

The impact of wolves on psychological distress among farmers in Norway

Abstract:

The reappearance of large carnivores in Europe can be viewed as a conservation success, however, the increase in carnivore numbers has also resulted in an increase in livestock predation. While multiple studies have been conducted into farmers' attitudes to large carnivores, the consequence of predation on farmers' mental health and wellbeing is under-researched. Using a mixed-method approach, this study examines the potential regional impact of the presence of wolves on farmers' psychological distress in Norway. Data from the nationally representative Trends in Norwegian Agriculture Survey was analysed using a multiple regression analysis. Psychological distress was measured using a 5 item Hopkins Symptom Checklist. Comparison with register data of livestock losses showed that sheep farmers living in regions where sheep have been killed by wolves within the last 5 years have higher psychological distress scores than (a) sheep farmers elsewhere in Norway, and (b) farmers in the same region without sheep. What makes our study different from others is that the Trends survey was not targeted at the wolf issue directly, meaning that accusations of farmer bias against wolves when responding to surveys cannot explain our results. We support this conclusion by exploring (and, ultimately, dismissing) alternative explanations and through 20 qualitative interviews with sheep farmers in a predation region (regional county of Hedmark) to investigate how carnivore presence is experienced. Stress, anxiety, sleep deprivation, and reduced quality of life were reported as key consequences of the carnivore pressure. The findings suggest that farmers do not need to experience animal deaths and injuries personally to experience the distress of predation. Living nearby and assisting farmer colleagues make this a shared condition.

1. Introduction

After centuries of persecution, populations of large carnivores (bears, wolves, lynx, and wolverines) are now recovering across many countries in Europe due to conservation efforts and favorable legislation (Boitani et al., 2015). Although this recovery can be viewed as a conservation success, the reappearance of large carnivores has resulted in both challenges and conflicts within many countries. In their absence, agriculture and rural land use have, to a certain extent, adapted to a more or less carnivore free environment with lifestyles, livestock, and economies dependent on a low degree of carnivore pressure. Despite the implementation of a plethora of measures (Eklund et al., 2017; Meuret et al., 2019), the reappearance of large carnivores has led to increased predation of livestock in many countries – affecting farmers in various ways (e.g. see Hinojosa et al. 2018). Although human-wildlife dimensions (HWD) is a growing study field (Dubois and Harshaw, 2013), the consequences of the presence and conservation of large carnivores on farmers' mental health and wellbeing is an under-researched topic.

Farmers as an occupational group are known to be prone to various mental health issues (see Hounsome, 2012). Aspects of the profession, including long working hours, relative isolation, and financial instability along with other uncertainties, have been found to influence farmers' mental health (Torske et al. 2016; Logstein 2016). The addition of large carnivore pressure to this list – particularly in regions that have, until recently, been relatively free from carnivores – can add another critical and potentially significant stressor to the farming profession. Media articles describe farmers regularly searching for cadavers and injured livestock, and report interviews in which farmers express a state of constant fear of livestock injuries and losses (Breivik, 2010; Johannessen and Sarmadawy, 2017; Øyhovden, 2018; Børresen, Hagen and Slåen, 2018). Nevertheless, the predominant means of assessing farmers' responses to and perceptions of carnivores is through the

measurement of attitudes (evaluative assessments of belief strength), while analyses of the consequences of the conservation of large carnivores' impact on farmers' lives, and psychological distress¹, are almost non-existent.

Attitude studies have led to a general consensus that farmers' views toward carnivores are almost invariably negative, strongly negative, or even hostile (e.g. Bright and Manfredo, 1996; Kellert et al., 1996; Bjerke et al., 1998; Bjerke and Kaltenborn, 1999; Kaltenborn et al., 1999; Ericsson and Heberlein, 2003; Ednarsson, 2006; Bruskotter et al., 2009; Dressel et al., 2014). Even where direct experience with carnivores is very low or predators are no longer present in the region, farmers' attitudes towards predation can nevertheless be strong (Kellert et al., 1996; Fritts et al., 2003). This lead Kellert et al. (1996: 980) to contend that studies up to that point "consistently reveal deeply ingrained biases among agriculturalists, particularly livestock producers, against wolves and other large predators, often independent of personal experience", a claim later repeated by Chavez et al. (2005). However, rather than ingrained biases (unfair prejudices based on preconceived ideas), others have suggested attitudes towards carnivores are generally formed through indirect experience of carnivore presence (e.g. through friends, family, and media) (Karlsson and Sjöström, 2007; Johansson et al., 2012, 2016; Ojalammia and Blomley, 2015) – in other words, farmers do not need to directly experience predation of livestock to be affected by their presence. Thus, there is a debate concerning what drives farmers negative responses to carnivores – are they simply biased or do they genuinely experience distress regardless of whether they are directly affected or not?

One of the problems with disentangling these explanations is that, in the course of conducting research about predation, the introduction of the topic alone may be sufficient to trigger an anti-

¹ Psychological distress is internal responses to external stressors (Lazarus and Folkman, 1984), and can be defined as negative stress. High levels of psychological distress are associated with psychopathology such as depression and anxiety (Andrews and Slade, 2001).

predator response. Concern that farmers might express bias when responding to farm surveys in order to promote their economic interests has been raised by van den Berg et al. (1998) (although their study subsequently showed no evidence of this) while other biases such social bias (e.g. a desire to maintain social capital in the farming community – see Sutherland and Burton, 2011) could also lead to an inaccurate response.

This paper seeks to disentangle some of these issues by exploring distress in sheep farming communities, relating this indirectly to the presence/absence of carnivores and engaging in in-depth investigation of the relationship between the presence of carnivores (wolves) and sources of distress caused by the close proximity. The focus is on sheep farmers because the larger size of cattle and different management regimes (in particular, less outfield grazing) mean that they are considerably less prone to carnivore attack. The paper is divided into seven sections. Following this introduction, we review literature on why and how carnivore presence could cause distress in farmers, present the study context in Norway, and outline the methodology of the study. For the analysis, we first present the results of a regression analysis conducted on a nationally representative survey of farmers in Norway and, next, explore the issue more thoroughly through an in-depth qualitative survey of 20 sheep farmers in Hedmark (one of the affected counties). The discussion re-examines the issue of distress caused by carnivores in the context of the findings and makes the case for connecting distress levels in the survey with the presence of carnivores, discusses the implications of the research for future carnivore policy, and makes recommendations for future research.

2. Carnivores and sheep farmers' psychological distress

Numerous factors associated with managing an agricultural business can lead to psychological distress when faced with a carnivore threat. The key issues raised in the literature have been (a) the

strength of the psychological attachment farmers have to their livestock, (b) the lack of control farmers are able to exert to reduce distress as a result of predation (combined with a lack of faith in the authorities), and (c) the changes farmers must make to their everyday lives in order to address the ambient pressures the presence of carnivores places on living in rural areas as a sheep farmer. Here we discuss each of these issues in turn.

Sheep farmers' strong emotional attachment to their farms and livestock has been widely established within the agricultural literature. From the concept of consubstantial (literally, being of the same essence) existence of sheep farmers and their stock outlined by Gray (1998), to the notion of "lifescapes" – interactions between humans, livestock and landscape that shape farmers' way of being in the world (Convery et al., 2005) – sheep farmers' lives and sense of self-worth have been found to revolve around their farms and their animals (also see Riley, 2011). All of these studies have illustrated how the breeding of livestock (sheep) by generations of family members on the farm creates a strong connection between the farmer, the farm family, the land, and the livestock. This connection leaves the livestock representing not only an economic investment, but an integrated part of the farm family's social and cultural world.

A particularly important aspect of attachment is to the bloodlines of the livestock. Sociological studies suggest that the skills and knowledge applied to breeding livestock sit at the center of the farmer's identity as a farmer, generating the peer esteem and social capital that bonds farming communities together (Yarwood and Evans, 2006; Burton et al., 2008; Sutherland and Burton, 2011). As a result of this attachment, predation can have a devastating effect on farmers. Mounet and Keogh (2006) observe that the "years of effort and pride in a job well done" destroyed by a carnivore attack can cause extreme stress, while the need to change the management practices can also worsen the condition of the livestock (with livestock condition being a key expression of the application of skills

and knowledge – Burton et al., 2008). However, looking after the animals can also lead to strong bonds with the livestock – as is evidenced by Meuret and Provenza’s (2014) observation that herders form strong attachments to the animals they care for. Attachment to livestock thus is not limited to long-established family farmers but also others such as new entrants and hobby farmers.

The lack of control over large carnivore management can also lead to psychological distress. Control is a powerful explanatory variable in stress research (Steptoe and Poole, 2016), and has been identified as an issue in human-wildlife conflict studies. Bjerke et al. (2000), for example, used the notion of “locus of control” to explore how control over scientific debates and management instruments gave scientists and wildlife managers a higher degree of control over predators than farmers experienced. This lack of control, the authors postulated, was responsible for farmers’ more negative attitudes toward large carnivores. However, the application of the concept to carnivore research is problematic as locus of control refers to generalised control beliefs about one’s life such as belief in luck, fate or the ability of others to exert control (Rotter, 1966) – rather than specific control beliefs such as the ability to control the presence of large carnivores. Another reason for suspecting that fears of carnivores are driven by more than “locus of control” comes from the uncertain connection between personality traits and fear/anxiety (Johansson et al., 2012).

Johansson et al. (2012; 2016) employ the concept of “social trust” rather than “locus of control” to understand how the presence of large carnivores influences anxiety and fear. The authors contend there are two paths for the antecedents of fear of wolves – one incorporating the environmental context (e.g. the perceived extent of damage the animal can cause or the perceived unpredictability of the animal) while the other concerns the social trust in large carnivore management.

Arguably, the antecedents of psychological distress among sheep farmers may follow the same two paths. Here, social trust is defined as the willingness to rely on those who are formally responsible (in this case for predator control) to develop the appropriate measures and take action to alleviate potential conflict. The level of social trust experienced by the individual is determined by comparing one's own salient values to the perceived salient values of the comparison person or group – combined with an assessment of whether the person/group is trustworthy. This is often reflected in a willingness to rely on management authorities to take appropriate actions to ensure public health and safety (Zajac et al., 2012). Johansson et al. (2016) contend that where there is high social trust in carnivore management, the experienced anxiety is low, whereas low levels of social trust add to feelings of anxiety. At the same time, they suggest that the importance of the two pathways varies depending on the geographical proximity to carnivore areas, with social trust being more important as an antecedent of fear for those who live closer to carnivore territory – i.e. who are more likely to experience carnivores.

Finally, a number of studies have illustrated how carnivore presence can necessitate a change in family life and farm management – and have identified that this change can cause a level of ambient distress. For example, farmers may need to create night-time enclosures, introduce dogs, change the routes to the mountain pastures (Mounet and Keogh, 2006), carry a weapon, or change the way they move around the farm (Browne-Núñez et al., 2015). This may also include a reduction in “safe grasslands” and unexpected and inconvenient changes to farm management practices, such as a need to hire shepherds to look after livestock, reduce the range of extensive grazing and/or build new infrastructure around the farms (Hinojosa et al., 2018). The challenges may vary according to context and type of carnivore. A plethora of measures have been implemented in many countries; guard dogs, high fences, night pens, and so on, although the implementation of these measures has often had less effect than hoped for (Eklund et al., 2017; Meuret et al., 2019).

3. Study context: Norway's carnivore policy and management

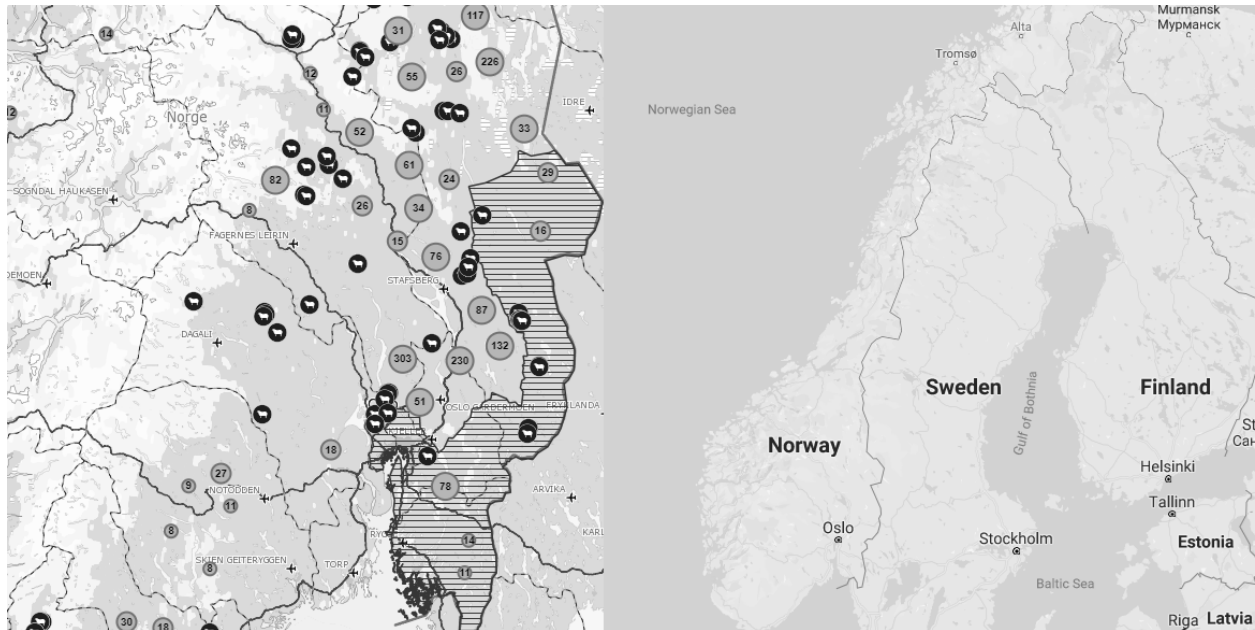


Figure 1. Designated wolf-zone (hatched) and the number of sheep reported injured or killed by wolves in the period 2013 - 2017 in Norway. (Source: Rovbase.no).

Like many countries in Europe, Norway has recently seen an increase in the number of large carnivores after 100 years of near extinction – in particular, an increase in the population of all the ‘four large carnivores’; lynx, wolverine, bear and wolf, and additionally eagles. The signing of the Bern Convention (1979) and the Convention on Biological Diversity (1992) obligates Norway to ensure sustainable management of these carnivores. With its very limited cultivated land (3 percent), animal husbandry historically developed around the extensive use of grazing resources in the outfields (Bele et al., 2013). During the many years of absence, Norwegian agriculture has adapted to a more or less carnivore free environment, and thus, beyond the international obligations, Norway’s carnivore policy promotes a ‘two-fold objective’ of preserving sustainable large carnivore populations and facilitating sustainable animal husbandry based on grazing resources.

Norway's carnivore policy aims to achieve this goal by geographically separating carnivores from grazing animals through the designation of protected carnivore management zones. This goal is referred to as "the Carnivore Agreement of 2011" and is based on parliamentary decision (Proposal 163 S (2010–2011)). The Government has set management goals for each of the four large protected carnivore species – wolf, bear, lynx, and wolverine - within different geographical zones (The Ministry of Climate and Environment, 2017), delineated separately for each species but with considerable spatial overlap between the zones. Thus, some areas have all four large carnivores within the same zone. In these zones, carnivores are given priority, while those practicing animal husbandry are expected to implement preventive measures to avoid carnivore damage (e.g. fenced grazing or moving production from sheep to beef). The remaining regions (not allocated to one or more carnivore species) are prioritized for livestock (Strand, 2016).

Over the last couple of decades, the number of grazing animals has declined in the carnivore zones (Hansen et al., 2019). This is especially the case in the wolf and bear zones as the need for effective preventive measures are considerable in these areas. In the wolf zone, there are hardly any grazing animals left in the outfield where the wolf has established itself. Thus, for summer grazing most sheep farmers either transport their livestock out of the wolf zone or graze them on inbye land with the help of electric fences. Despite a reduction in the number of sheep inside the carnivore zones, the total number of sheep in Norway has remained stable, as the number of sheep has increased in other regions (Hansen et al., 2019).

Uncontrolled growth in the numbers of carnivores in the carnivore zone is incompatible with the two-folded objective. Consequently, when a species' population reaches a pre-determined threshold, the regional carnivore committee has the authority to license hunting of a specific number of that species. According to the carnivore agreement, carnivores who pose a threat to grazing animals

outside the designated carnivore zones should be targeted for the cull (Strand, 2016). However, in cases where a management region has not reached its target threshold or the presence of carnivores is considered not to pose a threat to livestock, culling is not always practiced.

A significant proportion of the documented livestock loss caused by carnivores is reported from outside of the designated carnivore management zones. This applies to all of Norway's four large carnivores, although the proportion of livestock loss and proximity to the carnivore zone differs between the species. Seventy eight percent of the sheep cadavers presumed to be killed by a wolf in the period 2000 – 2015 were found outside the designated wolf zone (Hansen et al., 2019). These deaths were attributed to a combination of Norway's resident wolves extending out of the wolf zone and wolves crossing the border from Sweden. While most sheep are taken by wolverines and lynx, it is wolf predation that has received the most attention in Norway. This has been at least in part, attributed to the way wolves have become embedded in the folklore (Linnell et al., 2012 – also see Skogen et al., 2013). For farmers, however, their focus on the wolf may also – or rather - be related to the amount of damage one single wolf can do to a herd of sheep.

4. Data and methodology

This paper uses a mixed-methods approach based on data from (a) a national representative survey of Norwegian farmers, and (b) qualitative interviews with 20 sheep farmers in areas experiencing pressure from wolf predation. In this section, we first describe the quantitative material, including measurement and statistical analyses, before describing the qualitative material.

4.1 National survey

The quantitative analysis in this paper is based on data from the February 2018 iteration of “Trends in Norwegian Agriculture” – a biennial survey administered by Ruralis (www.ruralis.no) to a population of farmers representative at the national level. The survey covers a wide range of socio-cultural topics within agriculture, such as economy, investment plans, farm succession, and health. The targeted population is defined as farmers who are registered in the Register of Producers with the Norwegian Agricultural Authority and manage a farm with at least 0.5 ha of farmland (Zahl-Thanem et al., 2018). Using a random selection method, the survey was sent out to a national sample of farmers using both mail and email as a collection method. From the 6000 questionnaires that were sent out by mail and email (3000 each), a total of 1874 respondents completed the questionnaire (mail invitation n = 1232, email invitation n = 642). The overall response rate of the mail survey was 41.1% and the response rate of the email survey 21.4%.

We supplemented this survey data with municipality level data from the Norwegian Environment Agency’s ‘Rovbase’ (containing all registered livestock deaths in Norway) and Statistics Norway (characteristics of the municipalities). Using multiple regression analyses (OLS) in STATA 15.0, we examined individual and regional socio-demographic variables and assessed whether living in a wolf zone or a municipality with a history of wolf attacks on livestock, were important contributing factors on farmers’ psychological distress (measured on the scale detailed below).

The analysis and approach emerged from explorations of the dataset where it was observed that levels of psychological distress reported by sheep farmers appeared to show a strong relationship to the proximity to carnivore areas. This, we contended, provided us with a unique opportunity to explore distress caused to farmers by proximity to predators without the possibility of respondents consciously exaggerating the impact of wolves – a claim made in the past (Kellert et al., 1996; Chavez et al., 2005 – see above) and one very difficult to categorically dismiss through direct studies of

farmers' responses to carnivores. A series of qualitative interviews with farmers added explanatory value to the statistical analysis – and enabled us to closer explore the links between the presence of wolves and farmers' psychological distress.

4.1.1 Measurements

Psychological distress, the dependent variable in the analysis, was measured by the Hopkins Symptom Checklist-5 (SCL-5). The SCL-5 is a five-item shortened version of the Hopkins Symptom Checklist (SCL-25), which is a commonly used self-administered instrument designed to measure psychological distress, or, more specifically, symptoms of anxiety and depression in population surveys (Strand et al., 2003; Skorve et al., 2013). Given a high degree of overlap in completion of the instruments and high correlation between the different versions of SCL (Strand et al., 2003), the shortened version SCL-5 was used to limit questionnaire fatigue. In the SCL-5, respondents are given the following instructions: "To what extent have you been bothered by the following symptoms during the last 14 days?". Respondents were asked to evaluate the presence or absence of the following five symptoms: feeling down and sad, feeling fearful and anxious, feeling tense and uneasy, feeling hopeless when thinking about the future, and worrying too much about various things². These items were scored on a scale from 1 (not bothered) to 4 (very bothered). The Cronbach's alpha for the SCL-5, estimated from the sub-sample of 1,650 farmers used in our analysis, was 0.87, and the McDonald's Omega Reliability Coefficient was 0.76 – indicating a high internal consistency reliability in the scale. For the 51 farmers (3 percent) who had responded to some but not all of the five measures, an additive scale was calculated as a mean for the unanswered items.

² Directly translated from the Norwegian questionnaire.

In addition to the dependent variable, several independent variables were added to the analyses. *Gender* was coded as a dummy variable, with women assigned the value 1 and men the value 0. *Age* was coded as a categorical variable with three groups 'Under 40 years', '40 to 59', and '60 year or older'. This was measured by two dummy variables, with farmers 60 years or older as a reference category. Total *Household income* was coded into 11 categories from 1 ('below 100 000 Norwegian kroner', i.e. around 10 000 euro) to 11 ('over 1 000 000 Norwegian kroner', i.e. around 100 000 euro). The variable was treated as linear as it measured a linear increase or decrease in income. *Educational level* was a dummy variable where farmers with education at university-level were coded 1 and farmers with a degree on lower levels were coded 0. *Married or cohabiting* was a dummy variable with farmers having a partner coded 1, while farmers without a partner are coded 0. *Children* was measured in a dummy variable with farmers having children coded 1, and farmers without children coded 0. *Off-farm work* was coded as a dummy variable, where farmers with paid work outside the farm coded 1 and farmers with no work outside the farm coded 0. *Sheep production* was a self-reported measurement of the farmers' production on the farm, where farmers engaged in sheep production were assigned the value 1, while farmers without sheep production were assigned the value 0.

Additionally, several independent variables measuring characteristics of the respondents' municipalities were included in the analysis. *Sheep killed by wolves in the last 5 years* was coded as a dummy variable measuring whether the respondent lives within a municipality with a loss of sheep to wolves (1) or not (0). In order to avoid cases of doubt and misclassifications and ensure that there was some stability in the likelihood of experiencing wolves in the fields, a municipality with loss was defined as having 10 or more registered sheep cadavers due to attacks by wolves between 2013 and 2017. This creates a distinction between municipalities where wolves have predated sheep in recent times, and current wolf-free municipalities. *Wolf-Zone* is coded into a dummy variable measuring

whether the respondents' municipality is located within the designated Wolf-Zone (1) or not (0). The wolf-zone does not follow the municipality-zones perfectly, which means that some municipalities are both within and outside the wolf-zone. However, the majority of the farmers assigned the value 1 were within the wolf-zone, and those outside were living in close to the wolf-zone.

Analysing geographical differences in farmers' psychological distress, and the presence of wolves may potentially be biased if regional characteristics which may cause spurious effects are not accounted for. Thus, several municipality level variables were included in the analysis. *Centrality* is an official classification of Norwegian municipalities in a rural-urban dimension that varies from 1 (contains the most central municipalities) to 6 (contains the least central municipalities). The calculation of the centrality index was based on travel time to workplaces and service functions from all populated basic statistical units (see Statistics Norway, 2018). Further, *Unemployment rate* was a continuous variable measuring the percent of residents in the respondent's municipality that are unemployed. *Net migration* measured the difference between in-migration and out-migration in the respondents' municipality during the previous year. *Proportion with higher education* measured the proportion of residents in the municipality with higher education (i.e. university level). *Gross median income* measured the median income in the respondents' municipality. The descriptive statistics for these variables are presented in Table 1.

Table 1. *Descriptive statistics of study variables.*

	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>Min.</i>	<i>Max</i>
<i>Dependent variable</i>					
Psychological distress (SCL-5)	1650	1.418	0.528	1	4
<i>Individual level (Level 1):</i>					
Gender (dummy: women=1/men=0)	1650	0.166	0.372	0	1
Married or cohabiting (yes=1/no=0)	1650	0.855	0.352	0	1
Children (yes=1/no=0)	1650	0.867	0.339	0	1

Higher education (yes=1/no=0)	1650	0.333	0.472	0	1
Household income (1=low to 11=high)	1650	7.496	2.704	1	11
Age group (dummy: ref. 60 year or more)					
Less than 40 years	1650	0.139	0.346	0	1
40 to 59 years	1650	0.552	0.497	0	1
Off-farm work (yes=1/no=0)	1650	0.697	0.460	0	1
Sheep farmer (yes=1/no=0)	1650	0.388	0.487	0	1
<i>Municipal level (Level 2):</i>					
Centrality (1-6)	1650	4.099	1.135	1	6
Unemployment	1650	1.821	0.707	0.3	4.8
Net emigration	1650	1.715	10.074	-41.6	40.5
Proportion with higher education	1650	24.893	5.464	14.4	50.7
Median income (in 100 000 NOK)	1650	3.612	0.300	1.8	4.392
Sheep killed by wolves last 5 years (yes=1/no=0)	1650	0.203	0.402	0	1
Wolf zone (yes=1/no=0)	1650	0.128	0.334	0	1

4.2 Qualitative interviews with farmers

The qualitative interviews were conducted among sheep farmers in Hedmark county in the autumn of 2017. Hedmark has target thresholds for all the four large carnivores and golden eagles. We conducted 20 interviews with farmers in four different municipalities; two municipalities within and two municipalities outside the designated wolf-zone. Names and addresses of active farmers were based on applications for production subsidies provided by County Governor's Agriculture Department office. This included information about farmer's age and livestock numbers (i.e. type of production and farm size). We selected sheep farmers with various compositions regarding age, gender, farm size, and type of production in addition to sheep farming. Hence, farmers interviewed ranged from 29 to 68 years of age, the majority were male farmers, and in two interviews the farm couple was interviewed together. Farms varied in size and included both small, medium and large farms. Eight farmers combined farming with an off-farm job, while twelve were full-time farmers.

Thirteen of the farmers were living in a municipality outside the wolf zone, while seven were living in the wolf-zone.

The majority of interviews were conducted on the farm, although four were conducted as telephone-interviews. Interviews focused on themes such as the farmers' motivation for being a farmer, farm planning and succession, the impact of predation pressure, experiences with and attitudes toward carnivores and carnivore management in Norway and within their specific region. The purpose of the interviews was to understand farmer's relationship to carnivores in greater depth and, as such, unlike the quantitative survey, the issue of carnivores was the main topic of the interview. However, conversations on specific carnivore species were deliberately not initiated by the interviewer to allow farmers to determine the species focus of the interview. At the initiative of the farmers, most of the discussion about carnivores revolved around wolves. Interviews lasted for between one and two hours, and were tape-recorded and transcribed before being analysed. All respondents consented to the use of tape-recorder, and the recording was not considered to impact the interviews. All the interviewees are given fictitious names in this paper.

5. Results

This section is divided into two parts, the first presenting results from the quantitative analysis, and the second the results from the qualitative interviews with the farmers.

5.1 National survey

Table 2 shows the results from three linear regression models. Model 1 estimates the effects of the independent variables on the individual level, Model 2 consists of independent variables on both individual and municipal level, and Model 3 includes two interactional effects to distinguish between

sheep farmers and farmers with other agricultural productions. The dependent variable in all models is farmers' psychological distress (SCL-5). A positive sign coefficient indicates that an increase in the value of the independent variable leads to an increase in the value of the dependent variable, thus an increase in psychological distress. Conversely, if the sign of the coefficient is negative, an increased value of the independent variable leads to a decrease in psychological distress. Statistically significant coefficients are marked with one or two asterisks (*/**), depending on whether the effect is significant on the 0.05, or 0.01-level.

Table 2. Multiple regression analysis (ordinary least squares).

	Modell 1	Modell 2	Modell 3
Constant	1.563** (0.051)	1.375** (0.213)	1.343** (0.212)
<i>Individual level (Level 1):</i>			
Gender (dummy: women=1/men=0)	0.036 (0.035)	0.033 (0.035)	0.030 (0.035)
Married or cohabiting (yes=1/no=0)	-0.058 (0.041)	-0.057 (0.041)	-0.060 (0.041)
Children (yes=1/no=0)	0.071 (0.042)	0.072 (0.042)	0.070 (0.042)
Higher education (yes=1/no=0)	-0.003 (0.028)	-0.007 (0.028)	-0.005 (0.028)
Household income (1=low to 11=high)	-0.035** (0.005)	-0.035** (0.005)	-0.035** (0.005)
Age group (dummy: ref. 60 year or more)			
Less than 40 years	0.247** (0.043)	0.248** (0.043)	0.246** (0.043)
40 to 59 years	0.170** (0.030)	0.174** (0.030)	0.174** (0.030)
Off-farm work (yes=1/no=0)	-0.059* (0.029)	-0.065* (0.029)	-0.063* (0.029)
Sheep farmer (yes=1/no=0)	0.035 (0.029)	0.049 (0.028)	0.006 (0.031)
<i>Municipal level (Level 2):</i>			
Centrality (1-6)		0.009 (0.017)	0.013 (0.017)
Unemployment		0.000 (0.021)	0.004 (0.021)
Net emigration		0.001	0.001

		(0.001)	(0.001)
Proportion with higher education		-0.002	-0.002
		(0.003)	(0.003)
Median income (in 100 000 NOK)		0.050	0.058
		(0.046)	(0.046)
Sheep killed by wolf last 5 year (yes=1/no=0)		0.061	0.018
		(0.034)	(0.039)
Wolf zone (yes=1/no=0)		0.074	0.033
		(0.043)	(0.045)
Interaction (sheep farmer + sheep killed by wolf)			0.140*
			(0.070)
Interaction (sheep farmer + wolf zone)			0.294**
			(0.111)
R ²	0.062	0.068	0.075
Change F		1.39	6.01**
N=	1650	1650	1650

Table 2 shows that younger farmers have significantly higher levels of psychological distress than farmers over 60 years of age. This is applicable for farmers in the age group 40 – 59 years of age and farmers under 40 years of age, in all models. Differences in gender, educational level, and whether the farmer has a partner or children have no effect on the farmers' mental health. However, farmers with higher household incomes score lower on psychological distress than farmers with lower household incomes. Additionally, farmers with off-farm work score lower on psychological distress than farmers who do not have off-farm work. Finally, there were no differences in the level of psychological distress between sheep farmers and farmers producing other commodities at the national level.

None of the independent variables on the municipal level (Model 2) have significant effects on farmers' psychological distress, and these seven variables at the municipal level do not significantly improve the model. This shows that the level of psychological distress is randomly distributed within the municipal variables we have included in Model 2.

The most interesting pattern in Table 2 is found in Model 3. Here we see that the two interaction links between 'sheep farmers' and 'sheep killed by wolf', and 'sheep farmers' and 'wolf zone' have statistically significant effects on farmers' psychological distress. These two links improve the model significantly and show that sheep farmers living in areas where sheep have been lost to wolves during the last five years have significantly higher scores of psychological distress than farmers without sheep production in these areas and higher psychological distress than sheep farmers elsewhere in Norway. This indicates that wolves have an impact on sheep farmers' psychological distress in areas where wolves are present. The reasons we believe the distress is genuinely the result of wolf presence rather than alternative explanations are presented in the discussion section below.

5.2 Qualitative interviews

Almost all the 20 farmers interviewed in Hedmark could relate experiences of livestock predation. Many farmers had experienced loss of their own livestock, but even where this was not the case, helping neighbouring farmers look for cadavers was common. Some of the farmers observed that they were in a state of constant readiness in case of a carnivore attack. Although some farmers had experiences with loss of livestock to all of the four large carnivores, wolves were the carnivore of greatest concern because of the potential extent of the damage they could cause. Farmers described a wide variety of consequences of living in areas with wolves including psychological pressure, stress, sleep deprivation, anxiety and a reduced quality of life. The inability to protect livestock in the outfields sufficiently was pointed to by several of the farmers as leading to a feeling of powerlessness.

'Erik' and 'Martin' are examples of farmers living outside the wolf-zone and within the grazing prioritized area who have experienced large carnivore attacks on their livestock. Erik is in his fifties

and runs a beef and sheep farm. In the interview he described the carnivore situation in the outfields where he has his livestock as “a hell”.

Erik has suffered from sleep deprivation for 10-15 years corresponding to the arrival of carnivores in the region. This sleep deprivation, he contends, is caused by his concern for the welfare of his animals and a constant feeling that he should have been in the outfields protecting his livestock at the time of the carnivore attack. In common with many of the farmers, he also expressed considerable frustration about the extra work caused by the ‘carnivore foolishness’:

“What is the worst is all the stress. It is not the loss of the livestock. It is all the looking after the livestock - all the time I waste on this - and all the nights I do not sleep”

Martin has, after many years as a sheep farmer, reduced the size of his operation dramatically and started with pork production, and keeps the few remaining sheep in infield pastures. He relates the psychological impact the wolf attack had on him:

“There were so many horrible injuries [after wolf attack], and they were still alive. This made a terrible impression on me”

He continued with stories about several other attacks, and how hard it was for him to experience the animals’ suffering. As with Erik, Martin notes how the progressive worsening of the predator situation over the years has affected both his sleep, and his desire to continue farming sheep. Both Erik and Martin expressed great affection for their sheep, and noted that they had enjoyed being sheep farmers before the wolf attacks started. Both were disappointed with the policymakers and the carnivore management approach.

For Erik and Martin the psychological impact was worsened considerably by their direct experience with a carnivore attack. However, as the number of farmers who have experienced an attack is still relatively low (and thus unlikely to explain the results of the regression analysis), an important question is what impact does the existence of large predators in the region have on farmers who have not experienced a wolf attack? Evidence from the qualitative interviews suggests that close geographical proximity to predators alone can also lead to increased levels of distress. This experience of stress and fear was driven by the knowledge that a carnivore attack is something they might have to handle:

‘I know – more or less when there are wolves in the forest, so the fear has a grip on me. I receive warning messages all the time [joint warning system of text messages], being constantly reminded about carnivores’ (Laila).

Many farmers expressed feelings of powerlessness as a result of the external control of carnivore management strategies. Farmers were concerned that the decision to allow wolves to recolonise certain areas was made by policymakers and not by the farmers who were dependent on using the outfields for grazing. While sheep farmers in the wolf-zone are compensated in return for their decreased ability to use the outfield grazings, farmers in the grazing prioritized areas are not and therefore continued to use the outfields. However, living close to the wolf-zone proved difficult. Farmers observed that carnivores do not see the borders between zones, and, even where there is a natural river boundary acting as a barrier, wolves cross over these boundaries when the river freezes.

Problems have therefore escalated in the grazing-prioritized zone over the last two decades. Many of the farmers are frustrated, some are angry, while others gave an impression of being resigned to their

fate. They have limited opportunities to influence and improve the situation as these extracts illustrate:

“It is a constant pressure. The fear is that we have wolves permanently in this [grazing prioritized] area. I believe it will be the end of sheep farming in this area” (Sigurd)

“The predators are here and will be here until they are shot. And the carnivore management authorities, they are certainly not here” (Svein)

This sense of powerlessness is reinforced by the fact that when involving themselves in the carnivore debate, many experience negative feedback:

“It is a terrible burden as a farmer to stand on the barricades. If you stand up, you get so many hate messages. I do not want to expose myself in the public debate” (Steinar)

Some of the farmers talked about what they experienced as harassment and sabotage from pro-carnivore activists. This includes false notifications and reports to the Food Safety Authority about animal cruelty, interfering with legal wolf-hunting by making noise so that those with a hunting permit fail, and interfering with the sheep herding text message system. The debate on social media also seems to affect some of the farmers negatively, especially comments that invariably follow any public debate on predators:

“I find it very unpleasant when I read a Facebook-message that one should ‘hunt sheep farmers’. I find that very hard to handle, I find it disgusting: ‘Shoot a sheep farmer and save a wolf’” (Laila).

Many of the informants said they had stopped talking about carnivores to anyone other than fellow sheep farmers, and some commented they would not give interviews to newspapers anymore for fear of further harassment.

Further, several farmers observed that the carnivore situation has influenced the way their children are involved in the sheep farming. For instance, one farmer (Anders) said he used to involve his children when supervising sheep in the outfield and collecting them in autumn. Occasionally he had combined the supervision with a family picnic and fishing, but after several wolf attacks, he stopped doing this in order to prevent his children potentially witnessing the 'terrible' aftermath of a wolf attack. Many farmers mentioned that their job satisfaction was reduced, and that using the outfields for recreation is less attractive.

The farmers remaining in the wolf-zone have adapted to the situation by not using the outfield resources for grazing. Sheep are now kept in enclosures close to the farm, and farmers experience a new and more labour intensive work situation; daily supervision, maintenance and repairing fences, pasture rotation, medicating the sheep regularly to avoid helminth infection, and the need to either buy in more feed or rent more farm land to produce additional winter fodder. According to the farmers, this situation involves not only more work, increased costs, less income and poor future opportunities as sheep farmers, but also loss of life quality and independence.

6. Discussion

The initial finding from the quantitative analysis, that sheep farmers living in areas with presence of wolves experiencing higher levels of psychological distress, gains considerable support from the secondary qualitative analysis. Those who have experienced predator attacks directly clearly suffer

from distress conditions leading to sleeplessness, guilt, and a constant state of anxiety. Studies have suggested that where humans have been the victim of predator attacks members of the family can suffer post-traumatic stress disorder (PTSD) and other stress related conditions (Bauma et al., 2013). In this case, while the victims are not human family, the consubstantiality between the sheep, farm and farmer (Gray, 1998) and the extent to which the sheep can represent the collective breeding effort of generations of family members (Convery et al., 2005) illustrate why the experience of loss of life in horrific circumstances could lead to serious psychological trauma. The qualitative interviews suggests that farmers try to negate these high distress levels by changing their sheep management systems or moving out of sheep altogether. However, where the farms are located outside the predator zones, there is no or very limited public support or help besides compensation payments for carcasses that are proven to be killed by carnivores.

Farmers' emotional attachment to their livestock may also result in high levels of distress. While not all farmers are equally attached to their livestock (Bock et al., 2007), farmers with stronger attachments to their animals have been shown to have more negative attitudes towards large towards carnivores than those not so strongly attached (Vittersø et al., 1998). Thus, the effect of predation on farmers' psychological distress may vary from minimal concern to PTSD level symptoms. As Ludvik surmised during his interview:

'It is mentally challenging. Because if you find sheep that are half-eaten then... If you love your animals than you do not sleep at night. It's that simple'.

For farmers who have not experienced a predator attack, distress is still clearly evident. This is in keeping with previous research that suggests even the imagined presence of carnivores often generates considerable uneasiness and insecurity amongst people living within carnivore territories

(Ojalammia and Blomley, 2015). Fear of witnessing a carnivore attack on livestock alone appears to be sufficient to encourage farmers to change behavior such as not allowing children to be involved in the summer grazing activities. This could have potential ongoing consequences for farm succession as it could effect the socialisation processes critical for the development of successor identities (see Fischer and Burton, 2014). Even tools designed to help address the carnivore issue can add to the pressure, in particular the existence of text message based warning systems act as a constant reminder that carnivores are in the vicinity. Looking for lost animals or helping neighbouring farmers look for lost animals further raises the salience of the wolf presence – even where the animals have not been subject to carnivore attacks.

Adding to this pressure is the sense of powerlessness. One factor that emerged from the qualitative interviews is that farmers no longer feel they can influence the situation. Farmers felt that large carnivore management policies did little to address or acknowledge their situation. Lack of ability to influence or trust large carnivore management policies (e.g. Johansson et al., 2012, 2016) was not the only way in which farmers felt powerless. Some felt they were unable to enter debates or put their perspective on the carnivore issue into the public arena because of the risk of online trolling including hate messaging and the sending of false reports to the Food Safety Authority. This is perhaps a new way in which farmers are experiencing carnivore pressure. Norway has one of the highest rates of internet connectivity in the world (98 percent in 2016 – www.internetlivestats.com). Consequently, whereas farmers used to be relatively geographically isolated, today the ability of the public to access farmers has been greatly enhanced.

One interesting omission from our interview responses was concern for direct economic loss caused by predators. To some extent this is not surprising. Even in the worst-case scenario where individual farmers lose a considerable proportion of their flock economic losses are compensated for. That the

distress is not caused by potential economic costs is also suggested in the literature as neither the insignificant economic impact of predation (Chavez et al., 2005; Kovarik et al., 2014) nor the payment of compensation for stock losses (Muhly and Musiani, 2009) have been found to have a significant effect on farmers attitudes – which remained steadfastly negative in these cases. Predation has also been found to have little effect on land values. Muhly and Masani (2009), for example, in a study in the United States, found that increasing levels of predation by wolves between 1994 and 2003 had no impact on steadily increasing land prices.

Where carnivore presence clearly does affect farmers is in the way it forces them to make changes to their lifestyle. For those within the wolf zone, increasing levels of predation over the last decades have led to the implementation of a series of preventative measures. Those who continue with sheep farming have generally moved to inclosed grazing close to the homestead (Strand, 2018), abandoning traditional management practices. While these changes in management regime enable the continuation of sheep farming, they also involve a sacrifice in terms of the lifestyle of the sheep farmer with, according to respondents, increased animal sickness and greater workloads compared to outfield grazing.

Outside the wolf zone the lifestyle changes are no less evident. While farmers are able to use the outfields, they spend longer looking after the animals or, in a worst case scenario, looking for cadavers and injured livestock. This takes time from other important farm tasks such as pluriactivity and off-farm work – potentially causing additional stress for farmers. Importantly, it also means that when farmers are not in the outfields looking, they can experience a constant feeling that they ought to be spending more time making sure their animals are safe – a feeling that they should be somewhere else. Technology in the form of carnivore warning systems helps farmers to prevent attacks on one hand, but on the other means they are being “constantly reminded about carnivores”

(Laila) – again contributing to a sense of uneasiness when not with the livestock. In this way, carnivores can have a significant effect on farming communities even where they do not constitute a major economic threat or cause problems for significant numbers of farmers.

Having presented the available evidence, an important question to address at this point is how certain can we be that the relationship between predator attacks and farmer distress detected in the quantitative analysis is not attributable to other factors not included in the analysis? We argue a number of factors from both the quantitative and qualitative analyses point strongly to wolf presence as the cause.

First and foremost, the qualitative investigation indicates that sheep farmers in the region are experiencing distress as a result of the presence of carnivores – regardless of whether they have been directly affected by carnivores or not. This suggests that distress is likely to be widespread throughout these regions rather than limited to individuals directly affected by predation by wolves – and provides an explanation for why distress caused by predators could be detected in a survey of farmers over a broad region even when not every farmer have experienced loss of livestock. This also raises questions about previous assertions that, because farmers have not directly experienced carnivore attacks, their constantly negative responses are indicative of ingrained bias (Kellert et al., 1996; Chavez et al., 2005). Our study suggests farmers do not need to have direct experience with carnivores in order to experience distress directly and therefore form negative evaluations.

Second, obvious alternative sources of distress that are specific to (a) sheep farmers and (b) regions affected by carnivores (and that could cause the same effect in the survey) do not exist. This is not to suggest that farmers as a group are not subject to considerable stress. Aspects of the job including long working hours, relative isolation, financial instability along with other uncertainties related to

farming have been found to influence farmers' mental health (Torske et al. 2016; Logstein 2016; Khan et al., 2019), while internationally for sheep farmers specifically, the physiological effect of organophosphate pesticide use has been suggested to lead to higher levels of psychological distress, mental health problems and suicide risk (Khan et al., 2019). However, organophosphates are not used in Norway (Animalia 2017), long working hours and relative isolation would be the same for all farmers using the outfields in Norway, financial uncertainties are not a specific problem for predator regions, and the agricultural practices are common across the entire country. While we cannot entirely discount the possibility, there are no easily identified alternative explanations to our findings that have not been accounted for in the analysis.

Despite this, there are clearly some measures that could be taken to be more certain of the outcome in future studies. A strength of our study was the use of a large national representative survey of farmers where response bias against carnivores was able to be eliminated through the fact that carnivores were not the focus of the survey. This in combination with objective measures of livestock losses to wolves provided us with a robust set of data with which to explore the issue. However, while we doubt it would change the key findings, our qualitative investigation focused only on sheep farmers in areas with a carnivore presence – whether inside or outside the wolf zone. To gain an improved understanding of the situation, it could be valuable to examine beef farmers (a number of whom are likely to have formerly been sheep farmers) within the study area, as well as sheep farmers in areas with no experience of wolves. Finally, the dictum categorization of municipalities based on whether (ten or more) sheep had been killed by wolf during the last five years was somewhat vague, as any variation in the extent of losses experienced was lost. Ideally we would also have included the number of attacks in a region but that data was not available. What we were able to do is to make a core distinction between wolf free municipalities and municipalities where wolves have been active in recent time. Future studies analyzing the relationship between farmer distress and carnivores should make an effort to retrieve data on a lower level than municipality if available.

7. Conclusion

In response to increasing large carnivore numbers, Norway has adopted a policy of zoning some areas as priority zones for carnivores and others as priority grazing areas in the hope that this will reduce the conflict between carnivores and livestock farmers. Our study illustrates, however, that stopping carnivore attacks on livestock is only part of the problem. Economic compensation paid to farmers for the necessary management changes to accommodate predators within the carnivore zones or livestock losses inside and outside the zone does not appear to reduce farmers' distress. The distress is a clear function of living in close proximity to carnivores, and frustration, anger, anxiety, sleep deprivation and reduced life quality are commonly reported. These do not result from economic loss. Rather the distress is caused by factors such as the need to change lifestyle, work situation, feelings of responsibility and concern for livestock, emotional attachment to livestock, constant reminders of predators from predator warning systems, the inability to be speak up for fear of internet trolling and other types of harassment, and an overall distrust in the system of carnivore management. In this study we contend this distress was detected in the responses to a national survey of farmers – a survey that, by virtue of its failure to address the issue of carnivores, could not have been affected by response bias against carnivores.

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