep on open pastures be checked at least once per week in areas deemed "non-risk," though what constitutes "special risk" remains undefined. As a result, it is common practice in Norway to supervise grazing sheep only once a week. Although pasturing generally improves animal welfare, welfare is compromised during predator attacks and accidents, which can cause fear and suffering in the animals, evident in their elevated heart rates. In 2020 alone, over 14,000 animals were lost to large predators, accounting for approximately 64% of the total grazing-related losses. Lamb losses made up more than three-quarters of these incidents (Rovbase, n.d.).

In response, the Norwegian government allocated over NOK 37 million in 2020 to compensate for 14,695 confirmed cases of livestock deaths (Rovbase, n.d.). While these subsidies encourage outdoor grazing, they do not cover all associated costs, nor do they incentivize farmers to closely monitor their flocks, as frequent supervision incurs significant expenses. Understanding public landscape opinion

plays an important role in policy and decision-making related to agricultural practices and the protection of endangered species.

This study examines political attitudes towards land use amid livestock-carnivore conflicts. We conducted a survey presenting respondents with two new management scenarios in addition to the current status. One scenario proposed reducing carnivore populations while increasing free-range grazing, while the other suggested increasing carnivore numbers and fewer free range grazing sheep. Our study contributes to the existing literature in two main ways. First, by presenting respondents with a more comprehensive view of carnivore-livestock conflicts, we aim to capture more accurate political attitudes than studies that focus solely on either livestock or carnivores. Second, we explore how factors such as geographic centrality and sociodemographic composition influence attitudes and voting preferences regarding carnivore-livestock management.

The findings of this study provide insights into public preferences and motivations surrounding carnivore-livestock conflict management. This knowledge can aid in identifying common ground among stakeholders and inform the development of land management policies that enjoy greater public support.

2. Theoretical background and literature review

2.1 The role of identity, sympathy and commitment on a person's welfare, goal and choice.

Concerns about economic interests can arise not only from one's own economic losses, but also from losses incurred by others in the community. Knowing someone who has lost an animal in the community can potentially influence the choice towards conservation and reproduction of large carnivores.

The Amartya Sen's theory in the agency literature introduced an important aspect in welfare economics, that sympathy and commitment -in addition to self-interest- may influence one's welfare and goal and act of choice. To begin with Sen (1985) argues that a distinction should be made between self-centered welfare, self-welfare goal, and self-goal choice, where each plays a different part in traditional economic models. Sen (1985) defines these three concepts and explain how they can be violated because of sympathy, commitment, and how one identifies with others in society.

The first is self-centered welfare, which denotes that a person's welfare depends on her/his own consumption only, excluding sympathy to others. If the misery of others is influencing one's welfare then self-centered welfare is violated. Sen (1977) defines sympathy as a state where one's welfare is being affected by the position of others, for example by feeling depressed at the sight of misery of others. Sympathy therefore violates the self-centered welfare.

The second concept, self-welfare goal, refers to the only goal of a person is to maximize his/her own welfare. The self-welfare goal is violated when/if a person's goal involves other objectives than maximizing own welfare only (such as social justice and care for the welfare of others). Commitment violates self-welfare goal because a person's goal may not be to maximize own welfare but some other goal like helping to remove the misery of others from which he does not suffer himself.

Sen (1985) describes the third concept, self-goal choice as every act of a person's choice is guided by the pursuit of own goal and that it is not restrained by the recognition of other people's goals. Self-goal choice is violated if the persons choice is influenced or guided by considerations (i.e. others goal, social norms) other than the pursuit of one's own goals. Commitment[1] also violates self-goal choice because, for example, one can override or restrict the pursuit of his/her own goals in favor of a social norm or a certain rule of conduct.

To summarize the first concept implies welfare is a function of own consumption only. The second concept states that a person's only goal is to maximize their own well-being. And the third implies that every action of a person is guided by the pursuit of own goal. The first concept is violated by sympathy while the last two by commitment.

In line with the welfare concepts of Sen (1985) described above, we depart from the classical stated preference study design. First and foremost, we think sympathy and commitment are the main reasons why we have both sheep and carnivores in Norway. Both sheep farming (subsidies for sheep farmers) and preserving carnivores (surveillance/research etc) are costly over the tax bill, still there seem to be a quite strong political consensus we should have both. The self-interest concept hence seem to be a less important driver. We hence feel that asking for willingness to pay will biases results in the direction of the self interest concept that does

[1] "Commitment- acting to help remove some misery even though one personally does not suffer from it" (Sen, 1977)

not reflect the actual preferences. Therefore this study does not elicit preferences but a political opinion or vote of how people think things should be.

3. Methods and Data

3.1 Survey design and scenario description

Data were collected through e-mail survey conducted by a data collection agency (www.kantar.no) in October 2021. The complete sample consists of 1021 complete responses with a gross and net response rate of 35.9 and 34 percent, respectively. Too low drop out rate may signal a selection bias where highly interested individuals open the survey. On the other hand, one can argue that a low dropout rate may imply engaging survey design.

As discussed in section 2 we depart from the classical WTP study design. It can be said that sympathy and commitment are the main reasons why we have both sheep and carnivores in Norway. Both sheep farming (subsidies and compensations) and preserving endangered carnivores (surveillance/research etc) are all costly but still there seem to be a quite strong political consensus we should have both. The self-interest concept hence seems to be a less important driver. We hence feel that asking for willingness to pay will biases results in the direction of the self-interest concept that may not reflect the actual preferences. However, in order to increase the validity and reliability of our results, the survey[2] was designed following contemporary guidance for stated preference studies (Johnston et al., 2017). Even if the recommendations suggested by Johnston et al. (2017) are intended to design stated preference studies, clearly many of the suggestions regarding survey design and implementation are generally relevant to most surveys[3]. Examples include recommendations regarding scenario description and presentation of baseline conditions and changes, survey pretesting, ethics and data collection, choice of survey mode and including a No answer option.

The questionnaire begins by asking the respondents to rate the importance of increasing the amount and quality of different public goods and services, including livestock welfare and conservation of endangered species, and then proceeds to ask about their attitude toward land use and landscape changes concerning endangered large carnivores, livestock grazing, and reforestation. The main goal of these questions was to help respondents put the land-use conflict in a broader context. The subsequent sections of the questionnaire contained questions

regarding attitudes toward animal welfare and grazing benefits and about the respondents' outdoor activities.

The next part of the questionnaire contained the program vote question. The respondents were presented with a hypothetical scenario in which the government plans to implement one of the specified programs regarding carnivore-livestock conflict management. A short description of the current situation, the risks and benefits of grazing, and the population status of large carnivores in Norway were presented.

Given below is the question used to elicit the respondents' political opinion towards reducing the risk of predator attacks for free-range grazing sheep in unfenced land.

In Norway, sheep must graze on a pasture by law for at least 16 weeks per year as long as the weather allows it. Previous studies have shown that grazing has several benefits, as opposed to intensive indoor animal production. Grazing on pasture land reduces antisocial behavior and health risks, such as mastitis, in livestock. Grazing also enhances animal welfare. Grazing preserves biodiversity and provides an ecosystem service. However, sheep are vulnerable to predator attacks and other unfortunate incidents during free-range grazing. Among these large predators, wolves, lynx, wolverine, and brown bears have the status of critically endangered on the Norwegian Red List of Species 2015 (Rovdata.no). Consider the following alternatives: the status quo, Program A, and Program B. If the government were to implement one of the alternatives, which one would you be willing to vote for? Only one of the alternatives can be implemented. Tick only the one program you would vote for.

Status quo (year 2020)	Program A	Program B	Don't know
Number of large carnivores in Norway: 58 wolves, 398 lynxes, 386 wolverines, 150 brown bears, and 1382 golden eagles. Total number of sheep in 2020: 2.29 million. Confirmed and compensated losses: 2368 sheep and 12330 lambs.	10% increase in Carnivores* Naturally leads to more loss in sheep. More carnivores and fewer sheep in the mountains	10% increase in sheep and 10% decrease in carnivores* This leads to more sheep grazing on the mountains	

		and fewer carnivores	
I would rather keep the current status	I would rather have more carnivores up on the mountains in Norway	I would rather have more sheep grazing upon the mountains	
I would rather keep the status quo ☐	I vote for program A ☐	I vote for program B ☐	I Don't Know ☐

*Wolverine, lynx, bear, wolf, and golden eagles.

Table 1: Information table in the questionnaire

3.2 Variable specification and econometric approach

The variables were considered in potentially explaining the choice of alternative programs were sociodemographic characteristics, centrality index, closeness to a livestock depredation problem in terms of knowing someone who was affected, carnivore management zone, stock of sheep grazing outside, cabin trips, and hunting. The influence of human fear however has been ignored as it is not part of the scope of this work. Some of these variables are obtained from publicly available sources. The centrality index is available on Statistics Norway database[4]. Data on outdoor grazing sheep per municipality was obtained from NIBIO grazing statistics. Note that the grazing sheep are registered for only farmers registered in grazing association, representing 74% of sheep released for grazing. The variable Carnivore management zones (CMZ)[5] was constructed from publicly available rovbase maps.

3.2.1. Multinomial Logit model

We model policy choice using multinomial logit (MNL) model in which respondents face four choices: status quo, program A (more carnivores and less sheep), program B (less carnivore and more sheep), and "I don't know" option. The utility is modeled as a function of individual specific characteristics (characteristics that vary across individuals but not across the choices/alternative-invariant variables), X. therefore the utility function can be specified as follows

[4] SSB's centrality index is based on access to workplaces and service functions. The index runs from 0 which is only theoretically possible to 1000 which is the most central. Oslo for example is indexed 1000.

[5] A geo-differentiated management strategy to ease the carnivore-livestock conflict by separating zones for large carnivores and grazing livestock.

$$U_{ij} = X_i\beta_j + \ \varepsilon_{ij}$$

Where j denotes the choice and the subscript i denotes the individual. The error term ε_{ij} represents the presence of unobservable characteristics. The model assumes ε_{ij} are Weibull distributed and so difference in the ε has a logistic distribution. Individuals choose the choice that gives maximum utility. The probability that individual i chooses choice j is

$$P_{ij} = \frac{\exp\,(X_i\beta_j)}{\sum_k exp\,(X_i\beta_j)}$$

Assuming that all observation are drawn independently from the same distribution, the log-likelihood can be written as

$$\text{Log}\,L = \sum_i \sum_j y_{ij} log P_{ij}$$

Where y_{ij} is the outcome of individual i at choice j

The MNL model is well suited to our raw data since the outcome variable has four categories/alternatives. However, we are more interested in the two categories/alternatives (Program A and program B) out of the four, in which case a binary logit can be applied after excluding people who vote for status quo and the don't know option.

3.2.2. Binary Logit model

With a binary dependent variable having just two categories -program A and program B- a binary model is needed. To accommodate the binary model, the outcome variable was created containing one if Program B was chosen and zero if program A was chosen.

The dependent variable Y takes on of two values.

$$Y = \begin{cases} 1\ with\ probablity\ p, \\ 0\ with\ probablity\ 1-p. \end{cases}$$

The response probability of a binary outcome Y is

$$P(Y = 1|x_1, \dots, x_k) = \frac{\exp\,(\beta_0 + \beta_1 x_1 + \cdots + \beta_n x_n)}{1 + \exp\,(\beta_0 + \beta_1 x_1 + \cdots + \beta_n x_n)}$$

4. Results and Discussion

4.1 Sample representativeness

In Norway, the female population accounted for 50% of the total population in 2021 (SSB). In our sample, 48% of the respondents are male, and 52% are female, which can be considered quite representative of the population.

Table 2 shows the age distribution of the population and our sample. The percentages were calculated using the total population aged 20–89 years. Our sample consists of individuals aged 18 years and above, but 99.8% of our respondents are in the 20–89 age group. Of the population aged between 20 and 89 years, 43.6% of the population is aged between 20 and 44 years. In our sample, this group constitutes 34% of the 20–89 age group and is therefore slightly underrepresented.

In terms of education, 59.2 % of our respondents reported that they have completed a degree in university or higher education with a duration of four years or more, while in the population only 35.3% are registered as having higher education with a duration of up to or more than four years (SSB, 2020). With regard to the population distribution across regions, the populations that were included in our sample are considered representative (Table 3).

Table 2: Age distribution of the population and sample

Age group (years)	Population (%)	Sample (%)
20–24	43.63	33.95
45–66	36.8	45.14
67–79	14.93	18.68
80–89	4.63	2.26

Table 3: Region population and sample distribution

Regions	Population (%)	Sample (%)
Eastern Norway	50.8	51.03
Southern and Western Norway	29.2	30.07
Trøndelag and Northern Norway	18	18.90

4.2 Descriptive statistics

The data is a set of binary, categorical, and continuous variables. Table 4 presents a summary of the basic sociodemographic variables.

Our individual and household income variables are categorical variables of different income categories. The categories for annual personal income range from under NOK200,000 to above NOK1 million, and the category for household annual income ranges from under NOK200,000 up to NOK1.4 million and above, before tax. About half of the reported personal incomes are among the middle four categories (i.e., ranging from NOK300,000–700,000), while the rest are distributed below and above these income categories. To provide more insight, Table 4 presents two new variables, namely, mean annual individual income and mean household income. These variables were generated by taking the average of the upper and lower boundaries of a category. The mean of the average annual individual income before tax is NOK522,622, and the mean of the average yearly household income before tax is NOK858,434. The mean household size is 2.38, with 5 being the maximum number of people in a household. On average, households spend NOK6,160 per month on food.

Regarding marital status, 43.8% of the respondents reported that they are married, 23.5% cohabit, 19.5% are single, and 11.8% are either divorced, separated, or widowed. Regarding employment status, 53.9% have a full-time job, 30.7% are pensioners or disabled, 7.67% are part-time workers, 4.72% are students, 1.38% are housewives, and 1.67% are out of work or unemployed. More than half (51.8%) of the respondents reported that their main income source is a full-time, income-generating job, while 2.45% reported that it is a self-employed job, 7.44% a part-time job, 9.8% some kind of social security income, 21.8% a retirement pension, and 5% a student loan.

Table 4: Descriptive statistics

	Count	Mean	Standard deviation	Minimum	Maximum
Female	1021	0.52	0.50	0	1
Age	1021	51.4	16.2	18	89
Mean annual personal income before tax	904	522621.7	231729.7	100000	1000000
Household size	1021	2.38	1.14	1	4

Mean annual household income before tax	830	858433.7	343998	100000	1400000

4.3 Program preferences

Table 5 shows the votes for each program. Respondents were only able to vote for one program—more carnivores (Program A), sheep on the mountains and free-range grazing areas (Program B), or maintain the current status. The "don't know" option is included to avoid forced votes. It allows respondents to decline to choose one of the alternatives or the status quo. However, if we only want to know which alternative the respondents are inclined towards, we can exclude the "don't know" option. Respondents are not pressured to give a definitive answer when there is "don't know" or "no answer" option, but this can come at a cost, as some may avoid making the necessary cognitive effort to make a choice (Johnston et al., 2017). A total of 328 respondents (32.1%) preferred Program B over the alternative proposed program and the status quo. In a follow-up question, we asked these respondents to choose the three most important reasons, from a provided list, for their choice of program. The most popular reasons given by respondents who chose program B were that they would like to see more free-range sheep grazing without the risk of predator attacks (75.9%), that large carnivores affect outdoor life negatively (34.1%), and that they do not want to have large carnivores in their immediate areas (29%). The other reasons were that carnivores are not important to respondents (25%) and that carnivores need not be increased in Norway as long as they are abundant in other countries (21.3%). Some respondents in this group (6.10%) listed other reasons for choosing Program B which can be generalized as welfare for sheep and other livestock, better utilization of otherwise unprofitable areas, reduced negative consequence for farmers, carnivore population is still viable with a 10% reduction, ecosystem is more balanced, Norwegian food preparedness, and quality of livestock products.

Table 5: Program preferences

	Frequency	Percentage	Cumulative
Status quo	316	31.0	31.0
Program A	260	25.5	56.4
Program B	328	32.1	88.5
Don't know	117	11.5	100

Total	1021	100

In contrast, 25.5% preferred Program A. Of the 260 respondents who selected this program, 64% provided the reasoning that large carnivores have the right to exist in Norway, 64.2% indicated that the existence of carnivores was of value to them, and 22.7% indicated that they want to have the opportunity to encounter large carnivores. In addition, 11.2% of the respondents provided their own reasons, most of which can be profiled under biodiversity and ES provided by large carnivores, a belief that protecting the sheep is the responsibility of the farmer, and the belief that there is excessive sheep production in Norway. In total, 31% preferred to maintain the status quo, and 11.5% responded with "don't know." Similarly, we had a follow-up question for these respondents regarding why they chose the status quo or responded with "I don't know." This was an open-ended question, and most responses can be summarized under wider categories: i) the current situation has an acceptable balance/satisfied with the current status, ii) trust in authorities to make the right decisions feeling of inadequacy to give an opinion on the matter, and iii) want both sheep and predators/it is hard to choose between the options.

4.4 Estimation results

We estimated a multinomial logit model, which is presented in Tables 6. The dependent variable was the choice of programs. We present average marginal effects instead of beta coefficients. The results show that higher education (a bachelor's degree or higher) increases the likelihood of choosing Program A. With the other explanatory variables remaining constant, women are less likely to choose Program A. An increase in age corresponds to a decreased likelihood of choosing Program A. Increased age increases the probability of choosing Program B. Higher education corresponds to a lower probability of choosing Program B.

An increase in the number of sheep and ewes grazing in the community where the respondent lives is associated with an increased probability of picking Program B. Knowing someone whose animals were killed by predators is associated with a higher likelihood of preferring Program B. The variable of trips with accommodation in a tent or a hut is also significant. Those who engage in such outdoor activities are more likely to choose Program B.

Table 6: Model 1 including all alternatives—Multinomial logit results

	(1) Status Quo	(2) Program A	(3) Program B	(4) Don't know option
Age	0.00273**	-0.00262**	0.00337**	-0.00348***
	(0.00105)	(0.000877)	(0.00103)	(0.000642)
Female: 1=Yes	0.133***	-0.124***	-0.0204	0.0115
	(0.0344)	(0.0297)	(0.0342)	(0.0189)
Higher Education	0.0375	0.0978**	-0.104*	-0.0311
	(0.0434)	(0.0339)	(0.0453)	(0.0251)
Centrality Index	-0.000376**	0.000370**	0.0000161	-0.0000107
	(0.000137)	(0.000117)	(0.000135)	(0.0000757)
Carnivore management zone	-0.0160	0.0420	-0.0473	0.0213
	(0.0343)	(0.0291)	(0.0333)	(0.0192)
Number sheep and Lambs grazing in the Municipality Respondent lives in	-0.000000778	-0.0000120	0.0000303**	-0.0000175+
	(0.0000128)	(0.0000128)	(0.0000115)	(0.0000100)
Knowing someone whose animals have been killed by predators	-0.229***	-0.00855	0.244***	-0.00645
	(0.0330)	(0.0301)	(0.0298)	(0.0195)
Trips with accommodation in a tent or cabin	-0.1000**	0.0252	0.114***	-0.0389+
	(0.0361)	(0.0299)	(0.0339)	(0.0211)
Hunting	0.394	0.233	0.260	-0.887
	(11.15)	(8.274)	(8.334)	(27.76)
Observations	739	739	739	739

Note: Listed coefficients are marginal effects, and standard errors in parentheses

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7 shows a logit model in which the dependent variable is a binary variable coded as 1 if Program B was chosen and 0 if Program A was chosen. This is a model excluding status quo and don't know options. The significance of age and education also become more pronounced, which could have resulted from comparing two opposite programs in the logit model.

Table 7: Probability of choosing Program B over Program A—Logit results

	Logit Model basic
Age	0.00628***
	(0.00141)
Female; 1 = Yes	0.122**
	(0.0446)
Higher Education	-0.191***
	(0.0527)
Centrality Index	-0.000306+
	(0.000174)
Carnivore Management Zone	-0.0550
	(0.0427)
Number of sheep and lambs grazing in the municipality a respondent lives in	0.0000368+
	(0.0000190)
Knowing someone whose animals have been killed by predators	0.170***
	(0.0452)
Trips with accommodation in a tent or cabin	0.0763
	(0.0475)
Hunting	-0.0271
	(0.0631)
Observations	417

Note: Listed coefficients are marginal effects, and standard errors are reported in parentheses.

$^{+}$ *p < 0.10,* * *p < 0.05,* ** *p < 0.01,* *** *p < 0.001*

4.5 Attitudinal variables as an outcome variable

Table 8 shows the most negatively and positively correlated attitudinal and perceptual variables with voting for Program B and program A, respectively. These were perceptions about the role of large carnivores in maintaining biodiversity, attitudes about endangered species, attitudes about herding, and perceptions about GHG emissions from livestock. All these variables were

measured on a Likert scale but changed to binary variables for the analysis where 1 takes "agree" or "strongly Agree" and 0 otherwise.

Age and knowing someone who has lost an animal to predators are significantly negatively associated with positive attitudes and perceptions toward carnivores (Table 8, Columns 1 and 2), while female gender, education, living in an urban area, and living in CMZ areas are negatively associated. The signs across the columns were mostly consistent, and similar results were observed for the attitude toward shepherding as a solution for the carnivore-livestock conflict (Column 3) and the perception that livestock production is a major contributor to climate change (Column 4).

Table 8: Attitudinal and perception variables as outcome variables—Logit results

	(1) Large predators in Norway are necessary to maintain biodiversity in nature	(2) Conservation of endangered species is important	(3) Farmers should supervise their flock when it is grazing in predator-risk areas	(4) Livestock production has a significant environmental cost in terms of GHG emissions
Age	-0.00284*	-0.00272*	-0.00245*	-0.00663***
	(0.00111)	(0.00111)	(0.00110)	(0.00102)
Female; 1 = Yes	0.0700*	0.0945**	0.0183	0.0123
	(0.0354)	(0.0350)	(0.0358)	(0.0345)
Higher Education	0.109*	0.178***	0.0252	0.165***
	(0.0471)	(0.0498)	(0.0456)	(0.0400)
Centrality Index	0.000357*	0.0000107	0.000151	0.000795***
	(0.000141)	(0.000141)	(0.000142)	(0.000127)
Carnivore Management Zone	0.100**	0.0193	0.00835	0.0854*
	(0.0345)	(0.0343)	(0.0348)	(0.0334)
Number of sheep and lambs grazing in the municipality a respondent lives in	-0.0000182	0.00000526	0.00000171	-0.0000319*
	(0.0000116)	(0.0000119)	(0.0000120)	(0.0000145)
Knowing someone	-0.0975**	-0.0322	-0.117***	-0.0175

whose animals have been killed by predators				
	(0.0358)	(0.0358)	(0.0354)	(0.0360)
Trips with accommodation in a tent or cabin	0.0682^{+}	-0.0976**	0.0819*	-0.0295
	(0.0369)	(0.0345)	(0.0371)	(0.0364)
Hunting	-0.177***	0.00235	0.120*	-0.190***
	(0.0495)	(0.0480)	(0.0544)	(0.0564)
Observations	712	705	718	678

Note: Listed coefficients are marginal effects, and standard errors are reported in parentheses.in these four models the dependent variables are positively correlated with program A and negatively correlated with program B. significance code: $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In Table 9, perception toward grazing and the maintenance of a landscape view (Column 1) and attitude toward compensation to farmers for lost sheep (Column 2) are the dependent variables. Of all the attitudinal variables they were the most positively and the most negatively correlated with voting for Program B and voting for program A, respectively.

Apart from hunting, all variables were positively associated with the perception that grazing improves the landscape and with a positive attitude toward compensating farmers for lost sheep (Table 9, Columns 1 and 2). Except for gender and living in CMZ areas, all variables were significant.

Table 9: Perception toward grazing and attitude toward compensation to farmers—Logit result

	(1) Widespread sheep grazing will provide a better landscape view	(2) A compensation to farmers for their lost sheep and lambs should be maintained
Age	0.00306***	0.00559***
	(0.000737)	(0.000812)
Female; 1 = Yes	0.0225	0.0139
	(0.0248)	(0.0288)
Higher Education	0.131**	0.115**
	(0.0465)	(0.0375)
Centrality Index	0.000301**	-0.000137
	(0.0000977)	(0.000114)

Carnivore Management Zone	0.0366	0.0337
	(0.0245)	(0.0280)
Number of sheep and lambs grazing in the municipality a respondent lives in	0.0000272*	0.00000606
	(0.0000116)	(0.0000112)
Knowing someone whose animals have been killed by predators	0.0689**	0.284***
	(0.0258)	(0.0333)
Trips with accommodation in a tent or cabin	0.0679**	0.0567+
	(0.0255)	(0.0295)
Hunting	-0.0647*	-0.116**
	(0.0302)	(0.0406)
Observations	718	723

Note: Listed coefficients are marginal effects, and standard errors are reported in parentheses. Attitudinal dependent variables which are positively correlated with program B and negatively correlated with program A are used here. Significance code : $^{+}$ *p < 0.10,* * *p < 0.05,* ** *p < 0.01,* *** *p < 0.001*

5. Discussion

Residence is a commonly addressed variable in landscape preference studies, particularly in case studies that focus on specific regions. Location often takes the form of urban/rural, distance to the study area, and local and non-local tourism. Living or growing up in urban areas tends to be associated with positive attitudes toward large carnivores (Blekesaune & Ronningen, 2010; Franchini et al., 2021 Kaltenborn et al., 1999). Our results are quite consistent with these previous findings. People who live in urban areas were likely to choose Program A over both the status quo and Program B. Living in urban areas was significantly and positively associated with the perception variables i.e. the perceptions that large carnivores are necessary to maintain biodiversity in nature, that livestock production has significant environmental costs in terms of global GHG emissions, and that widespread sheep grazing offers a better landscape view.

When it comes to attitudes toward conserving endangered species, shepherding, and compensation to farmers, no significant influence of the urban area variable was detected, although the signs of the coefficients were as expected. Similarly, with regard to attitudes toward endangered species conservation, livestock shepherding, and farmer compensation, no significant influence of the urban area variable was found; however, the signs of the coefficients were as expected.

Living in CMZ areas was insignificant. However, the more sheep-grazing in a respondent's municipality, the more likely the respondent was to choose Program B. Such respondents were also more likely to feel that widespread sheep grazing offers a better landscape view. Similarly, knowing someone who had lost an animal to predators tended to incline respondents to choose Program B. This inclination is likely driven by direct or community-level experiences with predation, highlighting how personal connections to those affected by livestock losses can shape preferences. This finding aligns with Amartya Sen's theory in welfare economics, which emphasizes that sympathy and commitment, in addition to self-interest, can influence welfare and decision-making. Sen (1985) argues that traditional economic models often overlook how individuals' welfare and choices are shaped by their empathy for others and their commitment to broader social goals. For instance, knowing someone who has lost livestock to predators can invoke sympathy, violating the concept of self-centered welfare, where a person's well-being is affected by the suffering of others. This sympathy can lead individuals to prioritize policies that may not align with their direct economic interests but reflect a commitment to community well-being and shared social norms. This is evident in our finding that respondents familiar with predation losses were more likely to choose Program B, despite the broader ecological benefits of Program A.

Previously, it has been shown that landscape preferences may vary by gender. In addition, it is reported that women are more skeptical of the conservation of large carnivores (Blekesaune & Ronningen, 2010; Franchini et al., 2021). According to the results of our study, females were less likely to choose Program A than either Program B or the status quo, but we found that they tended to have the perception that large predators are necessary for biodiversity and to maintain a positive attitude toward conserving endangered species. These mixed findings suggest that while women may sympathize with conservation goals, they might also prioritize safety and economic stability, possibly due to stronger communal ties or roles in family and community well-being, further supporting Sen's theory on commitment**.**

Studies have shown that, in general, landscape preferences may change with age. In their analysis, Blekesaune and Ronningen (2010) showed that older people were relatively more negative toward bears than younger people. Bjerke et al. (1998) found similar results and reported that older people had high dominionistic, high negativistic, high utilitarian, and low naturalistic scores when compared with the young. Confirming to these results, we found that increased age was associated with a lower likelihood of choosing Program A and a higher likelihood of choosing Program B, compared to the base scenario of maintaining the status quo. Older respondents tended to have negative attitudes toward the conservation of endangered species, were less likely to have the perception that large carnivores are necessary to maintain biodiversity, and had a lower likelihood of believing that livestock production has significant environmental costs in terms of global GHG emissions. These respondents were also less likely to agree that farmers should monitor the herd in areas at risk from predators, more likely to agree that widespread grazing with sheep improves the landscape, and more likely to agree that predation compensation for farmers should continue.

In line with previous works, we found that individuals with higher education tended to choose Program A over either of the other options. Blekesaune and Ronningen (2010) reported that respondents with higher levels of education had more positive attitudes toward bears, and Bjerke et al. (1998) reported that respondents with lower education levels preferred either an extirpation or a reduction of the wolf population in Norway. When it comes to attitude and perception, we found a positive relationship between higher education and all the attitudinal and perception behaviors, including positive attitudes toward widespread sheep grazing and compensation for farmers.

In summary, the findings demonstrate that landscape preferences are not merely a function of self-interest but are significantly influenced by social factors such as sympathy and commitment, as argued by Sen's welfare economics. These factors play a crucial role in shaping public opinion and policy preferences, suggesting that environmental and wildlife management strategies should consider the complex interplay of identity, empathy, and social responsibility in decision-making processes.

6 Conclusion

This study explored preferences for carnivore-livestock conflict management in terms of changes in free-range grazing sheep and carnivore populations. We found that preferences were

somewhat equally distributed among maintaining the status quo, more carnivores, and more sheep options.

The aim of the study was to identify the attitudes and opinion/votes of the public regarding land use and the competing interests of carnivores and livestock grazing, as well as carnivore-livestock conflict management, by providing the respondents with a relatively complete scenario description.

We found that both centrality index/residence and sociodemographic characteristics influenced the respondent's choice of program. The results showed that increased age had a significant and negative effect on the likelihood of choosing the "more-carnivore" option and having positive attitudes toward conserving large predators. Conversely, age had a significant positive effect on the likelihood of choosing the "more sheep" program and positive attitudes toward free-range grazing sheep and government support for free-range grazing sheep (in terms of compensation for lost lambs and ewes).

However, the study also highlighted that positive attitudes do not always translate into policy preferences when respondents are forced to choose between competing interests. For instance, while many respondents expressed positive views on free-range grazing, this did not necessarily lead to a preference for livestock-friendly management policies in the context of carnivore conflicts. Similarly, individuals with higher education tended to hold positive attitudes toward both carnivore conservation and free-range grazing, yet they were more inclined to choose the "more carnivores" program and less likely to opt for the "more sheep" program.

These results suggest that attitudes alone are not reliable predictors of policy preferences, particularly in complex scenarios involving trade-offs between competing land-use interests. Therefore, while attitudinal studies are valuable, they should be interpreted with caution when used to inform decision-making processes.

By integrating Amartya Sen's welfare economics theory, this study also underscores the role of sympathy and commitment in shaping public preferences, beyond mere self-interest. These findings highlight the complexity of decision-making in environmental management, where social responsibility and empathy can significantly influence choices, suggesting that policies should account for these broader social factors.

Conflict of Interest Statement
The authors declare no conflicts of interest related to this work.

References

Armbrecht, L., Lambertz, C., Albers, D., and Gauly, M. (2018). Does access to pasture affect claw condition and health in dairy cows? *The Veterinary Record*, *182*(3), 79.

Barmoen, M., Bærum, K. M., Johansson, M., & Mathiesen, K. S. (2021). Trust in large carnivore science in Norway. *European Journal of Wildlife Research*, *67*(6). https://doi.org/10.1007/s10344-021-01538-7

Bernués, A., Rodríguez-Ortega, T., Ripoll-Bosch, R., & Alfnes, F. (2014). Socio-cultural and economic valuation of ecosystem services provided by Mediterranean mountain agroecosystems. *PLOS ONE*, *9*(7), e102479.

Bjerke, T., Reitan, O., & Kellert, S. R. (1998). Attitudes toward wolves in southeastern Norway. *Society & Natural Resources*, *11*(2), 169–178.

Blekesaune, A., & Rønningen, K. (2010). Bears and fears: Cultural capital, geography and attitudes towards large carnivores in Norway. *Norwegian Journal of Geography*, *64*(4), 85–198. http://dx.doi.org/10.1080/00291951.2010.528225

Bullock, C. H., & Kay, J. (1997). Preservation and change in the Upland Landscape: The public benefits of grazing management. *Journal of Environmental Planning and Management*, *40*(3), 315–334. http://dx.doi.org/10.1080/09640569712119

Divinsky, I., Becker, N., & Bar (Kutiel), P. (2017). Ecosystem service tradeoff between grazing intensity and other services - A case study in Karei-Deshe experimental cattle range in northern Israel. *Ecosystem Services*, *24*, 16–27.

D'Ottavio, P., Francioni, M., Trozzo, L., Sedić, E., Budimir, K., Avanzolini, P., Trombetta, M. F., Porqueddu, C., Santilocchi, R., & Toderi, M. (2018). Trends and approaches in the analysis of ecosystem services provided by grazing systems: A review. *Grass and Forage Science*, *73*(1), 15–25.

Ellis, K., Billington, K., McNeil, B., & McKeegan, D. E. F. (2009). Public opinion on UK milk marketing and dairy cow welfare. *Animal Welfare*, *18*(3), 267–282.

Forskrift om velferd for småfe. (2005, February 18). Lovdata. https://lovdata.no/dokument/SF/forskrift/2005-02-18-160

Franchini, M., Corazzin, M., Bovolenta, S., & Filacorda, S. (2021). The return of large carnivores and extensive farming systems: A review of stakeholders' perception at an EU level. *Animals 2021*, *11*(6), 1735.

Gassler, B., Xiao, Q., Kühl, S., & Spiller, A. (2018). Keep on grazing: Factors driving the pasture-raised milk market in Germany. *British Food Journal*, *120*(2), 452–467.

Goldberg, J. J., Wildman, E. E., Pankey, J. W., Kunkel, J. R., Howard, D. B., & Murphy, B. M. (1992). The influence of intensively managed rotational grazing, traditional continuous grazing, and confinement housing on bulk tank milk quality and udder health. *Journal of Dairy Science*, *75*(1), 96–104.

Grammatikopoulou, I., Pouta, E., Salmiovirta, M., & Soini, K. (2012). Heterogeneous preferences for agricultural landscape improvements in southern Finland. *Landscape and Urban Planning*, *107*(2), 181–191.

Hansen, I., Strand, G.-H., de Boon, A., & Sandström, C. (2019). Impacts of Norwegian large carnivore management strategy on national grazing sector. *Journal of Mountain Science*, *16*(11), 2470–2483.

Jacobsen, K. S., & Linnell, J. D. (2016). Perceptions of environmental justice and the conflict surrounding large carnivore management in Norway—Implications for conflict management. *Biological Conservation*, *203*, 197–206.

Johnston, R. J., Boyle, K. J., Adamowicz, W. V., Bennett, J., Brouwer, R., Cameron, T. A., Hanemann, W. M., Hanley, N., Ryan, M., Scarpa, R., Tourangeau, R., & Vossler, C. A. (2017). Contemporary Guidance for Stated Preference Studies. *Journal of the Association of Environmental and Resource Economists*, *4*(2), 319–405. https://doi.org/10.1086/691697

Kaltenborn, B. P., & Bjerke, T. (2002). Associations between environmental value orientations and landscape preferences. *Landscape and Urban Planning*, *59*(1), 1–11.

Kaltenborn, B. P., Bjerke, T., & Vitters; oslash, J. (1999). Attitudes toward large carnivores among sheep farmers, wildlife managers, and research biologists in Norway. *Human Dimensions of Wildlife*, *4*(3), 57–73.

Kleiven, J., Bjerke, T., & Kaltenborn, B. P. (2004). Factors influencing the social acceptability of large carnivore behaviors. *Biodiversity and Conservation*, *13*(9), 1647–1658. https://doi.org/10.1023/b:bioc.0000029328.81255.38

Knaus, W. (2016). Perspectives on pasture versus indoor feeding of dairy cows. *Journal of the Science of Food and Agriculture*, *96*(1), 9–17.

Krohn, C. C., & Munksgaard, L. (1993). Behavior of dairy cows kept in extensive (loose housing/pasture) or intensive (tie stall) environments II. Lying and lying-down behavior. *Applied Animal Behavior Science*, *37*(1), 1–16.

Mazzocchi, C., & Sali, G. (2018). Assessing the value of pastoral farming in the Alps using choice experiments: Evidence for public policies and management. *Journal of Environmental Planning and Management*, *62*(4), 552–567. https://doi.org/10.1080/09640568.2018.1430557

Miller, K., & Wood-Gush, D. G. (1991). Some effects of housing on the social behavior of dairy cows. *Animal Production*, *53*(3), 271–278.

Rovbase. (n.d.). Rovbase. Retrieved June 7, 2021, from https://www.rovbase.no/erstatning/sau

Rovvilt - Miljødirektoratet. (n.d.). Miljødirektoratet/Norwegian Environment Agency. https://www.miljodirektoratet.no/ansvarsomrader/arter-naturtyper/vilt/rovvilt/

Røskaft, E., Händel, B., Bjerke, T., & Kaltenborn, B. P. (2007). Human attitudes towards large carnivores in Norway. *Wildlife Biology*, *13*(2), 172–185. https://doi.org/10.2981/0909-6396(2007)13

Scarpa, R., Notaro, S., Louviere, J., & Raffaelli, R. (2011). Exploring scale effects of best/worst rank ordered choice data to estimate benefits of tourism in Alpine grazing commons. *American Journal of Agricultural Economics*, *93*(3), 813–828.

Schaak, H., & Musshoff, O. (2020). Public preferences for pasture landscapes in Germany—A latent class analysis of a nationwide discrete choice experiment. *Land Use Policy*, *91*, 104371.

Schulte, H. D., Armbrecht, L., Bürger, R., Gauly, M., Musshoff, O., & Hüttel, S. (2018). Let the cows graze: An empirical investigation on the trade-off between efficiency and farm animal welfare in milk production. *Land Use Policy*, *79*, 375–385.

Sen, A. (1985). Goals, commitment, and identity. *The Journal of Law, Economics, & Organization*, *1*(2), 341–355. https://doi.org/10.1093/oxfordjournals.jleo.a036895

Sen, A. (1977). Rational Fools: A critique of the behavioral foundations of economic theory. *Philosophy & Public Affairs*, *6*(4), 317–344. http://kie.vse.cz/wp-content/uploads/Sen-1977.pdf

Skogen, K., & Krange, O. (2003). A wolf at the gate: The anti-carnivore alliance and the symbolic construction of community. *Sociologia Ruralis*, *43*(3), 309–325. https://doi.org/10.1111/1467-9523.00247

Slade, E., Burhanuddin, M., Caliman, J., Foster, W., Naim, M., Prawirosukarto, S., Snaddon, J., Tuner, E., & Mann, D. (2014). Can cattle grazing in mature oil palm increase biodiversity and ecosystem service provision? *The Planter*, *90*(1062), 655–665.

Strand, G.-H. (2020). The combined effects of centralization and carnivore management on sheep farmers and sheep farming in Norway. *Human Dimensions of Wildlife*, *26*(4), 321–336. *https://doi.org/10.1080/10871209.2020.1818895*

Strand, G.-H., Hansen, I., de Boon, A., & Sandström, C. (2019). Carnivore management zones and their impact on sheep farming in Norway. *Environmental Management* 2019 64:5, 64(5):537–552.

van den Pol, M.H.A. de Haan, A.G. Evers, & A.P. Philipsen. (2010). Simulation of the effect of grass intake on the farmer's income. *Grassland in a Changing World. Proceedings of the 23rd General Meeting of the European Grassland Federation, Kiel, Germany, 29th August - 2nd September 2010.*, 100–102. http://library.wur.nl/WebQuery/wurpubs/402665

van den Pol, A., Vellinga, T. V., Johansen, A., & Kennedy, E. (2008). To graze or not to graze, thats the question. In *Proceedings of the 22nd General Meeting of the European Grassland Federation, Uppsala, Sweden, 9–12 June, 2008* (pp. 706–716).

van Zanten, B. T., Verburg, P. H., Espinosa, M., Gomez-y Paloma, S., Galimberti, G., Kantelhardt, J., Kapfer, M., Lefebvre, M., Manrique, R., Piorr, A., Raggi, M., Schaller, L., Targetti, S., Zasada, I., & Viaggi, D. (2013). European agricultural landscapes, common agricultural policy and ecosystem services: A review. *Agronomy for Sustainable Development*, *34*(2), 309–325.

Van Zanten, B. T., Verburg, P. H., Koetse, M. J., & van Beukering, P. J. (2014). Preferences for European agrarian landscapes: A meta-analysis of case studies. *Landscape and Urban Planning*, *132*, 89–101.

Weinrich, R., Kühl, S., Zühlsdorf, A., & Spiller, A. (2014). Consumer attitudes in Germany towards different dairy housing systems and their implications for the marketing of pasture raised milk. *International Food and Agribusiness Management Review*, *17*(4), 205–222.

Zahl-Thanem, A., Burton, R. J., Blekesaune, A., Haugen, M. S., & Rønningen, K. (2020). The impact of wolves on psychological distress among farmers in Norway. *Journal of Rural Studies*, *78*, 1–11.

Appendix A

A1

Table 10 corresponds to tables 6 in the text where in those tables marginal effects were reported. In all the models our base outcome is the status quo scenario therefore all the other alternatives will be compared to the status quo scenario. Model 1 has all the alternatives (Status quo, Program A, Program B, and no opinion/ ”don’t know”) while models 2 and 3 have just three alternatives (Status quo, Program A, and Program B). In model 2 we dropped observations who chose ”don’t know” while in model 3 we merged ”don’t know” responses with the status quo option, therefor the likelihood of choosing Program A/B is compared with the base outcome choosing either status quo or ”Don’t Know”. The results were quite consistent and robust across the different models.

Table 10: Multinomial model results.

	Model 1 Basic	Model 2 With dropped don’t know alternative
Program_A		
Age	-0.0233***	-0.0244***
	(0.00695)	(0.00717)
Female: 1=Yes	-1.057***	-1.085***
	(0.228)	(0.232)
Higher Education	0.388	0.445+
	(0.255)	(0.255)
Centrality Index	0.00310***	0.00290**
	(0.000890)	(0.000898)
CMZ_dummy	0.277	0.287
	(0.217)	(0.218)
Number of sheep and Lambs grazing in the Municipality Respondent lives in	-0.0000666	-0.0000806
	(0.0000925)	(0.0000947)
Knowing someone whose animals have been killed by predators	0.658**	0.616*
	(0.241)	(0.242)

trips with accommodation in a tent or cabin	0.426^{+}	0.423^{+}
	(0.230)	(0.232)
Hunting	-0.282	-0.289
	(0.334)	(0.334)
Constant	-1.541^{+}	-1.307
	(0.839)	(0.879)
Program_B		
Age	0.00365	0.00491
	(0.00630)	(0.00639)
Female: 1=Yes	-0.479*	-0.412*
	(0.200)	(0.201)
Higher Education	-0.454^{+}	-0.431^{+}
	(0.260)	(0.261)
Centrality Index	0.00121	0.00126
	(0.000785)	(0.000789)
CMZ_dummy	-0.113	-0.122
	(0.192)	(0.192)
Number of sheep and Lambs grazing in the Municipality Respondent lives in	0.000107^{+}	0.000107^{+}
	(0.0000642)	(0.0000643)
Knowing someone whose animals have been killed by predators	1.518***	1.516***
	(0.202)	(0.202)
trips with accommodation in a tent or cabin	0.694***	0.726***
	(0.203)	(0.206)
Hunting	-0.137	-0.106
	(0.280)	(0.280)
Constant	-1.788*	-1.945*
	(0.763)	(0.784)
don_t_know		
Age	-0.0618***	
	(0.0107)	
Female: 1=Yes	-0.273	
	(0.333)	

Higher Education	-0.520 (0.424)	
Centrality Index	0.00112 (0.00130)	
CMZ_dummy	0.390 (0.326)	
Number of sheep and Lambs grazing in the Municipality Respondent lives in	-0.000268 (0.000165)	
Knowing someone whose animals have been killed by predators	0.548 (0.355)	
trips with accommodation in a tent or cabin	-0.289 (0.362)	
Hunting	-14.37 (445.8)	
Constant	1.002 (1.187)	
Observations	739	683

Reported are coefficients and standard errors in parenthesis ($^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$).

A2 Survey

Your opinion matters!

Thank you for helping us with this study which is part of environmental and resource economics research at NTNU.The survey covers the topic of land-use conflicts and organic food consumption. There are no right or wrong answers; therefore, please answer the survey honestly and completely. The answers you give will be confidential, and you are anonymous. It will take about 15-20 minutes to complete this survey.

The carnivore-sheep tradeoff

1. Resources and budgets are limited, and hence a country cannot provide the highest level of all services to its citizens. In practice, tradeoffs must be made in the provision of goods and services. In your opinion, how important are the following goals?

	0.Very Important	1.Important	2.Moderately Important	3.Slightly Important	4. Not Important	5.don't know
Reducing local air pollution						
Increasing Norwegian self-sufficiency of food						
Conservation of endangered species						
More onshore wind-power development						
Improving railway infrastructure						
Improving livestock welfare						
Reducing greenhouse gas emissions						

Environmental attitude questions

2. please indicate whether you agree or disagree with each of the following statements

	0.Strongly agree	1. agree	2. neutral	3.disagree	4.Strongly disagree	5. Don't know
large predators in Norway are necessary to maintain biodiversity in nature						

Widespread sheep grazing will provide a better landscape view						
Farmers should supervise their flock when their flock are grazing in predator-risk areas.						
Livestock production has significant environmental cost in terms of global greenhouse gas (GHG) emissions						
Hunting of endangered species in Norway should always be prohibited						
Compensation to farmers for their lost sheep and lambs should be maintained						
Public access to						

forests and mountains shall be maintained						
Free-range grazing is an important aspect of animal welfare						
Refore station should be a priority						

Attitudes toward livestock welfare

3. how important is it for you that

	0.Very important	1.important	2.Moderately important	3.Slightly important	4.Not important	5.Don't know
livestock are raised without antibiotics (or growth hormones)						
livestock are fed organic feed						
Livestock have access to pasture/free-range						

4. which of the following attributes of sheep grazing are the most important in your opinion [select up to 3 options]
   - improved landscape view
   - landscape view with grazing sheep
   - Preserved biodiversity and Ecosystem service

- □ Enhance health and welfare of sheep
- □ grass-fed sheep products
- □ None
- □ Other ; please specify_____

5. Choose the outdoor activities you engage in? □Hiking □Jogging □ Cross-country skiing □fishing □Boat trips or Paddling □ trips with accommodation in a tent or cabin □ hunting □ None □Other:please specify__
6. Approximately How often did you go hunting in the past 12 months? ___ times
7. Approximately how often did you go for hiking in the past 12 months? ____times
8. Approximately how often did you go fishing in the past 12 months? _____times
9. Approximately how often did you go for trips with accommodation in a tent or cabin in the past 12 months? _____times
10. Approximately how often did you go for paddling or boat trips in the past 12 months? _times
11. Have you encountered large carnivores in the wild before? □no □yes
12. Would you be willing to have large carnivores in the area where you live? □no □yes
13. Did you have an animal killed by a large predator before? □no □yes □I donot own animal
14. Do you know someone whose animals have been killed by predators? □no □yes
15. Are you a member of any environmental organization? □no □ yes
16. Which political party do you support to handle topics related to carnivore-livestock conflicts?

    □ 0.Arbeiderpartiet □ 1. Høyre □ 2. Fremskriispartiet □ 3. Senterpartiet

    □ 4. Socialistisk Venstreparti □ 5. Venstre □ 6. Kristelig Folkeparti

    □ 7. Miljøpartiet de Grønne □8. Rødt □ I don't know □ I do not wish to answer
17. In Norway, sheep must graze on a pasture by law for at least 16 weeks per year as long as the weather allows it. Previous studies have shown that grazing has several benefits as opposed to intensive indoor animal production. Grazing on pasture land reduces anti-social behaviour and health risks-such as mastitis in livestock. Grazing also enhances animal welfare. Grazing preserves biodiversity and provides an ecosystem service. On the other hand, sheep are vulnerable to predator attacks and other unfortunate incidents during free-range grazing. Among these large predators, wolves, lynx, wolverine and brown bear have the status of critically endangered on the Norwegian Red List of Species 2015 (Rovdata.no)

Consider the following alternatives; the status quo, program A and program B. If the government is to implement one of the alternatives, which one would you be willing to vote for? Only one of the alternatives can be implemented. Tick only on one program you vote for.

Status quo (year 2020)	**Program A**	**Program B**	**Don't know**
Number of large carnivores in Norway: 58 wolves, 398 lynx, 386 wolverines, 150 brown bears and 1382 golden eagles. Total number of sheep in 2020: 2.29 million Confirmed and compensated losses: 2368 sheep and 12330 lambs	10% increase in carnivores* Naturally leads to more loss in sheep. More carnivores and fewer sheep in the mountains	10% increase in sheep and 10% decrease in carnivores* Lead to more sheep grazing on the mountains and fewer carnivores	
I would rather keep the current status.	I would rather have more carnivores up on the mountains in Norway.	I would rather have more sheep grazing upon the mountains.	
I vote to keep the status quo □	I vote for program A □	I vote for program B □	I Don't know □

*Wolverine, lynx, bear, wolf and golden eagles.

(*If your answer to question number 17 was A, please respond to question 18 and skip questions 19 and 20. If your answer to question number 17 was B, please skip questions 18 and 20 and*

answer question 19. If your answer was the status quo or I don't know, please skip questions 18 and 19 and answer question 20.)

18. What are the main reasons why you chose program A

[Select up to 3 options]

- ☐ I want to have the opportunity to meet large carnivores on walks in the woods and fields
- ☐ I may never see a large carnivore, but it is important for me to know that they exist in Norway
- ☐ Large carnivores have the right to exist in Norway
- ☐ Sheep should not be grazing on the mountains
- ☐ I chose program A for no particular reason
- ☐ Other;please specify_____

19. . Why did you chose program B? [Select up to 3 options]

- ☐ I would like to see more sheep grazing on the mountains without the risk of predator attacks
- ☐ Large carnivors are not so important to me
- ☐ Large carnivores are numerous in other countries, and we do not have to increase them in Norway
- ☐ I do not want large carnivores in my immediate area
- ☐ I think large carnivores affect the outdoor life of people negatively and thus does not want large carnivores in Norway
- ☐ I chose program B for no particular reason
- ☐ Other; please specify_____

20. Why did you chose the status quo or "I don't know"? please specify _____