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RESEARCH

Emotions shape attitudes towards wolf conservation management in the Italian Alps

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Abstract
Across Europe, wolves are recolonizing former habitats, but frictions between wolves and people remain a challenge. Better understanding of attitudes towards existing management practices is essential to devise wolf management that better considers societal aspects. In this study, we focus on a case study in the Italian Alps, where we conducted a quantitative survey to investigate attitudes towards wolf management. We used multiple regression analysis to determine which factors such as emotions and knowledge or belonging to a particular stakeholder group explained variations in attitudes towards wolf management. We found that almost half of our respondents felt scared about the presence of wolves, and that people who had less factually correct knowledge about wolves were more afraid than people who had better factual knowledge. Farmers reported significantly higher ratings of anger, fear, and frustration than the general population. We found that anger and fascination were significant predictors for attitudes towards management, but that fear, factual knowledge, education level and connectedness to nature were not. Our findings support further stakeholder engagement to take seriously and address the range of emotions of stakeholders that impact public support for wolf management and co-existence in the cultural landscapes of the Italian Alps.

Keywords Wolf (*Canis lupus*) conservation management · Human-wildlife conflict · Rewilding · Emotions · Fear · Co-existence with large carnivores · South Tyrol

Introduction

Across Europe, wolf (*Canis lupus)* numbers are recovering, and the species is recolonizing some of its previous habitats after being hunted to near-extinction in the 19th and 20th century (Ripple et al. 2014; Stauder et al. 2020). However, in many rural areas across Europe human-wolf conflicts are increasing, primarily due to economic concerns, fear for safety and frustration over management approaches (Ambarlı 2019; Anthony and Tarr 2019; DeCesare et al. 2018; Kuijper et al. 2019, 2024; Pohja-Mykrä and Kurki 2014; Zscheischler and Friedrich 2022). Particularly in the alpine regions of Europe, changing agricultural practices led to increased herd numbers with free-roaming livestock and fewer shepherds and guard dogs. This has resulted in herds that are more likely to be successfully attacked by wolves than smaller herds under the traditional pastoral management, which had been practised for centuries and allowed pastoral grazing to co-exist alongside wolves in Italy (Boitani 1992). The economic cost of compensation has raised questions regarding the future of rural landscapes and communities co-living with carnivores in cultural landscapes (Franchini et al. 2021; Recio et al. 2020). Understanding and ultimately improving stakeholder attitudes to wolves and their management is essential to reduce human-wildlife conflicts and find pathways towards co-existence with carnivores (Jürgens et al. 2023; König et al. 2020). Such co-existence is the basis of delivering long-term conservation goals, while also considering environmental justice aspects (the notion that conservation practices do not create or maintain unjust outcomes for people) and thus ensuring a more equitable distribution of costs and benefits to people living with large carnivores (McInturff et al. 2021). In this

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study we focus on attitudes towards current wolf management, and factors that influence these attitudes.

We use the example of South Tyrol in northern Italy as a case study area, where after an absence of over 100 years, wolves have been returning since 2010. This recent recolonization provides an opportunity to study attitudes on wolf management practices, and the factors, including emotions, shaping these attitudes. We employed a quantitative survey among residents to study perceptions of wolf management, rather than on wolves themselves, building on previous research on attitudes towards wolves in this region (Stauder et al. 2020). This more in-depth focus on management practices enables us to gain further insights in this highly mediated and debated human-wildlife conflict (Trainotti et al. 2023). Our focus is on the role of emotions and prior knowledge in explaining differences in attitudes towards management, and how attitudes differ between stakeholder groups.

In the following, we build on a brief overview of human-wildlife conflict and management literature, and provide information on our study area, before introducing the methodology of a quantitative survey among residents in South Tyrol to assess the relation between emotions, knowledge and opinions on current wolf management.

Background

Previous research on attitudes towards wolf conservation management and human-wolf conflicts

Human-wildlife conflicts are defined as conflicts between people and non-domesticated animals (Woodroffe et al. 2005). These conflicts negatively affect both people and wildlife, by creating negative societal and economic impacts that undermine environmental justice and social equality of conservation, as well as hampering the ecological outcomes of conservation efforts (König et al. 2020; Nyhus 2016; Redpath et al. 2013). Although at first glance human-wolf conflicts may appear to be solely about the direct impacts of wolves on people's livelihoods, e.g. through livestock predation, research indicates that livestock predation does not always directly correlate with negative attitudes towards carnivores (Nanni et al. 2021). Instead, conflicts may also be rooted in deeper social, cultural or political histories, reflecting broader conflict or overarching social tensions and value systems (Jürgens et al. 2023; Redpath et al. 2013) and have been suggested to mark spatial-cultural divides between rural and urban populations (Zscheischler and Friedrich 2022). In this regard, human-wildlife conflicts have also been framed as being human-human conflicts about wildlife management (Marshall et al. 2007). Thus, addressing challenges in wolf management goes beyond the field of ecology, and requires multi-disciplinary approaches that incorporate social sciences firmly into conservation science and practice (Bennett et al. 2017). Such an understanding will allow addressing the political and societal dimensions that govern human-wolf relations into conservation management and policy (Marino et al. 2021).

Previous research focused on attitudes towards the wolf as a species, including a global review of attitudes (Barmoen et al. 2024), and specifically across Europe, e.g. Croatia (Majić and Bath 2010), Germany (Arbieu et al. 2019), Hungary (Anthony and Tarr 2019), Italy (Bongi et al. 2023; Franchini et al. 2021; Glikman et al. 2012; Stauder et al. 2020), Latvia (Žunna et al. 2020), Norway (Krange et al. 2017), Portugal (Torres et al. 2020; Valente et al. 2024), Slovenia (Oražem and Tomažic 2018), Sweden (Ericsson and Heberlein 2003; Krange et al. 2017; Williams et al. 2002), and Switzerland (Cracco et al. 2024; Hunziker et al. 2001). In comparison, less research has focussed on the perception of wolf management in Europe (Torres et al. 2020), even though scholars have argued that attitudes towards species and their management require separation (Von Essen and Allen 2020), and management is integral to conflict resolution (Firlein 2018).

Successful management of wolves is highly dependent on the local social, economic and political context (Anthony and Tarr 2019; Treves and Karanth 2003). Attitudes therefore need to be assessed at the specific local level to inform effective management action (Vaske et al. 2022). In turn, research has shown that management which ignores differences in context potentially worsens conflict (Eklund et al. 2020). Thus, rural communities are both those most affected by wolf recolonization and those who are essential to achieving conservation goals (Firlein 2018). A failure to include rural societies and their concerns into conservation management objectives, and in particular a failure to address people's attitudes, may result in resistance or sabotage of carnivore conservation efforts in the form of poaching or increased support for legal killings (Firlein 2018; Moreto 2019; Nanni et al. 2021; Pohja-Mykrä and Kurki 2014).

In general, attitudes to wolf conservation and management were shown to be shaped by various factors, including communication channels (Anthony and Tarr 2019), knowledge level (Bongi et al. 2023; Ericsson and Heberlein 2003; Torres et al. 2020), political affiliation (van Eeden et al. 2021), stakeholder group (Vaske et al. 2022), and narratives people hold about wolves and nature in general (Jürgens et al. 2023). Emotions were also shown to be a strong influential factor shaping, for example, acceptability of puma and jaguars in Brazil (Engel et al. 2016). A global review of attitude studies showed that fear negatively affected attitudes towards wolves (Barmoen et al. 2024). Emotions most

elicited by videos of wolves included surprise, interest and fear, but the emotions of anger and joy predicted more variance in attitudes towards wolves in France (Arbieu et al. 2024). Emotions further played a role in attitudes towards wolf management in the United States (Anderson et al. 2023; Vaske et al. 2022) and in Portugal (Torres et al. 2020), as well as acceptability of wolf management actions among Dutch and German university students (Straka et al. 2020). As demonstrated by the emerging research field of emotional political ecology, far from just rational social interactions over species or resources, it is emotive realities that inform nature-society relations, embodied in experiences which are situated in specific sites and contexts (Nelson et al. 2016; Sultana 2015). Research that takes emotions seriously can therefore aid overall understanding of conflicts, social acceptance, the politicisation of actions and the acceptability of management strategies (Anderson et al. 2023; Barmoen et al. 2024; Engel et al. 2016; González-Hidalgo and Zografos 2020; Jacobs et al. 2014). As a consequence, the importance of emotions for wildlife conservation overall is increasingly being recognised (Arbieu et al. 2024; Castillo-Huitrón et al. 2020; Jacobs and Vaske 2019; Nelson et al. 2016). However, emotions towards carnivore management have comparatively received little attention, despite the importance emotions are shown to have in relation to attitudes and support for carnivores (Arbieu et al. 2021; Buijs and Jacobs 2021; Dheer et al. 2021; Flykt et al. 2013; Ghasemi et al. 2021; Johansson et al. 2016; Moures-Nouri et al. 2023; Vaske et al. 2022). In this study, we therefore integrate emotions as well as knowledge as an important factor in researching attitudes towards wolf management. In the next section, we now briefly trace the history of wolves and their management in Italy to contextualise the current study.

Wolves in Italy and South Tyrol – from near-extinction to recolonization

In Italy, human persecution brought the wolf to the brink of extinction in the 20th century, with only around 100 individuals left in 1960 (Meriggi et al. 2020). With the introduction of hunting prohibition in 1971, followed by full protection of the species in 1976, the legal framework was created for species recovery at the national level (Stauder et al. 2020). At European level, the wolf is protected by the 1979 Bern Convention and the 1992 EU Habitats Directive (Council Directive 92/43/EEC of 21 May 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora, 1992). Alongside protection offered by national and European legislation, in Italy, socio-economic changes such as the abandonment of high altitude pastures after World War II, abundant wild prey, and public support for environmental protection have enabled apex predators, including wolves, to naturally re-colonize historical ranges (Boitani et al. 2022; Stauder et al. 2020) (Fig. 1).

This recolonization process started in central Italy in the Apennine mountains, with wolves first moving towards the south-western part of the Italian Alps at the border with France, before moving toward the eastern part of the Italian Alps, including South Tyrol, where they are meeting with wolves from populations of the Dinaric mountains in the Balkans and from the Carpathians (Boitani and Linnell 2015; Ciucci et al. 2009; Marucco and McIntire 2010).

In northern Italy, wolves had co-existed alongside people practicing pastoral grazing for centuries, and traditional management practices had developed to allow for this co-existence to be economically viable. With the reduction of wolf numbers to near-extinction, wolves have been absent in many areas, and traditional pastoral grazing practices have been abandoned in a context of larger socio-economic shifts in farming practices, resulting in livestock herds that are more vulnerable to predation. This, in turn, has led to stakeholders clashing over the assertion of conservation interests versus the economic viability of pastoral grazing practices (Redpath et al. 2013; Zscheischler and Friedrich 2022). Non-governmental organisations in Italy continue to present wolf conservation as highly economically valuable, most notably through ecotourism (Donfrancesco 2024).

Study area

The study area is the province of South Tyrol, the northernmost province in Italy, located at the border with Austria and Switzerland. The province has a surface area of 7400 km^2 and is divided into eight ‘Bezirke’, or local administrative units (Fig. 2), with a total population of more than 530,000 (ASTAT 2021).

Agricultural land-use covers 62% of the surface area, although much of this is mountainous and thus not suitable for crop cultivation (EURAC 2020). A large proportion of farming is traditional pasture farming, 34% of the surface area of South Tyrol consists of alpine pastures where alpine transhumance is practiced, the traditional practice of seasonally droving livestock between lowland pastures in winter and higher-altitude alpine pastures in summer. Transhumance is an important part of the region’s cultural identity and has been added to the UNESCO Representative List of the Intangible Cultural Heritage of Humanity in 2023 (UNESCO 2023).

In South Tyrol, numbers of wolves have been increasing over the past years through recolonisation. IUCN data for 2018 shows limited presence of wolf in South Tyrol (Figs. 3 and 4). In 2020, a minimum of 18–22 wolves were present, increasing to estimates of more than 30 wolves in

Fig. 1 Wolves are recolonizing parts of their former range, including alpine areas (Wolf captured on wildlife camera with deer leg in forest area near Rhäzüns, Switzerland; credit: (Claudia Wartmann)

2021, more than 50 individuals in 2022 and an estimated 78 individuals and 7 packs in 2023 (South Tyrol State Administration 2023). Reported predation and associated compensation payments also increased. For example, in 2020 96 sheep, 2 goats and a calf were killed by wolves, with 17,911€ compensations paid, compared with compensation payments below 15,000€ in 2018 (Autonomous Province of Bozen 2020). Compensation payments further increased to 54,200 € in 2021, 103,007€ in 2022 and 99,209€ in 2023 (South Tyrol State Administration 2023). The economic costs of a wolf attack, once it has been verified by an expert, are fully covered by the regional government (Autonomous Province Bozen South Tyrol 2020). To reduce wolf attacks, the focus of current management is on herd protection measures, which include electrified fences that have to comply with certain minimum standards to receive 100% subsidies (voltage, height, etc.), permanent herding by shepherds using fencing and dogs, and the use of trained herd protection guard dogs (Fig. 5) that independently stay with the herd at all times (Autonomous Province Bozen South Tyrol 2020).

In South Tyrol, a previous study on public attitudes towards wolf recolonization has been conducted (Stauder et al. 2020), with a dataset collected in 2018, at a time when there were an estimated 6–10 wolves in the area (Wolf distribution in South Tyrol in 2018 see Fig. 2). The results indicated that people with a positive attitude towards wolves were more likely in favour of preventive measures, whereas people with negative attitudes were more in favour of lethal measures (Stauder et al. 2020). However, since the last data collection in 2018 on attitudes, wolf numbers have increased markedly in South Tyrol, and there has been a reported increase in wolf predation in the region. Public dissatisfaction with the wolf situation and how it is being handled in South Tyrol is prominent in public life including local politics and media coverage (see for example, Fontana 2023). This study therefore serves a dual purpose. Firstly, we focus on the perception of wolf management, rather than on the species and its acceptance overall. Secondly, we analyse underling factors and pay particular attention to the role of emotions and knowledge in explaining variation in attitudes on management to help inform future management.

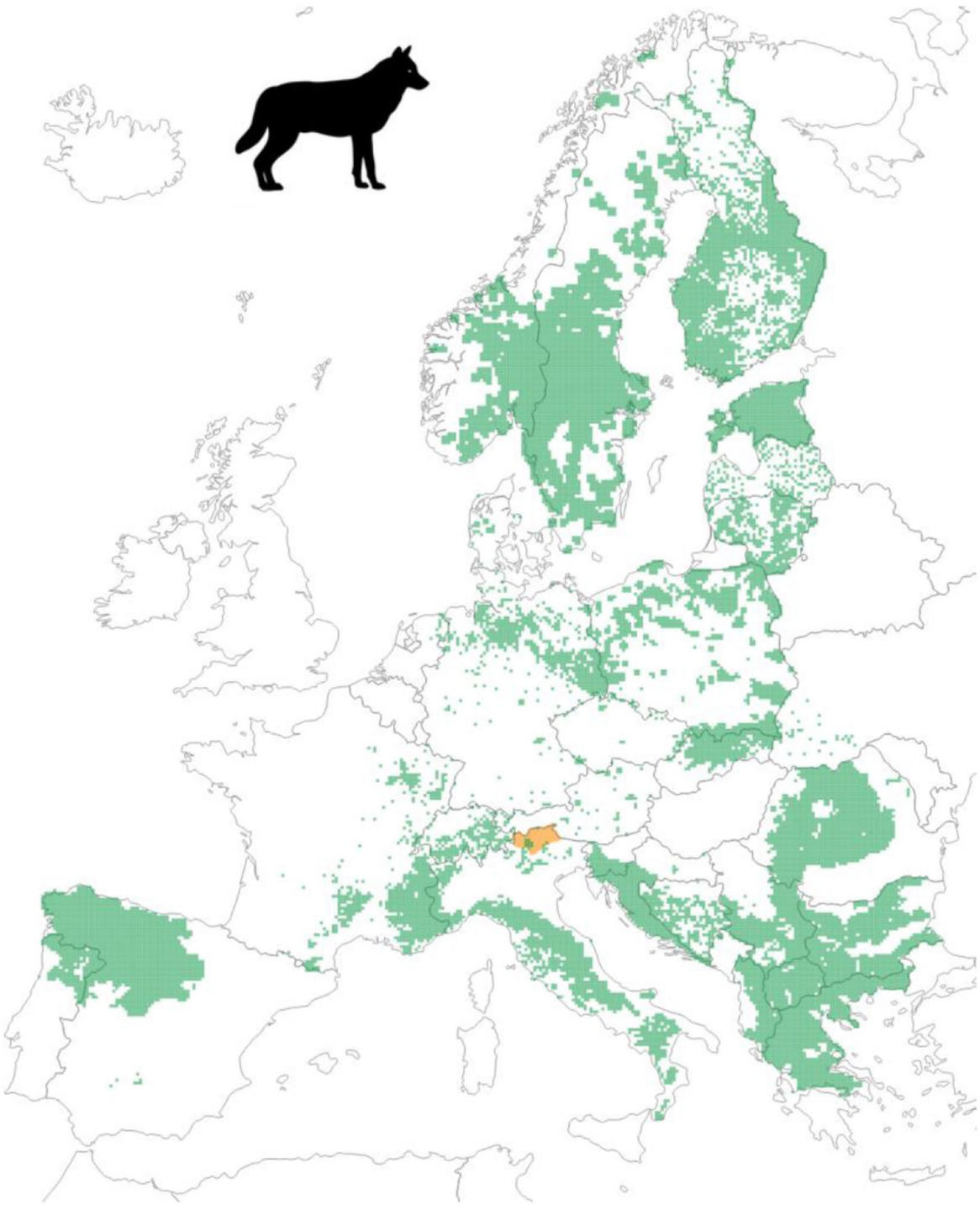

Fig. 2 Wolf distribution across Europe according to IUCN data (status 2018) with South Tyrol study region (in orange). Wolf distribution layer data source: (Kaczensky et al. 2021). Map: authors

Materials and methods

Data collection and analysis

We developed a questionnaire with 54 questions (Supplementary information 1), that was published in German, Italian and English, with German and Italian being the two local languages spoken in South Tyrol. Translations were done by the first author who is a native German and Italian speaker and resident of South Tyrol. The questionnaire included socio-demographic questions (age, gender, educational background, rurality of residence, and identification

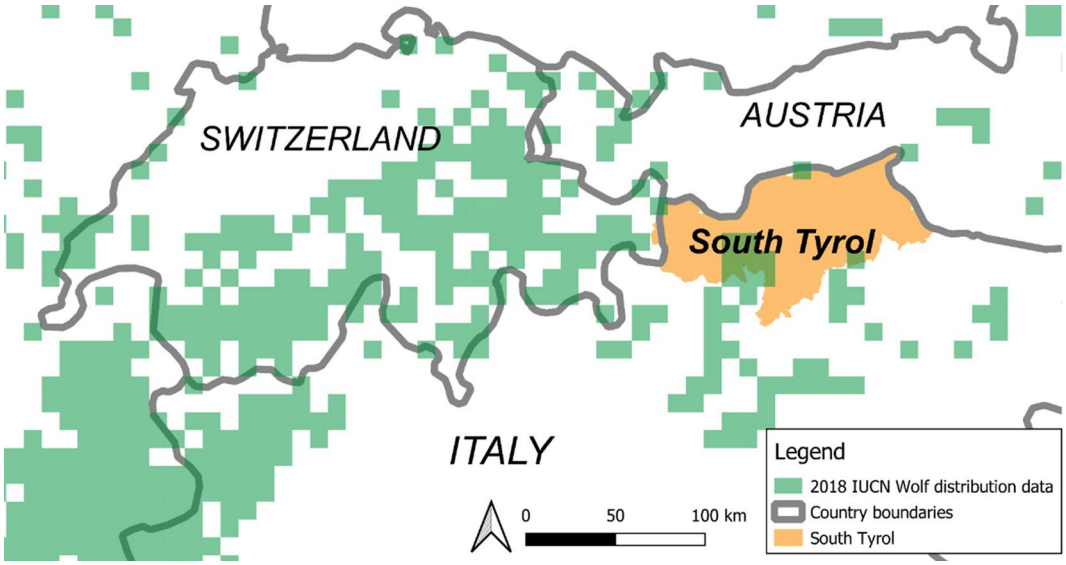

Fig. 3 The study area of South Tyrol in Northern Italy (in orange) bordering Switzerland and Austria, overlaid with wolf distribution data (status 2018). Data source: (Kaczensky et al. 2021), Map: authors

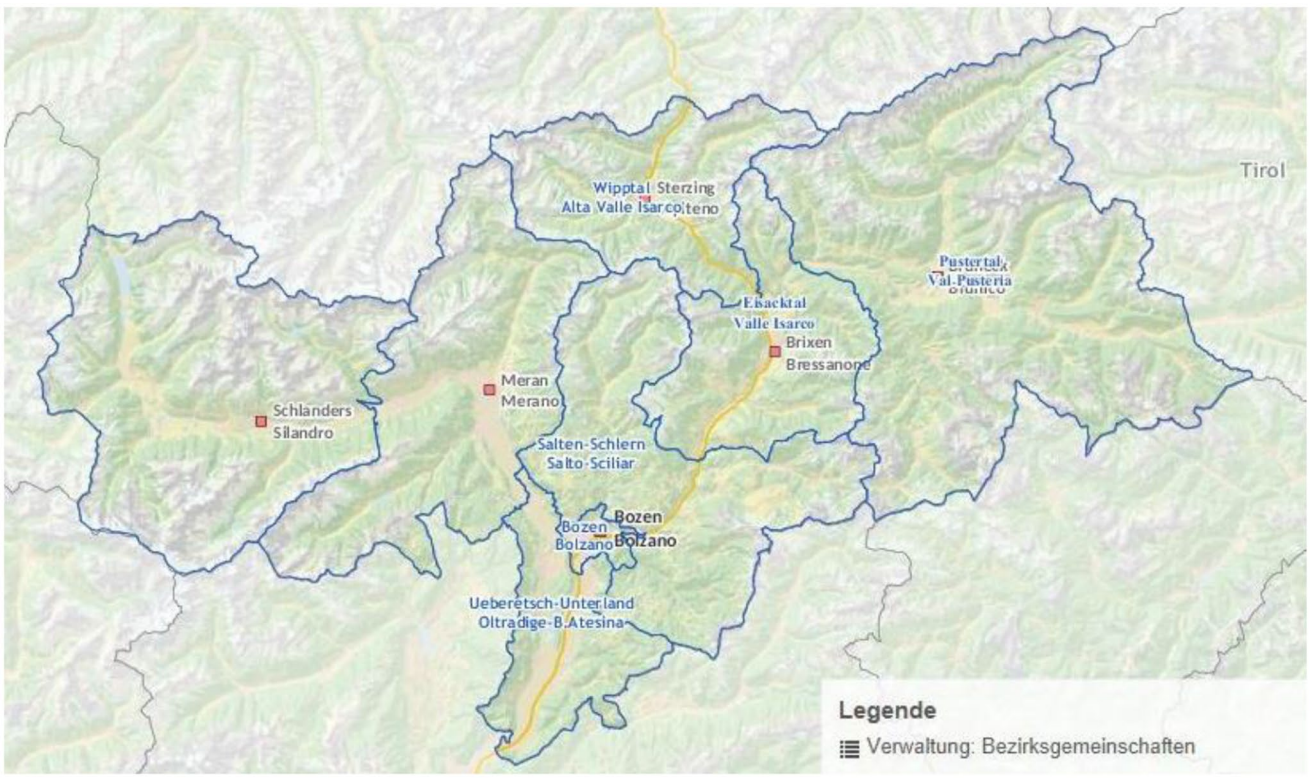

Fig. 4 Map of South Tyrol divided by administrative units of 'Bezirksgemeinschaften' (ASTAT 2021)

as belonging to an interest group (e.g. alpine pasture farmer, hunter, environmentalist, tourism). We included the *Connectedness to Nature Scale* (Mayer and Frantz 2004), an established and validated psychometric scale to assess people's connection with nature. We used the full scale consisting of 14-items, with a 5-point Likert answer scale from 'strongly agree' to 'strongly disagree', following Mayer and Frantz (2004), acknowledging that the direction of the scale that is presented to respondents can have effects on some respondent's answer strategies (Hofmans et al. 2007). To assess knowledge about wolf behaviour and biology we incorporated seven questions into one *knowledge* variable,

Fig. 5 Herd dog with a flock of sheep (Image: Wikimedia commons by Andy Fitzsimmons, CC BY-SA 2.0)

and asked respondents about the confidence in their knowledge about wolves. Respondents also had to answer about their sources of knowledge, and their personal experiences with wolves (e.g. *Have you ever encountered or seen a wolf?* replicated from a previous study (Stauder et al. 2020), and how compatible they felt their economic activities were with the presence of wolves. Respondents were given the option of answering 'I don't know', which we treated as not knowing the correct answer for the *knowledge* variable.

Based on the observation that emotions were still comparatively under-researched in wildlife management, despite their importance for wolf management (Dheer et al. 2021; Straka et al. 2020) we incorporated questions on emotions felt by respondents using psychological scales. As an exploratory study on emotions towards wolf management, we included separate questions on whether the presence of wolves in South Tyrol evoked disinterest, fear, anger, sadness, frustration and interest/curiosity based on emotions we identified as being commonly associated with wildlife in the literature (Arbieu et al. 2024; Castillo-Huitrón et al. 2020), with answers as 5-point Likert scales agreement or disagreement.

The last section included questions on various aspects of management. We used four questions on current management to create an explanatory variable on *management attitudes*, that included whether respondents believed management was effective, and sufficient, and whether management had improved over the last 5 years.

This study received ethics approval through the University of Aberdeen. We locally hosted the questionnaire at the University of Aberdeen to comply with data protection regulations and published it online using the questionnaire software SNAP 11 (Snap Surveys 2024) for three weeks in October 2022. The survey was open to anyone aged over 18 and living in South Tyrol.

Due to the unfunded nature of this study and associated budgetary constraints we used a convenience sampling approach to reach potential respondents. The questionnaire was distributed using a snowballing sampling technique through the first author's personal connections of having grown up and living in the region, distributed via Facebook groups such as *South Tyrolean hunting portal*, *Agriculture South Tyrol*, as well as groups with more general interests in the region such as *South Tyrol – Our passion*.

We performed statistical analyses using SPSS Statistics version 28 (*IBM SPSS Statistics for Windows*, 2021). Descriptive statistics were used to analyse variables such as knowledge of wolves and attitudes towards management options. To assess statistical significance of differences between these variables, we applied non-parametrical Mann Whitney tests for independent variables with two groups, while we used Kruskal-Wallis tests for differences between more than two groups, using $\alpha = 0.05$, followed by Bonferroni post hoc tests (Abdi 2007). We used Spearman's rho to test for correlation between knowledge and emotions held about wolves. To calculate the outcome variable of *attitudes towards wolf management*, we used confirmatory

Table 1 Principal component analysis showing factor loadings

Items	Loading factor 1	Loading factor 2
Management questions		
I believe management strategies are currently being employed	**0.475**	0.228
I believe current wolf management is sufficient to address the wolf situation in South Tyrol.	**0.804**	−0.266
I believe current wolf management is effective in handling the situation.	**0.845**	−0.193
I agree with what current wolf management is aiming to address.	**0.677**	−0.083
I believe wolf management has improved over the last 5 years.	**0.721**	0.073
Stakeholder engagement questions		
I believe stakeholder engagement in the current management process is successful.	0.333	**0.556**
I believe stakeholders are currently a part of management strategy design and decision making.	0.355	**0.741**
I believe that some stakeholders are unjustly excluded from the conversation while others hold too much power.	−0.306	**0.572**

factor analysis using nine items. We calculated a Principal Component Analysis using Varimax rotation, with a 2-factor solution where 5 items related to management clearly loaded highly onto one factor, and opinions on stakeholder engagement onto a second factor (Table 1).

Based on a high scale reliability for the first factor on management with Kronbach's Alpha of 0.755 we used this scale as our outcome variable *attitudes towards management*. The second component comprising of questions on stakeholder engagement showed low Kronbach's alpha with 0.286, and we therefore discarded this as a potential outcome variable on its own, instead reporting on stakeholder engagement items separately using descriptive statistics. We used self-reporting on stakeholder groups and used the groups of general public, farmers (alpine pasture farmers, as well as livestock and arable farmers), and environmentalists as these group represent potentially diverging attitudes and each had large enough numbers of respondents ($n > 20$) to be considered for statistical analysis.

To understand which of the variables were most influential for our outcome variable on *attitudes towards wolf management*, we used a multiple linear regression using explanatory variables including socio-demographics (*gender*, *age*, *education level*), geographical differences (*place of residence*), the level of knowledge (*wolf knowledge scale*), and the *Connectedness to Nature Scale.* For the explanatory variables comprising of emotions, we did not use all of the emotions from the questionnaire, as some of them showed high levels of correlation amongst each other (e.g. fascination was significantly negatively correlated with disinterest, and anger with frustration), violating model assumptions. We therefore limited the explanatory variables to two negative emotions (*fear*, *anger)* that were considered important in literature (Dheer et al. 2021; Pohja-Mykrä and Kurki 2014), as well as a positive emotion and interest (*fascination/curiosity*). We used scatterplots to assess homoscedasticity and found no indication that violated this assumption. The P-P plot of standardised residuals showed very little deviation from normality, meeting the assumption of normally distributed residuals. We tested for multicollinearity using correlation matrix and Variance Inflation Factor (VIF), and found no indication of multicollinearity with low values for VIFs across the model.

Table 2 Distribution of respondents by administrative unit

Administrative Unit	Number of respondents
Überetsch/Unterland	43
Burggrafenamt	35
Vinschgau	20
Eisacktal	17
Pustertal	17
Salten-Schlern	13
Bozen	12
Wipptal	5
No reply	7
Total	**169**

Results

Socio-demographic characteristics of respondents

We collected a total of 162 completed questionnaire responses out of 172 submitted. Most respondents (96%) completed the questionnaire in German, 4% responded in Italian. Most respondents were from Überetsch/Unterland, followed by Burggrafenamt and Vinschgau, and less responses from the mostly urban area of Bozen (Table 2).

In terms of gender distribution, 64.2% of respondents were women and 35.5% were men. The respondents were between 19 and 74 years old, with an average of 38 years (±13.6), median 36 years. The largest group of people categorised themselves as belonging to the general public (89), followed by 36 farmers ('Landwirte'), 23 respondents categorised themselves as environmentalists (in German: *Umweltschützer/Naturschützer*) and 18 as animal rights activists (in German: *Tierschützer*) (overlaps between groups were possible). The sample also included 4 alpine pasture farmers (German: *Almwirt*) and 4 hunters, again with overlaps possible between the groups (e.g. someone can be both an alpine pasture farmer and a hunter, or an alpine pasture farmer and a general farmer or '*Landwirt*').

Previous experiences with wolves

In the respondent group of the general public ($n=89$), 6.7% have seen a wolf in the wild, 66.3% in an enclosure and 27% have never seen a wolf. From the stakeholder group of farmer respondents ($n=36$), 19.4% have seen a wolf in the wild, 52.8% in an enclosure and 27.8 have never seen one. In terms of impacts, of the general public 3.4% reported an impact, whereas 13.9% of farmers reported impacts by wolf (such as livestock loss). Asked whether they felt scared or discomfort due to the presence of wolves, 48.3% of the respondents from the general public agreed, while 80.6% of farmer respondents agreed.

Knowledge of wolves

Results relating to questions about wolf knowledge are presented in Table 3.

Overall, respondents answered 2.96 questions correctly out of 6 (± 1.32, $n=161$). Men scored higher on the knowledge questions (3.35 ± 1.26, $n=57$) compared to women (2.74 ± 1.31, $n=104$), and the difference was significant (Mann-Whitney-U, Z-score: -3.104, $p=0.002$). We found no significant differences between respondents according to their education level (Kruskal-Wallis, $H=2.74$, $p=0.43$), or whether they identified as farmers or not (Mann-Whitney-U, Z=-0.573, $p=0.566$). Respondents' level of confidence was positively correlated to their knowledge level, but not significantly (Spearman's rho: 0.131, $p=0.98$). There were significant differences in knowledge levels between people who felt afraid due to the presence of wolves in South Tyrol and those who were not afraid (Mann-Whitney U: Z=-3.222, $p=0.001$). People who were afraid had significantly lower knowledge scores (mean $=2.61 \pm 1.27$, $n=78$) than people who were not afraid (3.32 ± 1.28, $n=77$).

Emotions associated with wolves

The strength of agreement with experiencing different types of emotions related to wolves in South Tyrol varied, but generally fascination and curiosity showed the strongest agreement across our sample on a Likert-scale from 1 to 5 (3.16 ± 1.31, $n=152$), followed by sadness (3.15 ± 1.23, $n=152$) and fear (3.11 ± 1.31, $n=154$). The level of agreement with these emotions differed across different groups. For example, it shows marked differences between farmers (alpine pasture and other farmers combined), compared to the general public (Fig. 6). Compared with the rest of the sample, farmers for example expressed significantly higher levels of fear (Mann-Whitney-U: Z= -2.971, $p=0.003$), anger (Mann-Whitney-U: Z= -4.452, $p<0.001$), frustration (Mann-Whitney-U: Z= -3.155, $p=0.002$), and less fascination/curiosity (Mann-Whitney-U: Z= -2.427, $p=0.015$). Farmers expressed more feelings of sadness, and less feelings of disinterest, but these differences were not significant (Mann-Whitney-U: sadness Z= -1.581, $p=0.114$; disinterest: $Z=-0.618$, $p=0.537$).

Testing for the relationship of different emotions with the wolf knowledge scale, we found that knowledge was significantly negatively correlated with fear (Spearman's

Table 3 Results for wolf knowledge questions

Question	Response (%)
Reason for disappearance	
Hunting by humans*	51.7
Habitat loss	33.1
Lack of prey	4.1
Date of disappearance	
18th century	16.3
19th century*	33.1
20th century	24.4
Don't know	18.6
Reason for return	
Reintroduced by humans & natural recolonisation	38.4
Reintroduced by humans	19.2
Natural recolonisation*	33.7
Source of wolf knowledge	
Online and print media	43.8
TV	15.4
Other	21.6
Dietary preferences of wolves	
Wolves do not primarily consume livestock*	68
Wolves primarily consume livestock	17.4
Wolves have to eat at least 10 kg meat / day	
No*	60.5
Yes	11.0
Number of wolves in South Tyrol	
0–20	22.1
21–40*	31.4
'Above 40'	40.7
61–100	15.7
More than 100	8.1

*Indicates correct answer

Fig. 6 Emotions expressed in relations to wolves in South Tyrol comparing general public with farmers

rho: -0.277, $p < 0.001$, $n = 152$). People who had more factually correct knowledge of wolves thus expressed less fear regarding wolves. However, there was no significant correlation between knowledge and anger (Spearman's rho: -0.101, $p = 0.214$, $n = 152$), frustration (Spearman's rho: -0.108, $p = 0.187$, $n = 152$), sadness (Spearman's rho: -0.078, $p = 0.343$, $n = 150$), fascination (Spearman's rho = 0.082, $p = 0.317$, $n = 150$) or disinterest (Spearman's rho: -0.148, $p = 0.075$, $n = 146$).

Opinions about current wolf management

Opinions on current wolf management differed according to stakeholder group, with farmers more strongly disagreeing that management was effective than the general public (Fig. 7). Farmers also more strongly disagreed that current management was sufficient than the general public or environmentalists (Fig. 7).

For the respondents from the general public, the most popular management options were 'monitoring' and 'preventive and protective measures, e.g. fences to protect livestock' with both 62.9%, followed by 'various strategies to deter wolves from areas inhabited by people' with 59.6%. When asked which management strategies they absolutely disagreed with, 37.1% of the general public indicated disagreement with killing wolves, followed by disagreement with relocation (27.3%).

For farmer respondents, the most popular management strategy was 'problematic wolves being killed' with 80.6% agreeing, followed by monitoring with 55.6%. The management strategy most selected when asked which one farmers absolutely did not agree with was 'preventive and protective measures, e.g. fences to protect livestock' with 41.7%, followed by 'relocation', which 38.9% of farmers absolutely did not agree with. Asked whether management of wolves had improved over the past 5 years, 44.4% of farmers strongly disagreed, compared to 19.3% from the general public and 13.0% environmentalists (Fig. 8).

Factors influencing attitudes towards wolf management

The linear regression model with the outcome variable *attitudes towards management* was significant $F(9,130) = 6.146$, $p < 0.001$, with an R-value of 0.546, and an r-square of 0.298 (adjusted r square = 0.250), indicating that the model explained 29.8% of variance observed. Of the explanatory variables entered, only the place of residence (Table 1), anger, and fascination were statistically significant predictors, whereas the wolf knowledge scale, connectedness to nature, fear, gender, age and education were not (Table 4).

Fig. 7 Responses to questions on current wolf management according to different stakeholder groups

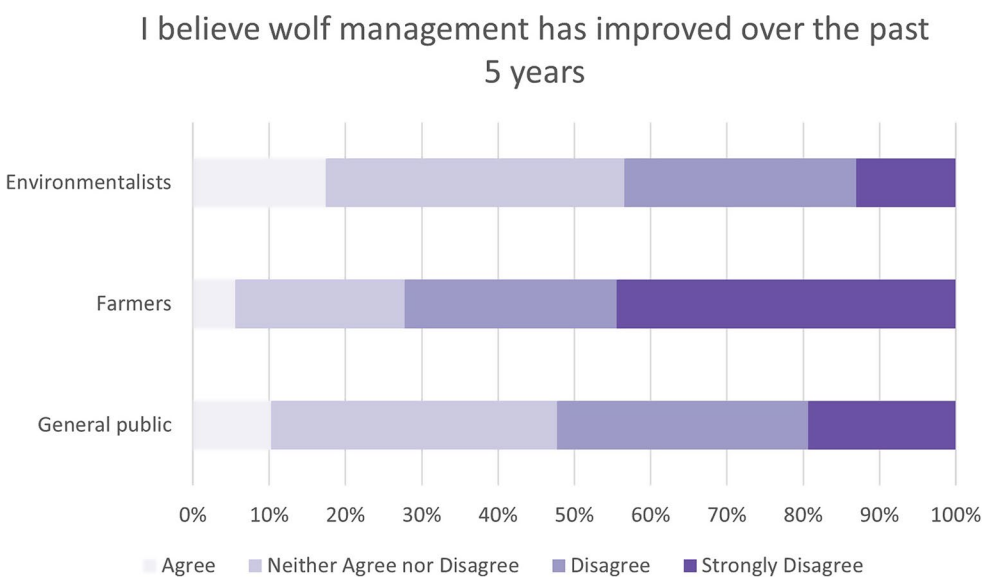

Fig. 8 Opinion on improvement of wolf management according to stakeholder groups

Table 4 Model coefficients for regression model of attitudes towards wolf management

Model	Unstandardized Coefficients		Standardized Coeff.	t	Sig.
	B	Std. Error	Beta		
(Constant)	3.240	0.645		5.022	0.000
Wolf Knowledge Scale	0.030	0.041	0.057	0.713	0.477
Connectedness to Nature Scale	-0.272	0.142	-0.146	-1.914	0.058
Fear	-0.040	0.055	-0.077	-0.730	0.467
Place of residence (Bezirk)	-0.044	0.022	-0.151	-2.027	**0.045**
Gender	0.031	0.110	0.023	0.286	0.775
Anger	-0.119	0.047	-0.258	-2.521	**0.013**
Fascination	0.111	0.050	0.214	2.228	**0.028**
Age	-0.004	0.004	-0.074	-0.946	0.346
Education	0.043	0.094	0.035	0.456	0.649

Perceived challenges for wolf management

From the general public, the perceived shortcomings in wolf management that were most frequently selected were 'poor stakeholder inclusion' with 50.6% and 'inaccurate or one-sided media representation' with 39.3%. Environmentalist respondents selected 'inaccurate or one-sided media representation' as one of the biggest challenges for wolf management with 56.5% selecting this answer, as well as perceived power imbalances among stakeholders (56.6%) followed by 'widespread misinformation' selected by 52.2%. In contrast, for farmer respondents the most frequently selected answer was 'poor stakeholder inclusion' with 66.7% followed by ineffective management (63.9%).

Discussion

The rapid recolonization of wolves in the Italian Alps draws considerable attention from the public and in the media (Fontana 2023; Trainotti et al. 2023), and it is important to study how local attitudes towards wolf management change over time. In this study we used a quantitative survey among residents in South Tyrol, Italy, to study attitudes towards wolf management and which factors such as knowledge, emotions or connectedness to nature were able to explain differences in attitudes.

Previous experiences, knowledge, and emotions about wolves

In our sample, most respondents had seen a wolf only in an enclosure, and very few respondents had ever seen a wolf in the wild. While a previous study in Germany indicated positive experiences of people when seeing wolves, whether in enclosures or the wild (Arbieu et al. 2020), we did not further study the type of experience people had. Although few people encountered a wolf in the wild, almost half of the respondents indicated they felt scared due to the presence of wolves. This potentially indicates a fear of the unknown, where increased encounters (of a positive nature), would lead to perceived higher benefits and acceptance of a species (Zajac et al. 2012), except when these experiences are negative. This was the case for eight respondents in our sample, 4 among them farmers, who had sustained economic damage due to wolves.

Overall, respondents scored relatively low on factual questions related to the history of wolf recolonization and wolf behaviour and biology. Many respondents for instance overestimated the current population size in South Tyrol,

and a majority incorrectly believed that wolves were reintroduced by humans or returned from existing populations while also being actively reintroduced, when they had migrated from other existing populations. There were no differences in factual knowledge between farmer respondents compared to the general public. Previous studies on knowledge about large carnivores in Europe also found low levels of knowledge scores, such as about Iberian wolves in Portugal (Torres et al. 2020) or lynx in Poland, where knowledge still affected attitudes (Bath et al. 2008). However, in our study, we did not find that knowledge explained variance in attitudes, which we discuss in more detail below. We found that people who indicated being afraid of wolves had significantly lower factual knowledge scores than those who indicated they were not afraid of wolves. Overall, fascination and curiosity emerged as the emotions most consistently shared across our sample. When comparing different stakeholder groups, farmers reported significantly higher levels of fear, anger, and frustration, along with lower levels of fascination compared to the general public. The more fear people expressed about wolves the less knowledge about wolves they had, in line with previous research that showed that at least for livestock farmers, higher levels of knowledge about wolves were related to lower levels of fear (Torres et al. 2020).

Opinions on wolf management

Previous research in South Tyrol indicated a positive public perception towards wolves during a time when there were relatively few wolves present (Stauder et al. 2020). While we cannot directly compare the two studies due to different sampling methods, the findings of our study indicate that attitudes towards wolf management were negative among some stakeholder groups, including farmers. While respondents from the general public mostly agreed with monitoring and preventative measures such as fencing, farmer respondents most favoured lethal control, which was the management option that the respondents from the general public most disagreed with. Our results highlight a contention between preferred management options such as lethal control between different stakeholder groups, which are at the core of human-human conflicts about wildlife management.

Using a regression model, we tested for the influence of different factors on the outcome variable of attitudes towards management. We found that the area of residence (*Bezirk*) where respondents lived was a significant predictor towards management attitudes. This indicates that place-based variables and potentially associated experiences with wolf management in respondents' own area of residence explain variance in management attitudes.

Furthermore, the emotions *anger* and *fascination* were significant predictors of management attitudes, but *fear* was not. Due to multicollinearity we did not include all emotions into the model, but our results are broadly aligned with previous studies that found emotions to have predictive potential for the acceptability of wolf management (Vaske et al. 2022), and with interest (or in our case *fascination*) with a species positively impacting people's attitude to conservation (Castillo-Huitrón et al. 2020). Although previous studies on tolerance about wolves in Italy showed knowledge level and education as significant predictors (Bongi et al. 2023), for our sample we did not find that knowledge level, or education was a significant predictor of management attitudes.

Perceived challenges for wolf management

The challenges for wolf management differed between the stakeholder groups. For instance, respondents from the general public and environmentalists had more concerns about inaccurate or one-sided media representation and misinformation. In contrast, for farmers, poor stakeholder inclusion, ineffective management strategies and perceived uneven power relations between stakeholders were among the largest concerns. As current management is focused on herd protection measures such as electrified fences and guard dogs, our findings suggest that widening management approaches to include other mechanisms is necessary, and that targeting specific outreach activities to different stakeholder groups may be beneficial in addressing specific concerns. Our results show that monitoring programs were the most widely accepted approach for the general public and may therefore represent a complementary measure to existing management. Further, enhancing stakeholder inclusion and engagement, as well as addressing power imbalances between different stakeholder groups are essential. For example, research indicated that the continued alignment of wolf management with capitalist consumptive practices, such as ecotourism, has placed unfair burden on local farming communities in Italy (Donfrancesco 2024), where the costs (e.g. livestock loss) and benefits (e.g. ecotourism) of co-existence with wolves are unequally distributed across society. More in-depth, qualitative research would be needed to follow up in more detail on the perceived imbalance of power in governance. Furthermore, misinformation and unbalanced media reporting were also identified as some of the major challenges by respondents from the general public and environmentalists. This connects to an earlier study on media coverage of wolves in Italy (Trainotti et al. 2023), which albeit revealing a generally balanced portrayal in the media, found that certain regions and media outlets exhibited instances of more biased reporting. Although the

overall factual knowledge about wolves was relatively low among our respondents, lack of information was perceived as less important among our respondents and our model indicated that better factual knowledge was not a significant predictor of attitudes towards current management, whereas emotions of *anger* and *fascination* were significant predictors. This results supports the increased focus of emotions in wildlife management and conservation as an important factor in shaping attitudes and decision-making (Castillo-Huitrón et al. 2020; Nelson et al. 2016).

Limitations and further work

Our sampling strategy used convenience sampling consisting of snowballing and distributing links to the questionnaire via local Facebook groups resulting in a relatively small sample of 162 completed responses. Using a convenience sampling is a clear limitation for our ability to generalise findings to the broader population, as it is not a representative selection of the population and may over or underrepresent certain groups. Furthermore, it is prone to selection bias of the respondents who volunteered to fill in a survey that was hosted online. The sample we obtained is relatively small, which further limits our ability for more in-depth analysis, e.g. between different groups. Although our sample contains relevant stakeholders such as farmers and hunters, and even though the proportion of hunters in our sample (2.39%) is larger than proportion of hunters in the population in South Tyrol with 1.4% of the population[1], the sample size was insufficient to distinguish hunters as a group for more in-depth statistical analyses. Future research should ideally use a larger probabilistic sample of the population where financially feasible, to allow for more advanced statistical modelling approaches such as multilevel modelling, which would allow separation of variance within and between groups of people living in different areas, and the use of, for instance, number of wolves, or livestock losses in each area, as additional explanatory variables to explain differences between attitudes in different areas. We would also suggest investigating stakeholder groups such as farmers and hunters more in-depth, as previous research in the Northwestern Apennines in Italy indicated these groups considerably diverge in their attitudes towards management (Bongi et al. 2023). For example, we recommend including more detailed variables regarding farming (e.g. number and type of livestock, type of farming such as livestock, arable farming) as additional explanatory variables. Finally, to study the complexities of emotions in more detail, we suggest that the findings in this study can be built upon through in-depth qualitative studies of local residents' emotive response to wolf presence and management, to better understand the complexity of these emotions than was possible using a standardised quantitative survey using reductionist psychometric scales to assess emotions such as fear or anger.

Implications for management

With continuing recolonization of their former ranges in the Alps, complex human-wolf relations in South Tyrol will likely continue to change, and adapting management to the changing context and public attitudes will be essential (Franchini et al. 2021). Based on this study, and the views expressed by respondents, there is evidence for investing in improving stakeholder engagement and relations, given that particularly respondents who identified as farmers indicated they felt a lack of engagement and inclusion. Such engagement can take different forms, and will need to be adapted to local contexts to be effective (Sterling et al. 2017). Further, given the importance of emotions found in this study, paying attention to, and having empathy with, the emotional dimensions of co-existence during stakeholder engagement processes may facilitate resolutions (Wynne-Jones 2022). Taking emotions seriously in this regard means moving beyond the notion that emotions need to be disregarded or avoided in order to make any progress, often in favour of more 'tangible and scientific evidence' for decision-making (Batavia et al. 2021), and instead consider emotions and their central role in how people actually make decisions (Nelson et al. 2016). A better understanding of emotions and their role for human-wildlife co-existence can also help in targeting activities to address co-existence challenges. For instance, where evidence from wildlife acceptance-attitude studies indicates 'opposition' or 'conditional support' (Metcalf et al. 2024), emotions may shed more light on underlying factors for such opposition.

Furthermore, in our study farmer respondents perceived power imbalances between different stakeholder groups, and there is a need for engagement efforts which navigate these power relations without further distancing already marginalised stakeholders (Brandt et al. 2018). Novel approaches for mediation in conflictive situations in wolf management in Italy show promise (Marino et al. 2021), where the focus is on building shared consensus between conflicting parties that are based on co-creating solutions, and finding agreement over management options. Such participatory and deliberative processes on wolf management and other carnivores will be essential in navigating the future of people co-existing with large carnivores in cultural landscapes (Donfrancesco 2024; Salvatori et al. 2020).

[1] Calculated from data available (Südtiroler Landesverwaltung 2024).

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Data availability The public survey data that support the findings of this study were obtained based on informed consent from participants on the use of the data for a specific research project and related research, and so are not publicly available.

Declarations

Ethical approval The questionnaire and methodology for this study are in accordance with the ethical standards of the University of Aberdeen and with the 1964 Helsinki Declaration and its later amendments and received ethical approval from the School of Geosciences at the University of Aberdeen.

Competing interests The authors declare no competing interests.

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