

# Do local communities support the conservation of endangered Przewalski's gazelle?

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**Abstract** Understanding local attitudes and opinion is vital to the success of conservation programs, especially in areas of expanding human populations such as China. Przewalski's gazelle (*Procapra przewalskii*) is an endangered ungulate found only in the eastern part of the Qinghai-Tibet Plateau. The gazelle is a conservation focus; however, little is known regarding how this animal is perceived by local people. To understand the relationship between demography, levels of conservation knowledge, and attitudes, we conducted 174 interviewer-led surveys in villages located inside, near, and away from the gazelle's home ranges around Qinghai Lake, China. About half of the interviewees were aware of gazelle conservation. No more than half of the interviewees were aware that grassland fence, livestock, roads, and wolves negatively impact upon gazelle. On the whole, the majority of interviewees supported the conservation of gazelle. There were high levels of support for both establishing a special protected area and investing more funds in conservation but very few interviewees reported personal benefits from gazelle conservation. Overall attitude of interviewees toward the gazelle differed significantly among regions and people

living near the range of gazelle were the most positive. Interviewees with conservation information were more positive than interviewees lacking such information. People who had more education or possessed more grassland had more positive attitudes toward the gazelle. This study suggests that greater communication is needed with local people. Programs that promote public engagement and participation are required for the conservation of Przewalski's gazelle and other larger herbivores on the Qinghai-Tibet Plateau.

**Keywords** Przewalski's gazelle · Human–wildlife relationship · Qinghai-Tibet Plateau · Qinghai Lake

## Introduction

A human-induced catastrophic extinction event is currently underway and evidenced by a species extinction rate 1,000 times greater than background rates (Pimm et al. 1995). Human–wildlife conflict caused by clashes between wildlife and the economic goals of humans is also placing pressure on species and is a major issue for conservation (Woodroffe et al. 2005). For example, groups of people may expect financial proceeds or services from wildlife, and detest wildlife species that do not provide direct profits (Gadd 2005). Local people whose livelihoods depend upon the direct exploitation of local resources often come into conflict with conservation programs designed to protect resources (Anthony 2007). As the most populous region on Earth, the extent and intensity of human–wildlife conflict in China is increasing rapidly (Jiang 2004a), especially for species that damage crops such as Asian elephants (*Elephas maximus*; Zhang and Wang 2003) and wild boar (*Sus scrofa*; Cai et al. 2008). Assessing and exploring the

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attitudes of people living with and alongside wildlife is important for conservation planning (Romañach et al. 2007), as local cooperation and participation are key factors in successful conservation programs (Mankin et al. 1999; Xu and Melick 2007).

Przewalski's gazelle (*Procapra przewalskii*) is endemic to China and occurs over a small range only (Jiang 2004b). Last century, human activity resulted in the destruction of ideal habitat for the gazelle and its distribution declined (Jiang and Wang 2001). As of the early 1990s, the gazelle was only found around Qinghai Lake with about 300 individuals (Jiang et al. 1995, 1996), and its remnant populations were confined to several isolated locations (Jiang 2004b; Ye et al. 2006). This species was subsequently listed as a Category I (Endangered in China) National Protected Wild Animal Species under Chinese law in 1989 and classified as Critically Endangered by the International Union for Conservation of Nature (IUCN) from 1996 to 2008 (IUCN SSC Antelope Specialist Group 2008).

In order to protect wetland ecosystems and wildlife, the Qinghai Lake Nature Reserve was established in 1975 and designated a national nature reserve in 1997. Przewalski's gazelle is one of the main target species of protection; however, only gazelle on the "Bird Island" are within the protected area (Jiang 2004b). To improve livestock productivity, grasslands were leased to local herdsman who have transformed them into fenced paddocks (Liu and Jiang 2002). These fence lines impair the ability of gazelle to escape predators such as wolves (Jiang et al. 2000), strangle gazelles, and are the main threat to their survival (Jiang et al. 2000; Li et al. 1999). Domestic sheep compete with gazelle for food during the 8-month winter characteristic of the Qinghai-Tibet Plateau (Liu and Jiang 2004). Road networks around the lake have formed barriers to the free movement of gazelle (Li et al. 2009a). Furthermore, co-existence of Przewalski's gazelle, local communities, and their livestock presents a dilemma of gazelle conservation and the defense of economic interests of local communities (Jiang 2004b).

Despite a large number of studies on food competition, habitat selection, causes of decline, group size and composition, vigilance, and sexual behavior in Przewalski's gazelle (Jiang et al. 2000; Lei et al. 2001, 2003; Li and Jiang 2002; Li et al. 2009b; Liu and Jiang 2004; You and Jiang 2005), the attitudes of local people living alongside this species remain unknown. For example, are local residents aware of conservation strategies directed at the gazelle? Do they support gazelle conservation? Do people's attitudes differ between communities and what are some of the reasons behind these opinions? Here, we examine local attitudes toward Przewalski's gazelle around Qinghai Lake. We not only explored attitudes and conservation values of

local communities, we sought to determine the effect of socio-economic and experiential factors upon such attitudes. Through the collection of this important data we hope to guide future conservation programs not only for this important species but for ecosystems throughout the Qinghai-Tibet Plateau.

## Methods

### Study area

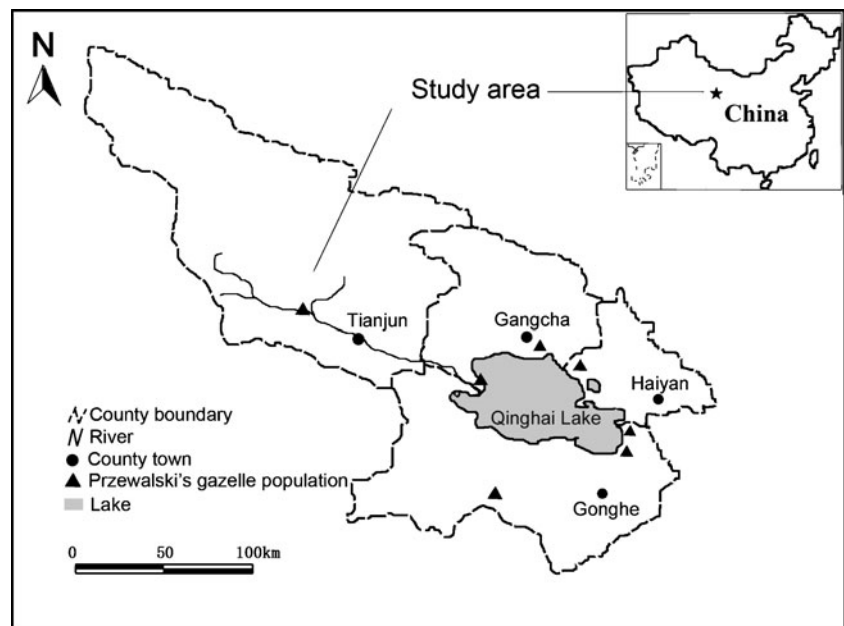
We surveyed local communities around Qinghai Lake (36° 28'–38°25' N, 97°53'–101°13' E; Fig. 1) that lie within the present range of Przewalski's gazelle. Qinghai Lake is the largest (4,583 km<sup>2</sup>) semi-saline lake in China and lies 3,200 m a.s.l. It is fed by approximately 40 rivers and streams but the water table has descended 3.7 m since 1959 due to long-term changes and drier climatic conditions (Ma and Jiang 2006). The area is characterized by a continental climate with dry and cold winters, strong winds in spring and winter, high levels of solar radiation and a short frost-free period. Mean annual temperature is 1.1°C at Hudong on the east shore of the lake and 0.3°C at Jiangxigou on its southern shore. Temperature extremes are 25°C and –31°C. Annual precipitation varies from 360–370 mm in the north-west to 395–412 mm in the south-east, with most falling between June and September. Annual evaporation is about four times greater than annual precipitation (Chronicles Compiling Committee of Qinghai Province 1998). The lake, except for the delta of the Buha River on the west shore, is frozen from December to March.

Approximately 100,000 people whose majority is Tibetan inhabit areas around Qinghai Lake making it one of the most densely populated area across the Qinghai-Tibet Plateau. Since the 1950s, similar to other regions in China, economic and social conditions in this region have changed greatly. Grassland has been leased to herders for a period of 50 years since 1978 and these former pastoralists have gradually settled down and implemented a rotational grazing system: in summer and autumn, herders stock the summer pastures over 4,000 m a.s.l. where no gazelle inhabits; the herders return with their livestock to the winter pastures between 3,000 to 4,000 m a.s.l. where the gazelle inhabits (Jiang 2004b).

### Data collection and analysis

We conducted face-to-face interviews using structured questionnaires in January 2007 and April 2009. We interviewed households located in local communities that occurred within the extent of occurrence of Przewalski's gazelle (i.e., the area contained within the shortest

**Fig. 1** Location of the study area



continuous imaginary boundary that encompassed all the known, inferred, or projected sites of present gazelle occurrence, excluding cases of vagrancy). Households were randomly selected and classified into one of three groups based on their proximity to isolated areas frequented by different gazelle population (i.e., known home ranges of gazelle): households located inside the home ranges of gazelle ( $n=77$ , 36% of the total number of household of this group of communities; with 95% confidence level and a confidence interval of 9), near (within 1–5 km of gazelle's home ranges,  $n=52$ , 35%; with 95% and 10) and away from (5–20 km,  $n=45$ , 26%; with 95% and 11). Only one adult member of a household was interviewed.

For each interviewee we recorded his/her gender, age, family size (number of people per household), family income (annual income per household), education background, area of grassland belonging to the family, and the number of cattle and sheep owned. We also asked interviewees whether they had seen a Przewalski's gazelle and in which season; whether they were aware of gazelle conservation and where they derived their knowledge. Four questions were included regarding the effect of grassland paddock fence, livestock, roads, and wolf predation (Table 1). All questions concerning knowledge of threats and attitude were measured using a three-point scale of negative, neutral, or positive. Answers were evaluated using previous studies (Jiang et al. 2000; Jiang 2004b; Li et al. 2009a; Liu and Jiang 2003), for example, if the interviewee's answer concurred with previous research, we considered the answer "positive". Finally, we constructed nine questions designed to assess attitudes of interviewees toward Przewalski's gazelle (Table 1). We informed

interviewees that the Institute of Zoology, Chinese Academy of Sciences was conducting the research and assured all interviewees they would remain anonymous. The interviewer-led surveys were conducted in Chinese and responses were provided in the same language. Interviews were conducted by the authors only.

We analyzed our survey data using SPSS 15.0 (SPSS 2005). Knowledge regarding threats and interviewee attitudes were converted to numeric values (-1, 0, or +1). We summed responses for each interviewee across the nine attitude questions to give a combined score (possible range: -9 to 9, higher scores indicate more positive attitudes toward the gazelle). Cronbach's alpha was used to assess the reliability of the attitude score (Cronbach 1951) and the value was 0.72. Descriptive statistics were derived for all socio-economic, experience, knowledge, and attitude variables.

We used Kolmogorov–Smirnov tests to check normality of data and transformed data to meet assumptions of normality and homogeneity of variances. Non-parametric analyses were used to compare the differences between data sets that could not be normalized. We compared the differences of education background, knowledge of threats, and combined attitude score using Kruskal–Wallis and/or Mann–Whitney  $U$  tests among regions. Additionally, we examined the difference of combined attitude score between interviewees with and without conservation knowledge with a Mann–Whitney  $U$  test. Bivariate analyses were conducted between individuals' knowledge of threats, attitude statements, combined score, and potential explanatory factors (socio-economic and experience variables). Data were presented throughout as mean $\pm$ SE and  $p\leq 0.05$  was considered statistically significant.

**Table 1** Interview questions used to assess attitudes towards and knowledge of threats to Przewalski's gazelle

Questions	Item code
<b>Knowledge of threat</b>	
What kind of effects do you think grassland paddock fences have on gazelle?	Grassland fence effect
What kind of effects do you think livestock have on gazelle?	Livestock effect
What kind of effects do you think roads have on gazelle?	Road effect
Do you know that wolves often prey on gazelle?	Wolf predation effect
<b>Attitude</b>	
What is your opinion on the conservation of gazelle around Qinghai Lake?	Gazelle conservation
What is your opinion on establishing a special protected area for gazelle?	Establish protected area
What is your opinion on investing more funds in gazelle conservation?	More funds for conservation
What is your opinion on local people taking part in the conservation of gazelle?	Local people participation
What is your opinion on competition for grass between gazelle and livestock?	Gazelle compete for grass with livestock
If grasslands were adequate, would you decrease your stocking rate in gazelle habitat?	Decrease stocking rate
If there were gazelle grazing on your grassland, would you drive them off?	Drive gazelle off
If you saw injured gazelles, would you seek wildlife department for help to rescue them?	To rescue injured gazelles
Do you think you can benefit from the conservation of gazelle?	Benefit from conservation

## Results

### Characteristics of sample

We completed 174 interviews (150 males, 24 females). Approximately 75% of the interviewees were 25 to 50 years of age (range, 18–77). The number of people per household ranged from two to 13. The area of grassland belonging to each household varied greatly (range 5–667 ha) with 80% of households having grassland less than 100 ha in area. In total, 87% of the interviewees owned livestock and of these 84% had sheep (66% more than 50 sheep) and 78% had cattle (51% more than ten cattles). Family income was symmetric (skewness=0.054, SE=0.186) with 52% of sampled households having an annual income >10,000 CNY (1 CNY≈0.15 USD), and 18% having an income <5,000 CNY per year. Education background varied significantly among regions

( $\chi^2=14.565$ ,  $df=2$ ,  $p<0.05$ ). Overall, 76% of the interviewees claimed that they had seen the gazelle (Table 2); six in ten saw the gazelle in all seasons and a seasonal bias in winter (77%) was detected.

### Knowledge of gazelle conservation and threats

Eighty-nine interviewees (51%) possessed knowledge of conservation-related information regarding gazelle and was sourced primarily from media and interpersonal sources. Less than 2% of conservation knowledge was derived from local wildlife departments (Fig. 2). The proportion of interviewees with knowledge of gazelle conservation declined with increasing distance from known gazelle's home ranges. We found that 71%, 56%, and 11% of the interviewees lived inside, near, and away from the range of gazelle were aware of its conservation, respectively.

Public understanding of threats facing gazelle varied considerably. Approximately a quarter of interviewees were aware that livestock negatively affected gazelle. Awareness of the impact of roads and wolves (both about one in three interviewees) and grassland paddock fence (50% of the interviewees) was higher (Table 3). Among the three groups of local communities, the number of people that felt reducing the height of fences would benefit gazelle varied from 33% to 62%. However, more than two thirds of the interviewees who lived inside the range of gazelle believed that livestock did not disturb the gazelle. Forty percent of the interviewees living inside the range of gazelle felt roads could affect gazelle. Such an opinion dropped to 37% in the interviewees who lived near the range of gazelle, and to 16% when living away from the range of gazelle. We found significant differences between communities in their knowledge of the effect of livestock on gazelle ( $\chi^2=20.747$ ,  $df=2$ ,  $p<0.001$ ) and wolf predation ( $\chi^2=8.145$ ,  $df=2$ ,  $p<0.05$ ) but not paddock fence or roads. These differences were apparent when comparing people that lived inside the range of gazelle with those that lived near (wolf predation:  $Z=-2.27$ ,  $p<0.05$ ; livestock:  $Z=-2.61$ ,  $p<0.05$ ) or away from the range of gazelle (wolf predation:  $Z=-2.53$ ,  $p<0.05$ ; livestock:  $Z=-4.68$ ,  $p<0.001$ ) only; no significant difference was found between interviewees that lived near or away from the range of gazelle.

### Attitudes toward Przewalski's gazelle

The majority of interviewees (63%) were in favor of the conservation of Przewalski's gazelle and a greater proportion of these people lived both inside and near the range of gazelle than away from. Similarly, more interviewees living closer to the gazelle felt positive about the establishment of a protected area and the use of more funds for conservation

**Table 2** Characteristics of the interviewees who lived inside, near, or away from the home ranges of Przewalski's gazelle

Variable	Inside the range ( <i>n</i> =77)	Near the range ( <i>n</i> =52)	Away from the range ( <i>n</i> =45)	Total ( <i>n</i> =174)
Attributes of the interviewee				
Male (%)	88	77	93	86
Mean age ( $\pm$ SE)	35 $\pm$ 1	41 $\pm$ 2	41 $\pm$ 2	38 $\pm$ 1
Socio-economic variables				
Mean family size ( $\pm$ SE)	5.1 $\pm$ 0.2	4.7 $\pm$ 0.2	4.3 $\pm$ 0.2	4.8 $\pm$ 0.1
Possess grassland (%)	100	98	78	94
Area of grassland ( $\pm$ SE, ha) <sup>a</sup>	139 $\pm$ 18	21 $\pm$ 2	26 $\pm$ 2	73 $\pm$ 9
Annual family income ( $\pm$ SE, CNY)	16,400 $\pm$ 2,264	131,247 $\pm$ 1,136	9,724. $\pm$ 1,459	12,827 $\pm$ 929
Education background (%)				
Illiteracy	67	86	47	68
Primary school	21	2	29	17
Junior high school	5	6	20	9
Senior high school	4	6	4	5
College or university	3	0	0	1
Experience variable				
Had experience with gazelle (%)	81	89	56	76

<sup>a</sup> Those households without grassland were not included in statistics

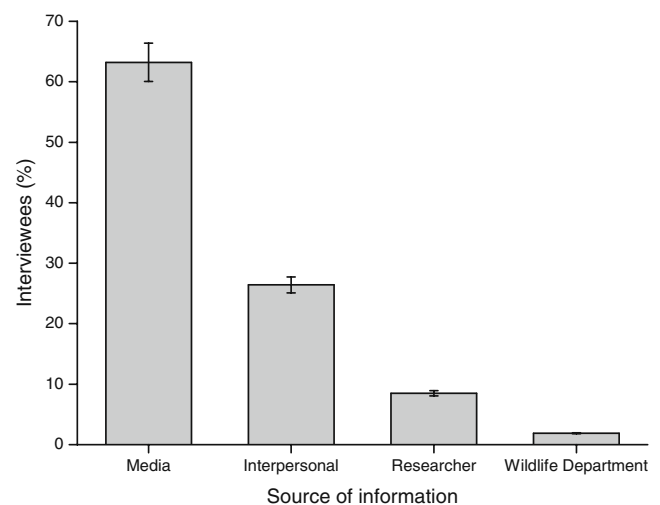
than interviewees living away from this animal (approximately 75% of the interviewees living away from the range of gazelle were indifferent). Support for the involvement of local people in gazelle conservation varied from 16% to 42% between communities (Table 3).

The clear majority of people living close to the gazelle (88% and 69% for those living inside and near the range of gazelle, respectively) believed that gazelle might compete with livestock for grass. Concurrently, a majority of people living both inside and near the range claimed they would not deter gazelle from grazing on their grassland. As expected, the majority of people living away from the range of gazelle were indifferent in this regard. Sixty-nine percent of people living inside the range of gazelle and 44% of those living near the range stated that they would attempt to decrease the stocking rate in the habitat of gazelle. More than 60% of the interviewees indicated they would seek help from authorities when they encountered injured gazelles (Table 3) despite low levels of positivity regarding personal benefits from gazelle conservation (inside the range of gazelle, 29%; near, 15%; and away, 13%).

When attitude scores were summed across the nine attitude questions it became clear that people living neither too close nor too far from the gazelle were the most positive (inside the gazelle of gazelle, 2.04 $\pm$ 0.31; near, 2.77 $\pm$ 0.37; away, 0.89 $\pm$ 0.26;  $\chi^2=15.53$ , *df*=2, *p*<0.001). Lastly, the combined attitude score for interviewees lacking conservation information (0.73 $\pm$ 0.21) was significantly lower than that for interviewees with information (3.13 $\pm$ 0.27; *Z*=-6.53, *p*<0.001).

#### Factors influencing attitude

Some explanatory factors were significantly correlated with interviewee knowledge of threats and interviewee attitudes (Table 4). Interviewees' level of education was positively correlated with combined attitude score for those living inside the range of gazelle only (*r*=0.34, *p*<0.01; Fig. 3a). A positive correlation was also found between combined attitude score and the amount of grassland owned, again, for interviewees living inside the range of gazelle only (*r*=0.34, *p*<0.01; Fig. 3b). An interesting pattern was found



**Fig. 2** Sources of conservation knowledge on Przewalski's gazelle. Eighty-nine interviewees had knowledge of gazelle conservation and some provided more than one answer (*n*=106)

**Table 3** Interviewees' knowledge of threat and attitude towards Przewalski's gazelle [mean ranges from -1 (negative) to +1 (positive)]

Item code	Inside the range				Near the range				Away from the range				Total			
	– (%)	+ (%)	Mean	SE	– (%)	+ (%)	Mean	SE	– (%)	+ (%)	Mean	SE	– (%)	+ (%)	Mean	SE
<b>Knowledge of threat</b>																
Grassland fence effect	26	52	0.26	0.10	19	62	0.42	0.11	2	33	0.31	0.08	18	50	0.32	0.06
Livestock effect	77	23	-0.53	0.10	50	33	-0.17	0.13	16	20	0.04	0.09	53	25	-0.28	0.06
Road effect	38	40	0.03	0.10	48	37	-0.12	0.13	20	16	-0.04	0.09	36	33	-0.03	0.06
Wolf predation effect	36	49	0.13	0.11	56	31	-0.25	0.13	31	4	-0.27	0.08	41	32	-0.09	0.07
<b>Attitude</b>																
Gazelle conservation	23	69	0.45	0.10	12	79	0.67	0.09	2	33	0.31	0.08	14	63	0.48	0.06
Establish protected area	6	54	0.49	0.10	4	64	0.60	0.08	0	24	0.24	0.07	3	48	0.45	0.05
More funds for conservation	5	74	0.69	0.07	15	56	0.40	0.10	0	27	0.27	0.07	7	56	0.49	0.05
Local people participation	36	40	0.04	0.10	14	42	0.29	0.10	11	16	0.04	0.08	23	35	0.11	0.06
Compete for grass with livestock	88	8	-0.81	0.06	69	21	-0.48	0.12	38	0	-0.38	0.07	70	10	-0.60	0.05
Drive gazelle off	26	69	0.43	0.10	14	75	0.62	0.10	2	13	0.11	0.06	16	56	0.40	0.06
Decrease stocking rate	9	69	0.60	0.08	14	44	0.31	0.10	4	2	-0.02	0.04	9	44	0.35	0.05
To rescue injured gazelles	8	62	0.55	0.07	10	83	0.73	0.09	0	33	0.33	0.07	6	61	0.55	0.05
Benefit from conservation	57	29	-0.29	0.15	52	15	-0.37	0.10	16	13	-0.02	0.08	41	18	-0.23	0.06

between combined attitude score and experience of interviewee with gazelle: these two factors were negatively correlated for people living inside the range ( $r=-0.32$ ,  $p<0.01$ ) and positively correlated for those living away from the range ( $r=0.46$ ,  $p<0.01$ ; Fig. 3c). There was no significant correlation between combined attitude score and other factors across the three types of communities (all  $p>0.05$ ).

## Discussion

### Knowledge of gazelle conservation

Local communities inside the distribution range of Przewalski's gazelle are the most important stakeholders in its conservation. Thus, it is vital to invite them and to consider their opinions for carrying out corresponding management projects successfully (König 2008). Given the populations growth and distribution expansion of this endangered species (Jiang 2004b; Ye et al. 2006), people living not only alongside the gazelle but also away from the current home ranges of gazelle would be of importance as the gazelle re-colonizes its former range (Hu and Jiang, unpublished). Here, we found limited awareness, generally, of the conservation activities implemented to protect this species because of the low level of awareness for interviewees who lived away from the range of gazelle. This implies a poor level of local participation and communication in communities away from the range of

gazelle in respect that the gazelle's range is expected to expand. Local nature reserve and government administrators have not implemented strong and consistent efforts to increase levels of local participation throughout the distribution range of gazelle. This fact will likely hamper the effectiveness of conservation plans for Przewalski's gazelle and greater communication and involvement is needed.

### Regional differences

We identified regional differences in the attitude toward Przewalski's gazelle, as has been found in other studies of this nature (Irby et al. 1997; Ericsson and Heberlein 2003). As expected, the distance that a person lived from the gazelle's home range influenced his/her attitude toward this species.

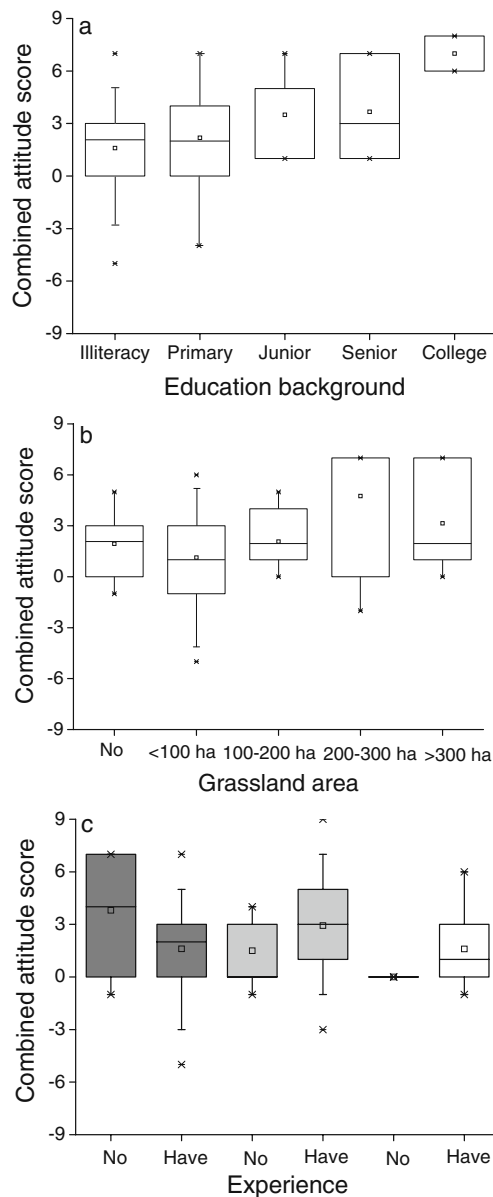
Although interviewees living inside the range of gazelle possessed more conservation information than those of the other two groups, they also encountered higher levels of direct conflict (grazing, etc.). Gadd (2005) indicated that human-wildlife conflict may erode local support for conservation and it is clear that the public will tolerate some aspects of living with wildlife until these activities result in a safety concern or economic loss (Coluccy et al. 2001; Dowle and Deane 2009). Our findings concur, as we found greatest levels of positivity among people who lived near the range while those who lived inside the range had the most accurate objective knowledge but moderate positive attitude. Anthony (2007) showed that interviewees who rarely communicate with the staff of local nature

**Table 4** Correlations between knowledge of threat or attitude towards Przewalski's gazelle and explanatory factors based on bivariate analyses

	Family size			Area of grassland			Family income			Education level			Experience with gazelle		
	Inside the range	Near the range	Away from the range	Inside the range	Near the range	Away from the range	Inside the range	Near the range	Away from the range	Inside the range	Near the range	Away from the range	Inside the range	Near the range	Away from the range
<b>Knowledge of threat</b>															
Grassland fence effect	-0.09	0.11	-0.03	-0.12	0.12	-0.34 <sup>a</sup>	-0.19	-0.43 <sup>b</sup>	-0.07	0.12	0.10	0.12	0.31 <sup>b</sup>	0.19	0.55 <sup>b</sup>
Livestock effect	-0.18	0.10	0.12	0.03	-0.02	0.17	-0.03	-0.12	-0.47 <sup>b</sup>	0.01	0.36 <sup>b</sup>	0.26	-0.04	0.06	0.07
Road effect	0.01	-0.08	0.02	0.18	0.02	-0.26	0.09	-0.11	0.15	0.12	0.36 <sup>b</sup>	-0.01	-0.25 <sup>a</sup>	0.09	-0.07
Wolf predation effect	0.16	-0.15	0.03	0.01	-0.02	0.11	-0.07	0.27	0.30 <sup>a</sup>	-0.03	0.08	-0.36 <sup>a</sup>	-0.11	-0.06	-0.70 <sup>b</sup>
<b>Attitude</b>															
Combined attitude score	-0.10	-0.11	-0.03	0.34 <sup>b</sup>	-0.17	-0.31	-0.24	0.00	-0.15	0.34 <sup>b</sup>	0.14	0.20	-0.32 <sup>b</sup>	0.17	0.46 <sup>b</sup>
Gazelle conservation	0.05	0.15	-0.03	0.20	-0.09	-0.34 <sup>a</sup>	-0.15	-0.22	-0.07	0.15	-0.24	0.12	-0.20	0.18	0.55 <sup>b</sup>
Establish protected area	0.13	-0.17	-0.08	0.30	-0.18	-0.08	-0.48 <sup>b</sup>	-0.05	-0.39 <sup>b</sup>	0.46 <sup>b</sup>	0.27	0.46 <sup>b</sup>	-0.22	0.28 <sup>a</sup>	0.51 <sup>b</sup>
More funds for conservation	0.03	-0.07	-0.05	0.08	-0.01	-0.08	-0.11	-0.15	-0.37 <sup>a</sup>	0.16	0.30 <sup>a</sup>	0.51 <sup>b</sup>	-0.04	0.20	0.54 <sup>b</sup>
Local people participation	0.14	0.10	0.01	0.24	0.05	-0.24	0.06	-0.01	0.16	0.24 <sup>a</sup>	0.01	-0.03	-0.39 <sup>b</sup>	0.06	0.08
Compete for grass with livestock	0.18	0.16	0.00	-0.02	-0.08	0.22	0.09	0.01	-0.10	-0.02	0.31 <sup>a</sup>	-0.01	0.00	0.17	-0.45 <sup>b</sup>
Decrease stocking rate	-0.03	-0.01	0.11	0.14	0.11	-0.13	-0.12	-0.03	0.17	0.14	0.00	-0.30 <sup>a</sup>	-0.10	0.07	-0.08
Drive gazelle off	-0.14	-0.14	-0.09	0.35 <sup>b</sup>	-0.24	-0.31	-0.27 <sup>a</sup>	0.03	-0.01	-0.10	-0.36 <sup>b</sup>	-0.01	-0.17	-0.03	0.26
To rescue injured gazelles	-0.18	0.00	-0.09	-0.04	-0.15	-0.22	-0.14	0.17	-0.22	0.29 <sup>b</sup>	0.09	0.35 <sup>a</sup>	-0.04	0.04	0.63 <sup>b</sup>
Benefit from conservation	-0.18	-0.13	0.09	0.15	-0.16	-0.04	-0.15	-0.05	-0.10	0.34 <sup>a</sup>	0.38 <sup>b</sup>	-0.05	0.04	-0.02	-0.04

<sup>a</sup> Correlation is significant at the 0.05 level (two-tailed)

<sup>b</sup> Correlation is significant at the 0.01 level (two-tailed)



**Fig. 3** Combined attitude scores (–9 strongly negative, 9 strongly positive) of interviewees towards Przewalski’s gazelle versus **a** education level and **b** grassland area of interviewees who lived inside the range; **c** experience with gazelle for interviewees who lived inside the range (gray), near the range (light gray), and away from the range (white). Solid line is median, square is mean, edges of box are quartiles, and whiskers are 5th and 95th percentiles

reserve tend to show higher levels of indifference; indeed, in our sample, people living away from the range of gazelle provided the most neutral answers to our survey and recorded the lowest awareness of aspects of this species. In combination, this suggests that many local communities support gazelle conservation only in areas that have sufficient access to information about the gazelle and where gazelle do not come into direct conflict with their economic interests and safety.

It will improve their attitudes positively to give herds- men who lived away from the range of gazelle more information about the gazelle currently; however, the expected expansion of the range of gazelle and potential increasing conflicts might induce more negative attitudes among people currently holding more positive attitudes. Concurrently, it might be hard to improve attitudes of herds- men who lived inside the range of gazelle positively by doing the same, because of the existing conflict between gazelle and their economic interests. Thus, additional strategies, such as purchasing or leasing grasslands only for use by gazelle, which have been proven successful for many cases (The Nature Conservancy 2009), are needed.

#### Factors influencing attitudes

The attitudes of local communities towards wildlife may vary according to many factors such as gender (Hill 1998; Martino 2008), prior experience of wildlife (Dowle and Deane 2009), income (Gould et al. 1989), region (Irby et al. 1997), and education background (Williams et al. 2002). Our results are consistent with the perspective that awareness of conservation values increases with levels of education (Ericsson and Heberlein 2003) as higher educated interviewees living inside the range of gazelle were more aware of its conservation. Increased household wealth have been shown to positively influence attitudes (Infield 1988; Newmark et al. 1993) and households with lower incomes often have less tolerance for conflict brought about by wildlife. Household income in this study, which was about 30% lower than the average for rural regions in Qinghai Province, China (Bureau of Statistics of Qinghai Province, Survey Office of the National Bureau of Statistics in Qinghai 2008), had no significant influence on combined attitude scores. However, we did find that for interviewees living inside the range of gazelle, herders who had more grassland were more willing to protect the species: presumably, they are less worried about competition between gazelle and their livestock. Furthermore, between interviewees who lived inside and away from the range of gazelle, the opposite effect of experience with gazelle on the combined attitude score may be due to the different levels of conflict between gazelle and economic interests of interviewees.

#### Conservation implications

Local attitudes towards Przewalski’s gazelle will likely influence the success of its conservation. For wild ungulates, exploitative competition with livestock is usually unavoidable (Mishra et al. 2004; Putman 1996), and all populations of the gazelle, including the one on the “Bird Island”, are in areas on or surrounded by grasslands



predominantly grazed by sheep and cattle. Gazelle and domestic sheep directly compete for food resources (Li et al. 2008; Liu and Jiang 2004) and human–gazelle conflict inevitably leads to negative attitudes, as documented in herdsmen here. As much as possible conservation strategies should consider mutual interests and benefits to conservationists and herders alike by working with local communities to agree on the shared and sustainable use of grasslands (Mallon and Jiang 2009). The costs and benefits incurred to local communities with livestock because of the gazelle presence need to be assessed. In fact this is prescribed under the “Law of the People's Republic of China on the Protection of Wildlife” which states that local wildlife managers have the duty to defend the interests of people when they suffer losses through conservation (Standing Committee of the Seventh National People's Congress 2004). In this study, less than 20% of the interviewees knew that Przewalski's gazelle is restricted to areas around Qinghai Lake. Thus, it is crucial to highlight the gazelle's limited distribution to provide local people with a sense of pride or “ownership” in helping to conserve this species.

## Conclusion

Our survey suggests a need to develop and improve communications between the local community, conservationists, and wildlife managers involved in protecting Przewalski's gazelle. Of broader significance is that all large herbivores on the Qinghai-Tibet Plateau experiencing declining populations are disproportionately threatened (Mallon and Jiang 2009) and only by understanding the relationship between the attitudes of local people and their socio-economic status, can decision-makers better design scientific content and approaches of conservation education programs. The results can be used to identify deficits in local communities' knowledge and to increase awareness and support for conservation on the Qinghai-Tibet Plateau. Over the long-term, through enhanced communication and a better understanding of mechanisms of increasing public involvement, this study would assist in determining the effect of conservation education efforts to meet the overall conservation goal.

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