

# Loss of traditional knowledge aggravates wolf–human conflict in Georgia (Caucasus) in the wake of socio-economic change

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**Abstract** Reports of the damage from wolf attacks have increased considerably over the last decade in Georgia (in the Caucasus). We interviewed locals about this problem in two focal regions: the Lanchkhuti area (in western Georgia) and Kazbegi District (in eastern Georgia) where livestock numbers had increased by an order of magnitude owing to dramatic shifts in the local economies over the last decade. This coincided with expanding habitats for wolves (abandoned plantations, for example). We found that the perceived damage from wolves was positively correlated with a poor knowledge of wolf habits and inappropriate livestock husbandry practices. Our results suggest a loss of traditional knowledge contributes strongly to the wolf–human conflicts in Georgia. Restoring traditional, simple but good practices—such as protecting herds using shepherd dogs and introducing bulls into the herds—can help one solve this problem.

**Keywords** Carnivore–human conflicts · Wolves · Livestock husbandry · Socio-ecological studies · Traditional knowledge · Georgia

## INTRODUCTION

Conflicts between humans and wolves are common in countries where there are sizable populations of this species (e.g. [Bisi et al. 2007](#); [Balčiauskas 2008](#)). Georgia is one such country where the existence of viable wolf populations, genetically connected to populations in neighbouring countries, is well documented ([Kopaliani et al.](#)

[2014](#); [Pilot et al. 2014](#)). The last decade has seen a sharp increase in complaints on wolves killing livestock and even attacking humans in rural Georgia ([Kopaliani et al. 2009](#)). Here we explore the problem of intensified wolf–human conflicts in two focal regions of Georgia: (1) an area in western Georgia around Lanchkhuti which includes villages in Guria, Imereti, and Adjara provinces, and (2) Kazbegi District in eastern Georgia (Electronic Supplementary Material, Fig. S1). The climates of these two regions contrast markedly: the villages of the Lanchkhuti area enjoy a warm temperate maritime climate that allows oranges and tea to be grown, whilst the villages of Kazbegi District are situated in the subalpine zone, where the main crop is potatoes. Nevertheless, both focal regions have undergone dramatic changes in their economies after the collapse of the Soviet Union, and we have hypothesized that these changes could be a considerable contributor to increased conflicts between wolves and humans.

Comparing these two regions with their contrasting climate, and hence different types of local economies, can help in revealing general drivers of wolf–human conflicts in Georgia ([Stimson 2014](#)). Despite the differences, the two regions also show several similar characteristics. Firstly, beginning with the 1970s, the local economies became specialized and export-oriented. In the Lanchkhuti area, growing mandarin oranges and tea for export to Russia became the single-most important source of income. At the same time, Kazbegi District became a corridor for the gas pipeline connecting Russia to Armenia. Villages along the pipeline were supplied with free gas, and this prompted locals to build gas-heated greenhouses and grow strawberries and vegetables to export to Russia. As a result of economic specialization, the villagers in both regions often abandoned livestock husbandry. In the early years of this millennium, Russia closed the market for Georgian

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agricultural goods, and free gas was no longer available for greenhouses. The export-oriented economies both in the Lanchkhuti area and Kazbegi District collapsed and villagers switched back to livestock husbandry. Cattle numbers correspondingly increased about tenfold (Tevzadze 2009). At the time of our fieldwork, a farmer in the Lanchkhuti area typically owned 10–15 heads of livestock, almost entirely cows. In Kazbegi District, a farmer typically owned about 50–100 heads of livestock, mostly cows (ca. 80 %), sheep (up to 15 %), horses (up to 4 %) and very few donkeys (less than 1 %). Before the economic switch in the Lanchkhuti area, the tea farmers owned only one or two cows. Similarly, before the economic shift in Kazbegi District, greenhouse farmers owned no more than one or two cows and no sheep at all.

Secondly, both regions have seen considerably increased numbers of wolves (Kopaliani et al. 2009; Tevzadze 2009). Villagers in the Lanchkhuti area stated that they had found traces of a wolf presence in places where it had been absent for the last 50–60 years, and the re-appearance of wolves had become especially noticeable and frequent over the last 5 years. An increase in suitable habitats for wolves was documented in both regions (Electronic Supplementary Material, Figs. S2, S3). In the Lanchkhuti area, these are abandoned tea plantations, while in Kazbegi District, these are thickets of the common buckthorn (*Hippophae rhamnoides*). Actually, wolves had never been spotted near the greenhouses or tea plantations before the economic shift, and once the farmers had switched back to livestock husbandry and the number of cattle had started to increase, wolves became a problem. The wolves that attacked livestock lived close to pastures and villages, and damaged mostly the converted farms. The abandoned tea plantations or buckthorn thickets are close to these farms, and only they suffered from increased wolf attacks.

Last, but not the least: in both regions, there were villages with poor roads where the export-oriented economy was not feasible, and livestock husbandry had remained the main traditional occupation of the inhabitants. The livestock of these traditional farmers did not increase, and this provided us a reference baseline to see whether increased wolf–human conflicts were widespread or, rather, related to cases of switching back to livestock husbandry.

We designed a semi-structured questionnaire and interviewed villagers of the Lanchkhuti area and of Kazbegi District. We hypothesized that the change in local economies, from exported agricultural goods to subsistence livestock production, was associated with the increase in wolf–human conflicts. Our secondary hypothesis was that the impact of agricultural change was greater for households without a cultural tradition of livestock husbandry (e.g. the use of large shepherd dogs and bulls to deter predators).

## MATERIALS AND METHODS

We conducted our study in 2008–2009. Respondents were interviewed face-to-face by the research team members, and semi-structural questionnaire forms were completed at these meetings (Wengraf 2001). The questionnaire consisted of four parts: the first contained usual questions of a demographic character (age, education, gender, income). The second was designed to assess (1) respondent's knowledge of wolf behaviour and (2) his/her fear of wolves (Electronic Supplementary Material). The third part asked respondents to assess the damage from wolves in terms of lost animals (sheep, cows, horses and donkeys) and the number of dogs killed by wolves. Finally, the fourth part of the questionnaire collected data about the history and practice of livestock husbandry (whether the respondent's family had recently switched or not to livestock husbandry from another business, what size of dogs they owned (small, mid-sized or large shepherd dogs), and whether there were bulls in the herds. Farmers interviewed usually represented their own family except in assessing of the damage to cattle from wolf attacks. In the latter case, they would rather refer to the damage per village. These data were used by us as an assessment of the perceived damage from wolves. Some of the farmers also added the damage to their own farms, but the data were incomplete and we did not use them.

We constructed a socio-ecological data matrix from the completed questionnaires. Quantitative data (age, income, damage expressed as the numbers of lost livestock/dogs) were entered into the matrix as numbers without any transformations. Qualitative data and assessments were quantified as follows. The presence and the size of owned dogs were described with a four-grade scale (no dog = 0, small dog = 1, mid-sized = 2 and large shepherd = 3). Respondents were either school leavers (=1) or university graduates (=2). Fear of wolves was assessed with a five-grade scale (very low = 1 to very high = 5). A knowledge of wolf behaviour was similarly assessed on a five-grade scale (very poor = 1 to very good = 5). The data as to whether respondent's family switched to livestock husbandry recently from another business, or whether it was their traditional activity were entered as a binary variable (traditional = 0 and switch = 1).

The socio-ecological data matrix was used to calculate descriptive statistics and the Pearson correlation coefficients among the socio-ecological variables. All statistical analyses were conducted using the Statistix 9 program (Analytical Software, Tallahassee, FL, USA).

In subsequent years, we revisited the study areas and met with some of the farmers who were interviewed during 2008–2009. We asked their opinion about the wolf problem in their region, and used these opinions to

**Table 1** Correlation matrix of socio-ecological variables in Kazbegi District, Republic of Georgia. Only statistically significant values (Pearson's correlation) are shown where bold characters highlight strong links (correlation coefficient >0.5). The variables: Age refers to the age of the respondent; Damage—total number of livestock killed by wolves as estimated by the respondent for his/her village; Dog size—if the respondent family possesses a dog, if so is it of small, medium or large size; Education—respondent's grade of education, secondary or higher; Fear refers to the level of fear of the respondents towards wolves; Knowledge—how well the respondent understands wolf's behaviour; Lost dogs—total number of dogs killed by wolves as estimated by the respondent for his/her village; Switch—whether the respondent family had to switch to livestock husbandry from greenhouses/orange orchards/tea plantations

	Age	Damage	Dog size	Education	Fear	Knowledge	Lost dogs	Switch
Age	–							
Damage		–						
Dog size		–0.42	–					
Education	0.41			–				
Fear		<b>0.61</b>	<b>–0.66</b>		–			
Knowledge		<b>–0.58</b>	<b>0.64</b>		<b>–0.91</b>	–		
Lost dogs				0.40	0.36	–0.38	–	
Switch		<b>0.61</b>	<b>–0.77</b>	0.43	<b>0.85</b>	<b>–0.78</b>		–

monitor how the human–wolf conflict was developing in the focal regions.

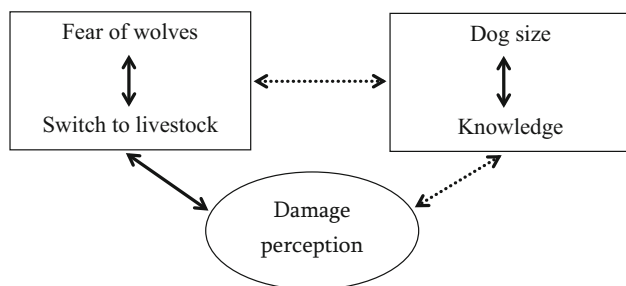
## RESULTS

We completed a total of 34 semi-structured questionnaires from the villages of east and west Georgia. In western Georgian villages, we interviewed eight respondents whose families had switched from growing tea and mandarin oranges to livestock husbandry, while another six families from the same region had maintained traditional livestock husbandry. In eastern Georgia, sixteen families had switched from greenhouse business to livestock husbandry, whilst another four families had maintained traditional livestock husbandry. The mean age of respondents was  $46 \pm 13$  SD years, the oldest being 80 and the youngest 16 years old. On average, respondents estimated the damage to his/her village as  $36 \pm 37$  SD heads of cattle, minimum and maximum ranging from zero to 156 for the last year. The mean number of lost dogs was  $2 \pm 2$  SD, the minimum and maximum ranging zero to ten. Five respondents did not keep any dog, whilst others were owners of small dogs (seventeen respondents), mid-sized (three respondents) or large 'shepherd' dogs (nine respondents). The analysis of the responses to the questions showed that the knowledge of wolf behaviour ranged from very poor to very good and, similarly, fear of wolves also ranged from very low to very high (see below). Mean income was stated as less than 500 Georgian Lari (GEL) by eastern Georgian respondents and below 150

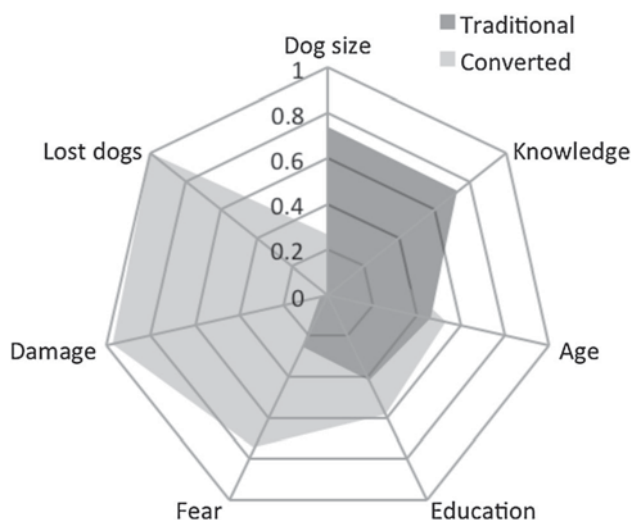
GEL by western Georgian respondents. Usually, there were 20–50 livestock per dog (irrespective of dog size).

The demographic data (age, education), the husbandry history (switch or traditional livestock husbandry), respondents' perceptions of increased loss of cattle (estimated numbers of lost animals and dogs, fear of wolves) and management styles (dog size, the knowledge of wolf behaviour) correlated with each other in distinct ways (Table 1). The switch to livestock husbandry, the fear of wolves and perceived damage showed a strong positive correlation with each other. The correlation between knowledge of wolf behaviour and the owned dog size was also positive and tight, yet these two variables correlated strongly and negatively with the switch to husbandry, fear of wolves and the perceived damage. There were other cases of significant (albeit not so strong) correlations: education correlated positively with age, the number of lost dogs and the switch to livestock husbandry; the number of lost dogs also correlated positively with a fear of wolves but negatively with a knowledge of wolf behaviour (Table 1).

The results of correlation analyses indicated clusters of variables that were highly associated with the socio-economic switch from an export to a local economy (Fig. 1). Specifically, we can distinguish two groups of variables that strongly correlated with the perceived damage from wolves and with each other. First, a fear of wolves and the switch to livestock husbandry correlated *positively* with the damage from wolves; second, the dog size and the knowledge of wolf behaviour correlated *negatively* with the damage from wolves. This grouping of variables reflects that, overall, the socio-ecological profile of respondents that switched recently to livestock husbandry differed strikingly from that of the respondents who had maintained husbandry traditions unbroken (Fig. 2). The two groups were comparable in age and education, yet respondents who switched recently to livestock husbandry reported overwhelmingly more damage from wolves, kept smaller dogs, showed a much greater fear of wolves and much less knowledge of wolf habits, and all the lost dogs belonged to them. In contrast, the respondents who retained an unbroken tradition of livestock husbandry reported no perceived increase in damage from wolves, kept large-sized dogs and bulls among their cattle, showed less fear of wolves and a much better knowledge of their habits, and did not report any lost dogs (Fig. 2). While respondents who switched recently to livestock husbandry easily appreciated the importance of shepherd dogs for cattle protection, the role of bulls was not so obvious to them. In contrast, the respondents who kept to traditional livestock husbandry explained that bulls can protect their herds from wolf attacks by causing cows to remain in closer proximity to each other. Experienced herders installed one bull in each group of cows and the bulls protected them from wolves simply by keeping



**Fig. 1** Schematic representation of the interplay among the socio-ecological variables. *Solid and dashed arrows* refer to positive and negative correlations, respectively. Two groups of positively correlated variables can be distinguished that (1) increase the perception of damage from wolf attacks (fear to wolves, recent switch to livestock husbandry), and that (2) decrease the perception of damage from wolf attacks (ownership of large shepherd dogs, understanding of wolves behaviour based on traditional knowledge); damage perception is represented by two uncorrelated variables—the number of lost livestock and the numbers of lost dogs



**Fig. 2** Socio-ecological profiles of two groups of villagers; Traditional—families that retained the unbroken livestock husbandry tradition; Converted—families that switched to livestock husbandry recently from other businesses. Variables are compared on per respondent basis and the proportions of these values between the groups are shown

the cows together (all the owners of large shepherd dogs were those who also kept bulls in the herds).

## DISCUSSION

Our findings show that a poor understanding of wolf behaviour and poor livestock management constitute a considerable part of the problem in wolf–human conflicts in Georgia. Negative attitudes towards large carnivores, particularly wolves, have complicated efforts to restore predator populations in Scandinavia (Røskaft et al. 2007; Bisi et al. 2007).

Village dwellers are usually those who have strongly negative attitudes (Balčiauskas et al. 2005). Poor knowledge of habits and behaviour of large carnivores can be one driver of those attitudes, along with a high probability of wolf–human conflicts where an increased number of livestock meets wolf populations (Røskaft et al. 2003). However, our study shows that the problem is not fear of wolves per se, but the poor practices of livestock management. This is highlighted by the contrast between the villagers who kept an unbroken tradition of livestock husbandry and those who switched to livestock husbandry recently after the economic crisis. The respondents who kept to traditional livestock husbandry did not report any increased damage from wolves, used shepherd dogs to protect their cattle, and installed bulls in the herds. Conversely, the respondents who shifted to livestock husbandry recently were those who reported increased damage from wolves but did not use shepherd dogs (hence the negative correlation between dog size and perceived damage by wolves) and did not keep any bulls. The poor knowledge and practice of livestock husbandry by this group of respondents can be explained by the recent economic history of these regions. Previously, livestock husbandry was a small part of the local economy when the major agricultural activity was production of export crops, e.g. tea in the Lanchkhuti area and greenhouse vegetables in Kazbegi District. Cattle (if any) were kept almost all the time at or near the home, and there was little need to protect them in pastures. Hence, the use of shepherd dogs was discontinued and bulls were considered ‘useless’ by these families. The crisis and the resulting shift of major economic activity to livestock husbandry brought about a dramatically increased numbers of cattle in both regions, but this increase happened without changing habits of cattle care. In other words, these villagers ‘had forgotten’ how to protect their cattle, and they did not acquire shepherd dogs or install bulls in the herds even though livestock husbandry became the most valuable part of their economy. Similar problems of poor management associated with increased damage to livestock from wolves have also been reported from elsewhere—in particular from southern Italy (Meriggi and Lovari 1996; Ciucci and Boitani 1998). Complaints about wolf attacks in Georgia started to appear after 2003, the ‘pivotal’ year of the economic switch. This coincided with an increase in livestock and suggests an apparent correlation with herd sizes. However, we did not analyse this correlation quantitatively because data on the size of owned herds was not reliable as the respondents were reluctant to disclose precise numbers.

Traditional farmers used to keep their herds on the pastures for months, led by bulls. In the evenings, farmers took only the milch cows back home accompanied by shepherd dogs, and this movement of cows from pasture to villages occurred without wolf attacks. In contrast to this, the converted farmers organized ‘herding’ (either hiring other villagers as herders, or sharing the duties among themselves),



but this measure was insufficient, and their herds mostly suffered from wolf attacks during the evenings when returning from pastures in conditions of poor visibility. Wolf attacks also occurred in these villages at nights, as small dogs could not defend livestock against wolves. Moreover, small dogs would hide if they detected wolves nearby. Hence, the protection afforded by dogs depended on their size. Large dogs were kept at home during the day, but they protected the farm and livestock at night. Small dogs followed their owners all the time but were not able to protect the herd.

Apparently, owning shepherd dogs and bulls can effectively reduce damage from wolves. Actually, this can be the main avenue to improve livestock's defence against wolves, and the experience of the farmers who kept traditional livestock husbandry shows that the conflict between wolves and humans can be managed. Conservationists (in a broad sense) can also contribute to solving these conflicts. Wolf populations can be monitored closely in order to reveal and remove the 'problematic individuals' who specialize in hunting livestock and attacking humans (Linnell et al. 1999, 2003; Løe and Røskaft 2004).

Soon after our study (specifically, in 2011), construction of a cascade of hydroelectric stations began along the river Tergi and its tributaries in Kazbegi District. Later, two large landslides occurred which blocked the main roads in 2014. The construction works and landslides severely disturbed the new wolf habitats (buckthorn thickets) and, apparently, wolves left the vicinities of villages. As a result, wolf attacks on livestock sharply decreased over the last 2–3 years, and the converted farmers have lost their motivation to change their husbandry practices. We suggest that after the completion of construction works, the wolves will be back, and the conflict between them and the converted farmers will restart. In the Lanchkhuti area, however, the situation is different: the converted farmers (at least those who took part in our study) are starting to introduce large shepherd dogs to protect their herds. Accordingly, the reports on wolf attacks are apparently reducing. We suggested to the local authorities as well as non-governmental groups an organized campaign to accelerate the implementation of appropriate husbandry practices among the converted farmers. So far, the response from these stakeholders appears to be slow.

## CONCLUSIONS

Our work highlights the importance of traditional knowledge for carnivore–human relationships. Socio-economic shifts are possible in any part of the world where carnivores and farmers cohabit, and one driver of the increased conflicts between the predators and farmers can be just a poor knowledge of wolf behaviour and of the lost traditions of husbandry. Yet this problem can become easily

manageable by restoring good practices based on simple traditional measures of cattle protection such as owning large shepherd dogs and bulls.

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