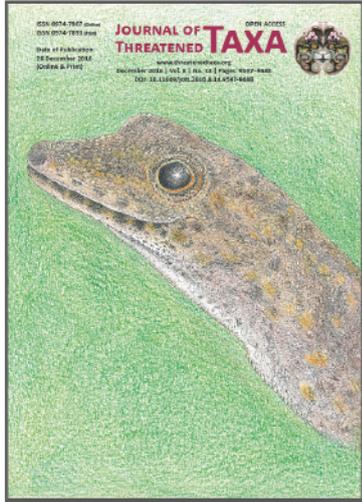


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ARTICLE

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VULTURES AND PEOPLE: LOCAL PERCEPTIONS OF A LOW-DENSITY VULTURE POPULATION IN THE EASTERN MID-HILLS OF NEPAL

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Abstract: The cause for rapid decline of the South Asian vulture population in 1990s was unknown for many years until diclofenac was proved to be the main reason for such decline in 2004. The vulture populations from Nepal has also undergone rapid decline that causes low awareness among people about its ecological importance. For declining species that have large range and are mostly associated with humans, people's attitudes can have direct effects on their survival because of the multiple linkages and potential for both positive and negative impacts of human behaviour for these large scavengers. However, little is known about vultures in the eastern mid-hills of Nepal. Therefore, we conducted a study in Ramechhap, a district in the eastern mid-hills of Nepal, to assess the vultures' status and human relations using transect and questionnaire surveys respectively. Himalayan Griffons *Gyps himalayensis* and Egyptian Vultures *Neophron percnopterus* were found in the area, and the majority of respondents interviewed had a positive attitude towards vultures (58.8%) and their conservation (47.3%). Although neglected in previous studies, a neutral attitude (20% towards vultures and 15.8% towards vulture conservation) can be significant (largely related to ignorance) and can be readily turned to negative due to the vulture's carcass consuming behaviour and lack of conventional appeal to many people, with implications for the success of a conservation programme. In our study, carcass scarcity appeared to be an increasing concern with about 90% of the respondents reporting burying cattle carcasses, and that this practice has recently increased. In the course of the study period, however, two (unburied) carcasses were observed. Our study found that nimesulide, a potentially toxic NSAID for vultures, was used for veterinary purpose in the study area, which could be a serious threat to vultures. Other human activities such as carcass poisoning pose threats to vultures in the study area. Therefore, for long term vulture conservation, local attitudes and behaviour should be considered along with ecological aspects of vultures.

Keywords: Attitude survey, awareness, carcass scarcity, conservation attitude, eastern Himalaya, neutral attitude, nimesulide, Ramechhap, social aspects of conservation, vulture conservation.

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For Authors Details and Author Contribution see end of this article.

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INTRODUCTION

Nepal supports all nine species of South Asian vultures (Phuyal 2012). After the unprecedented massive decline in the vulture population since 1990s, researches identified the consumption of carcasses treated with a non-steroidal anti-inflammatory drug (NSAID), diclofenac, being behind the main population crash (Green et al. 2004; Oaks et al. 2004; Shultz et al. 2004). When the vultures get exposed to diclofenac, they develop acute visceral gout and die due to renal failure (Oakes et al. 2004; Shultz et al. 2004) within 48 hours of exposure (Swan et al. 2006).

The vulture populations in Nepal were no exception and declined sharply. The population decline of Oriental White-backed Vulture *Gyps bengalensis* and Slender-billed Vulture *Gyps tenuirostris* were more than 90% between 1995 and 2011 (Chaudhary et al. 2012). The major decline in vulture population has resulted in a ban of manufacture and import of veterinary formulations of diclofenac in Bangladesh (Ramírez et al. 2014), India (MoEF 2006), Nepal (DNPWC/MoFSC/GoN 2009), and Pakistan (Green et al. 2007), emphasizing the use of meloxicam, the only NSAID currently considered safe for vultures (Naidoo et al. 2009, 2010). Nowadays, secondary poisoning is growing as a threat for the vultures as unintentional or deliberate poisoning of animals has caused significant vulture mortality (Harris 2013; Joshi et al. 2015). Food shortage is another emerging threat to vulture survival, as people prefer to bury carcasses in order to prevent disease (Baral & Gautam 2007), resulting in less food available to the vulture (Joshi et al. 2015).

Despite having the highest number of ecosystems and species diversity in Nepal (HMG/N/MFSC 2002), the Nepalese mid-hill (1,000–3,000 m) is poorly represented in the protected area management system of the country (Acharya 2004). In addition, the studies on vulture in Nepal are from the lowlands (Baral et al. 2004; Subedi 2008), trans-Himalayan regions (Acharya 2006; Acharya et al. 2009, 2010), and western mid-hills (for e.g., in Rampur, Baral et al. 2005; in Arghakhanchi, Bhusal 2011; in Baitadi, Karmacharya 2011 and Joshi et al. 2015), but far less in the eastern mid-hills. Knowledge gaps for large ranging species such as vultures (sometimes over 20,000km²) (Gilbert et al. 2007) in an area can seriously impact conservation activities for the species. This is because even if there are no vultures in the eastern mid-hills, adverse conditions for the vultures in the area can act as a sink for the vultures of surrounding areas, further contributing to the decline of this group

of vultures and this condition can hinder the ongoing vulture conservation programme. Despite the ban on diclofenac, there are many cases where diclofenac is still available in the veterinary medical shops of Nepal (Acharya 2006; Paudel 2008; Subedi 2008; Acharya et al. 2009). With this scenario, the availability of diclofenac and other NSAIDs lethal to vultures is an important factor that must be considered for vulture conservation.

Residing near human habitation, vultures are directly affected by the activities of the people. Attitude and intention may predict behaviour, which can indicate support for management or conservation effort (Heberlein 2012; Reimer et al. 2013). There is, however, a lack of species-specific attitude studies for rare or uncharismatic species; the formation of attitude and behaviour towards species should be understood and positive attitude should be promoted to avoid further losses (Bjerke et al. 1998; Baral & Gautam 2007; Reimer et al. 2013). The studies of the attitude survey either consider positive or negative attitude, often neglecting the proportion of the population holding the neutral attitude, which can eventually turn into positive or negative from a single event (Ericsson & Heberlein 2003). In this study, we analysed the human relations along with status of the vultures through transect and questionnaire surveys. We also tried to analyse the importance of the neutral attitude that has been generally neglected in other vulture attitude surveys.

MATERIALS AND METHODS

Study Area

Ramechhap (27.33333–27.83333°N and 85.83333–86.58333°E), a plough-shaped mid-hill district of the Central Development Region, Nepal (Fig. 1). It covers an area of 1564.32km², most of which lies in the hills and the mountains at altitudes between 439m and 6,959m above mean sea level. There are 55 village development committees (VDCs) in the district. Due to different geophysical conditions, the climate varies from sub-tropical to alpine. In the winter season, the mean daily temperature of the mid and higher hills is about 11°C and that of valleys is 20°C. In the summer season, the mean daily temperature of the high hills is 20°C, mid-hills is 30°C or higher, and valleys is 30°C. The average annual rainfall of the district is 2,055mm (DDC 2004).

Vulture Status Survey

We conducted transect surveys to assess the number of vultures present in the area, and also

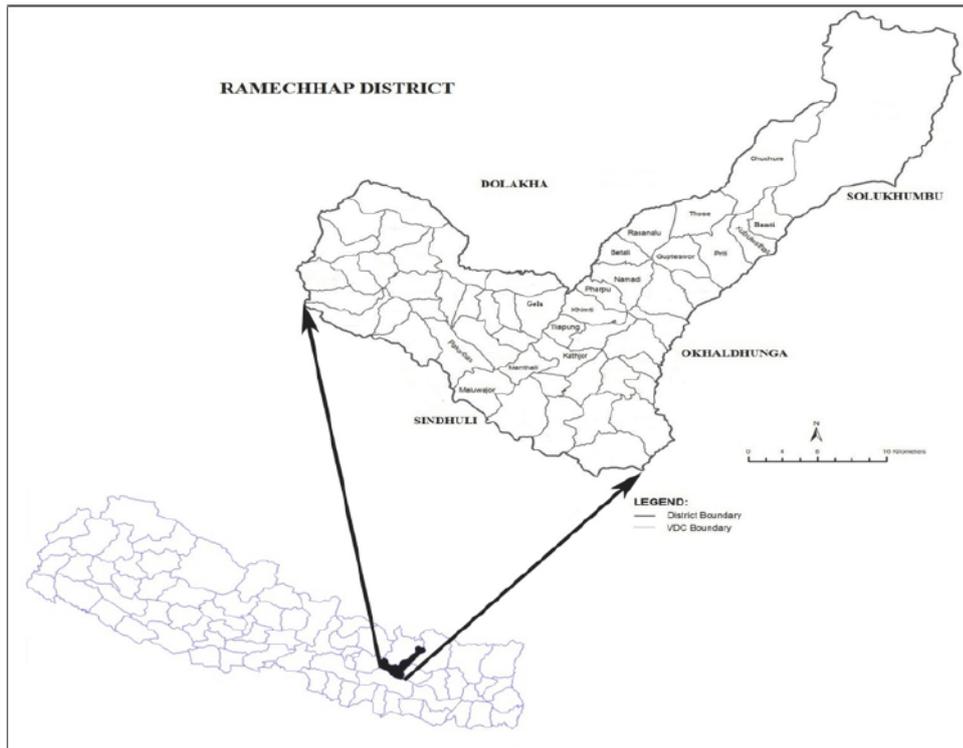


Figure 1. Location of Ramechhap District in Nepal map. The name of VDCs surveyed for vulture status is presented in the larger district map.

observed the vultures feeding on carcasses. We utilized the predetermined route (trails used by local people) as transects (Gregory et al. 2004; Acharya et al. 2009), surveyed on foot, and recorded all observed vultures. Length of the transect covered varied according to settlement, altitude and weather. We conducted transect survey in rain-free days with good visibility. Although, the transect survey was conducted on slightly cloudy days, we terminated the survey if there was rainfall for more than one hour in a day or visibility was not clear to locate the vultures. As vultures are active throughout the day, transect surveys were carried out between 08:00hr and 17:00hr (± 0.5 hour at starting and ending time according to availability of lodging sites). Although the length of transects was shorter in slopes (4–4.5 km per day) comparing to the plains (6–6.5 km per day), the average length of transects was about 5.5km per day during the transect surveys. In Nepal, most of the carcasses are disposed on river banks, therefore the route was selected where possible nearer the river courses during the study to improve the chances of encountering unburied carcasses and thereby vultures. The elevation of the transects ranged from 440–3,051 m.

The transect surveys were conducted in January and repeated and extended in April (Fig. 2) in order to coincide with the breeding season of the vultures (Baral

et al. 2005; Bhusal 2011) to maximize the probability of locating vultures' nests in the area. For the first transect survey, (6 days, from 6–13 January 2012), the count started from the border of Those VDC and Chuchure VDC to the border of Khimti VDC and Tilpung VDC. For the second transect survey (12 days, from 3–16 April 2012), we first repeated the same trails and then extended the transect from the border of Those VDC and Chuchure VDC to Seleghat (border of Ramechhap District and Sindhuli District) and from Rasnal VDC to Chuchure VDC. Our transect survey covered 17 VDCs of Ramechhap District (Fig. 2). We observed vultures with binoculars (Bushnell Legacy WP, 8×42), identified the birds with 'Nepalka Charaharu' (Birds of Nepal, Nepali Version, Grimmett et al. 2003), photographed the vultures for further identification with a camera (Nikon p500, 4–144 mm) and located the coordinates of vultures with GPS (Garmin Etrex H) as far as possible.

Questionnaire preparation

During the first transect survey, we performed informal interviews and discussions among locals in the lodging sites to ascertain the attitude level, threats and other background information related to vultures in the study area. We discussed the preliminary information among peers, professors and experts in Kathmandu and prepared structured questionnaires for this study.

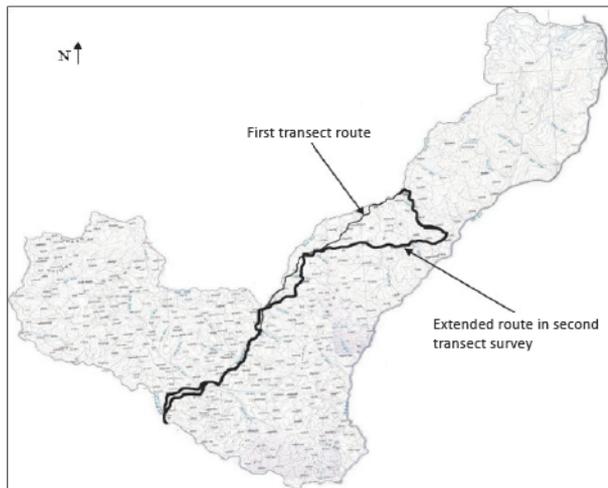


Figure 2. Study area showing two transect routes for vulture status survey

We selected five graduate students of environmental science to assist in the questionnaire survey. Prior to the questionnaire survey, we performed sample questionnaires between the interviewers. After getting the feedback from these sample interviews, we finalized the questionnaires.

The questionnaire for local people consisted of 14 closed questions and eight open questions to express their answers more clearly (see Appendix I). The questionnaire was structured for two outcomes: (i) to know the practices of the respondents that may be likely to affect vulture survival such as number of livestock, number of livestock deceased and probability of exposure of lethal drugs to vultures; and (ii) respondents' attitude towards vultures such as killing of vulture, perception towards declining of vulture population, ugliness of vultures and their willingness to conserve vultures.

In most parts of Nepal, veterinary medicines are sold not only from veterinary medical shops but also from agrovet shops. In these places, the agricultural materials such as fertilizers, pesticides, seeds and agriculture related machines are sold along with the veterinary medicines. Therefore, we conducted questionnaire survey among the veterinary medical and agro vet shops (VMAVSs) of the study area, where the questionnaire included five closed questions and eight open questions (see Appendix II). The questions were related to use of diclofenac and other harmful NSAIDs, use of meloxicam, knowledge of ban of diclofenac, probability of the use of the human diclofenac in livestock.

Undertaking the questionnaire survey

We conducted structured questionnaire survey

(Huntington 2000; Baral & Gautam 2007) in March–April 2012, among the 165 randomly selected houses of three randomly selected VDCs, Khimti, Pharpu and Betali. For the questionnaire survey, we used a household list from voter name list of the three VDCs offices. Then, the households were numbered and were selected randomly using MS Excel. All the selected numbers were visited as far as possible, however, for those households with no people above 16 years of age, the household immediately after the selected household was approached. We carried out the questionnaire survey related to threats to vultures and attitudes towards vulture conservation in person during home visits, delivering the questions to the respondents orally in Nepali. During the questionnaire surveys, we applied a representative technique, that is we approached anyone ≥ 16 years that was available in the house. For the economic status of the respondents, we considered non-monetary parameters (e.g., number of livestock, house type, number of family members, occupation, area of the land). After the questionnaire survey, with the help of raw data of the study area, we assumed monetary value to those non-monetary parameters by consulting with the peers, socio-economic experts, and professors of Tribhuvan University, Nepal. We categorised the economic status per person into very poor (yearly income <NRs 25,000), poor (yearly income NRs 25,000–75,000), lower middle (yearly income NRs 75,000–1,25,000), upper middle (yearly income NRs 1,25,000–2,00,000) and rich (yearly income >NRs 200,000) ($\$1 \approx$ NRs 90).

We measured the attitude of local people towards vulture using five related questions (question numbers 7, 8, 9, 10 and 12 of Appendix I) and combined these questions to form a single attitude scale. We graded each answer with a number and summed response for each question as negative (1), positive (3) and neutral (2). Based on these numbers, we considered the respondents scoring greater than 10 as having positive attitude, those less than 10 as having negative attitude and those respondents scoring 10 as having neutral attitude. We linked the attitudes of people towards vulture directly to attitude of people towards vulture conservation from their view on conservation (question number 13 of Appendix I).

We conducted structured questionnaire surveys for VMAVSs to study the availability of NSAIDs. We located all VAMVSs of the six VDCs (VDCs considered for first transect survey) and the district headquarter, Manthali VDC, and found six VAMVSs in the areas; one in each Those, Betali, Khimti VDCs and three in Manthali

VDC. We interviewed all six VMAVSs delivering the questions orally in Nepali. During the questionnaire survey, we only interviewed a single person involved in treatment and selling of the veterinary medicine in each VMAVSs. After completion of questionnaire interview, we requested them to divulge the medicines they used to treat inflammation in livestock and only after their consent (and all of them agreed), we searched the NSAID medicines in their shops.

We also included information from observation during transect survey, personal communication with different people (such as veterinary professionals, local club members (women group member, local cooperative members), and local stakeholders (such as owners of tea shops, lodge, teachers) that were not included in questionnaire survey) by visiting them personally as well as consulting with them during our survey, and some new information that arose during questionnaire survey from the respondents.

Analysing the data

We presented the transect survey data in a descriptive manner and tabulated form. We analysed the questionnaire data with the help of SPSS version 16 and MS Excel. We expressed mean and standard deviation for ratio variables and frequencies for the nominal variables. The association between two variables was tested using chi-square test with the 95% confidence level. We expressed the information obtained during informal interview and observation in a descriptive manner.

RESULT

Status of vultures

We observed 22 Himalayan Griffons *Gyps himalayensis* and seven Egyptian Vultures *Neophron percnopterus* in seven places over two days of April 2012 during the second transect survey (Table 1; Images 1, 2 & 3). Of these, 12 Himalayan Griffons were observed at one carcass (Images 2 & 3), which was stuck in the bank of the Tamakoshi River at Benighat (27.35686°N & E 85.98576°E).

Demography of the respondents

Our questionnaire survey covered 53.3% female and 46.7% male, ages ranging from 16 to 83 years (mean age= 41.45 years and median age = 40 years). The demography of the respondents is shown in Table 2. We found the male respondents had a higher education

Table 1. Observation of vultures during transect survey

Location	Species	Numbers	Activities	Coordinates
Kathajor, above Tamakoshi River	EV	2	Soaring	
North of confluence of Sunkoshi and Tamakoshi rivers, Benighat	HG	12	Around carcass	27.35686°N & 85.98576°E
Above the Hattitar hills	HG	8	Soaring	
Soaring 1km north from the Hattitar Hill	HG	2	Soaring	
Pakarbas	EV	1	Feeding on dump	27.37802°N & 86.00485°N
Pakarbas	EV	2	Soaring	
Manthali, Bank of the Tamakoshi River	EV	2	Feeding	27.38537°N & 86.05013°N

HG - Himalayan Griffon, EV - Egyptian Vulture



Image 1. Egyptian Vultures in flight in Pakarbas, Ramechhap



Image 2. Himalayan Griffons (circle) and carcass (square) in Benighat, Ramechhap

level than the female respondents ($\chi^2=10.197, p=0.017$). Similarly, the respondents belonging to Brahmins and Chhetris had higher education level than other ethnic groups ($\chi^2=13.788, p=0.032$). Likewise, respondents involved in agriculture and paid labourers were the least

Table 2. Demography of the respondents

Socio-economic Parameters		Percentage
Caste	Brahmins and Chhetris (so called upper castes)	40
	Indigenous	38.8
	Dalits (so called lower castes)	21.2
Education	Could not read and write	33.9
	Primary level	40.6
	Secondary level	15.2
	College level	10.3
Occupation	Agriculture	63
	Own business	13.9
	Teachers	3
	Paid Labourers	7.3
	Students	9.1
	Others (cook, work in private company etc)	3.6
Economic Status	Very poor	7.3
	Poor	24.2
	Lower middle	40
	Upper middle	21.2
	Rich	7.3

educated than other occupations ($\chi^2=1.223$, $p<0.001$). The economic status of the respondents, however, was not associated with their education level ($\chi^2=20.604$, $p=0.056$).

A total of 375 livestock of 96 respondents had deceased within a five-year period. Of these respondents, 89.6% buried the carcass, 7.3% threw the carcass in the river or from a cliff, 2.1% gave to others and 1% sold the carcass. Out of the 156 respondents having livestock, 69.9% usually got their livestock treated by veterinary professionals (Doctor or Junior Technical Assistant, JTA). Of the respondents, 86.5% had given medication to their livestock in which 62.2% respondents had brought from government veterinary shops and 37.8% had brought them from private veterinary shops.

Attitude of the respondents

Out of 165 respondents, 58.8% had a positive attitude, 21.2% had a negative attitude and 20% had a neutral attitude towards vultures (Table 3).

Only 121 respondents had observed vultures in their area; of them, 55.56% had noticed vulture declines and the main cause of the vulture decline perceived by them is shown in Fig. 3. None of the respondents said they had killed vultures, but two (1.2%) of the respondents had used vulture’s bone to scare away the spirit (Image 4) and as ‘Mahakali oil’ (a type of herbal massage oil) for

Table 3. Attitude of the respondents

Parameters of attitude		Percentage
Vultures are ugly	Yes	38.2
	No	35.2
	No idea	26.7
Vultures are a bad sign	Yes	26.7
	No	43
	No idea	30.3
Vultures are declining	Yes	65.5
	No	6.7
	No idea	27.9
Vultures have an important role in the environment	Yes	21.2
	No	41.2
	No idea	37.6
Vultures should be conserved	Yes	47.3
	No	37
	No idea	15.8

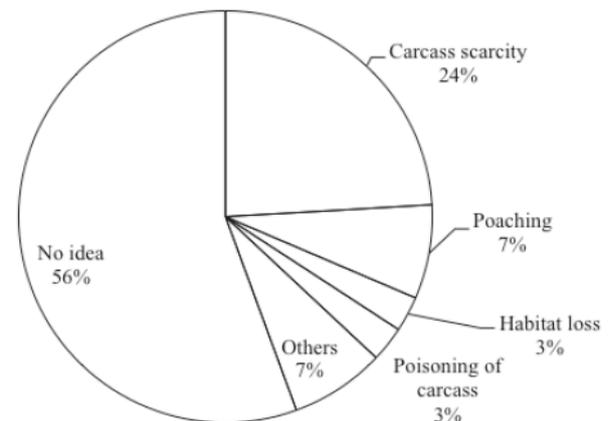


Figure 3. The cause of vulture decline according to the respondents (note: others refer to heat, migration of vultures, pesticides, environmental pollution, and use of medicine in livestock)

strong bones.

The respondents had different views regarding the role of the vultures in the environment, reasons to conserve or not to conserve them (Table 4).

The attitude of the respondents towards vultures was significantly influenced by gender (male were more favourable), education level (positive correlation), observed vultures in their areas (more favourable), noticed the vulture decline (more favourable), considered vultures as ugly (less favourable), symbol of bad luck (less favourable), and vultures’ important role in the environment (more favourable); however ethnicity, economic status and occupation of the respondents

Table 4. Respondents' views towards vultures

Reason as perceived by respondents	Percentage	
Important role of the vultures in the environment	Sanitation	71.43
	Harmless to humans	11.43
	Ecosystem balance	8.57
	Do not know exactly	8.57
Vultures should be conserved	It is good to conserve	28.21
	For environment balance	16.67
	Cause no harm to human	15.38
	Have right to live	14.1
	It is a part of nature	6.41
	For future	1.28
	Others (endangered, every species is special, gift of god, had heard about vulture conservation)	16.67
Vultures should not be conserved	Carcass eating habit	24.59
	No need to conserve	19.67
	No care about them	11.47
	They are of no use	8.19
	They bring bad omen	4.92
	They bring diseases	3.28
	Others (no sense to the respondents, no idea, dirty)	8.19

apparently had little influence on attitude towards vultures (Table 5). Apart from this, the occupation (high paid were more favourable) and economic status of the respondents (positive correlation) played significant role in shaping their attitude towards vulture conservation (Table 5). Elder people were less supportive to vulture conservation concept; however, these people did not have a negative attitude towards vulture. Respondents who had a favourable attitude towards vulture were highly in favour of vulture conservation (63.92%) compared to neutral (33.33%) and negative attitudes (14.29%) ($\chi^2 = 40.408, p < 0.001$).

We did not find any of VMAVSS selling medicines containing diclofenac and but one agro vet shop in the Manthali VDC contained nimesulide (believed to be toxic to vulture: Cuthbert et al. 2016) as viol; other VMAVSS did not contain any other NSAIDs except meloxicam. From 2010–2011, all of six VMAVSS informed us they had replaced diclofenac with meloxicam. We found two private veterinary professionals (33.33%) however unaware of the ban of diclofenac in Nepal.

Causes of vulture decline

From the field observation and the personal communication with local people, the other probable



Image 3. Himalayan Griffons on and near carcass in Benighat, Ramechhap



Image 4. Vulture bone kept for chasing away evil spirit in study area

causes of vulture decline besides diclofenac from the study area were listed to be:

- Carcass scarcity:** The two carcasses observed during transect surveys and 89.6% of the respondents reported burying livestock carcasses suggested the area had fewer carcasses available for the vultures.
- Use of harmful drugs:** We found nimesulide in an agrovet shop that may have adverse impact on the vulture populations in the area.
- Poisoning:** One respondent during a questionnaire reported that some 10–12 vultures were killed due to consumption of poisoned feral dog carcass during 2002.

DISCUSSION

This is the first documented study of vultures in the eastern mid-hills of Nepal. In Nepalese society, vultures are generally considered as an unattractive bird and bearer of bad luck (Baral et al. 2007); attitudes are influenced by physical and behavioural characteristics

Table 5. Significance of the parameters with the respondents' attitude towards vultures and conservation

Attitude of respondents	Parameter	χ^2 value	p value	Interpretation
Towards vulture	Gender	19.084	<0.001	Male had more favourable attitudes than female
	Age	28.110	0.172	Respondent's attitude towards vulture was not associated to respondent's age
	Education	12.636	<0.001	The favourable attitude towards vulture increased with increasing education level of the respondents
	Ethnicity	5.306	0.257	The ethnicity of the respondents was not associated with their attitude
	Economic Status	4.881	0.770	The economic status of the respondents was not associated with their attitude
	Occupation	17.481	0.064	The occupation of the respondents did not determine their attitude
	Ever seen vultures	43.962	<0.001	Those who had seen the vultures had positive attitude towards vultures
	Consider vultures as ugly	66.708	<0.001	Those who considered vultures as ugly had negative attitude towards vultures
	Consider vultures as symbol of bad luck	76.499	<0.001	Those who considered vultures as a symbol of bad luck had negative attitude towards vultures
	Vultures have important role in the environment	92.163	< 0.001	Those who had realized vultures' role in the environment had positive attitude towards vultures
	Noticed the decline of vulture population in the area	56.340	<0.001	Those who had noticed vulture decline had positive attitude towards vultures
Towards vulture conservation	Gender	20.955	<0.001	Male were favourable towards vulture conservation than female
	Age	40.045	0.011	Respondents with increasing age were less supportive towards vulture conservation concept
	Education	36.191	<0.001	The favourable attitude towards vulture conservation increased with increasing education level of the respondents
	Ethnicity	2.799	0.592	Ethnicity of the respondents was not associated with their attitude towards vulture conservation
	Economic Status	16.196	0.040	Respondents with high economic status were favourable towards vulture conservation than those with low economic status
	Occupation	27.930	0.002	Respondents with highly paid occupation were favourable towards vulture conservation than others
	Ever seen vultures	8.884	0.012	Those who had seen the vultures had a positive attitude towards vulture conservation
	Consider vultures as ugly	12.575	0.014	Those who considered vultures as ugly had a negative attitude towards vulture conservation
	Consider vultures as bad sign	16.661	0.002	Those who considered vultures as a symbol of bad luck had a negative attitude towards vulture conservation
	Noticed decline in the vulture population	8.150	0.086	Respondents' notice towards declining vulture population did not influence their attitude towards vulture conservation
	Vultures have important role in the environment	65.218	<0.001	Those who had realized vultures' role in the environment had positive attitude towards vulture conservation

of the species as people prefer to conserve familiar, charismatic or those species having utilitarian benefits, ignoring unfamiliar, rare and uncharismatic species, despite their ecological significance (Serpell 2004; Martín-López et al. 2007; Reimer et al. 2013). Despite these beliefs, a majority of the respondents have a positive attitude towards vultures (58.8%) and nearly half of the respondents have positive attitude towards vulture conservation (47.3%) in our study area. Similarly, males, people with higher education level, high economic status, and with positive attitude towards vultures were more favourable towards vulture conservation. Peoples' negativity towards vulture conservation, it was seen,

increases with age. We believe this differences relates to the increased level of communication associated with young people, who have thereby been exposed to information that highlights the positive health and environmental benefits of vultures.

We did not find any vulture's nest during the study in the area. Although, during the questionnaire survey, 21.7% of the people informed the presence of Red-headed Vulture *Sarcogyps calvus*, Oriental White-backed Vultures and Himalayan Griffon in the study area more than 10 years back; only Himalayan Griffons and Egyptian Vultures were observed during the study period. This may be either because vultures

have declined from the study area during 1990s as in other parts of South Asia or these vultures might have been missed by the survey. Egyptian Vultures are generally associated to dumping sites as observed in our vulture survey, and also recorded in low numbers in Pyuthan, Salyan and Palpa Districts of central and western Nepal, however, more frequent in Kaski and Arghakhachhi Districts (Subedi & Decandido 2014). Nevertheless, Himalayan Griffons were more recorded than Egyptian Vultures in our study, which might be due to Himalayan Griffon's relatively high density. The Himalayan Griffons are recorded in more numbers from far-western Nepal (Joshi et al. 2015), Upper Mustang (Acharya et al. 2009) and Annapurna Conservation Area (Virani et al. 2008) than our study, which suggests that the Himalayan Griffon might have lower density in the area than in western Nepal.

We found that the neutral attitudes have occupied a significant proportion (20% towards vultures and 15.8% towards vulture conservation). The sudden decline of vultures during 1990s and their disappearance may have increased the unfamiliarity with a number of people and may have created the neutral attitude towards vultures. Weaker attitudes towards vulture and its conservation can become a barrier to successful conservation programmes as people with neutral (or weaker) attitudes are less likely to care about the species or be indifferent to change their attitudes (as in the case of the wolf in Sweden Ericsson & Heberlain 2003). If we do not consider the neutral attitude, it can turn to negative attitude due to the unattractiveness and carcass eating behaviour of the vultures. Providing information about status and importance of vultures can gather support for conservation programmes as accurate information is helpful to transform into positive attitude towards the species and promote local support for the conservation (Martín-López et al. 2007; Baral et al. 2007; Barnes 2013; Ghimire et al. 2014).

With high proportion of people in favour of vulture conservation, the Egyptian Vulture and Himalayan Griffon populations might have a lower probability of intentional persecution. The carcass burying activity seems particularly unfavourable for Himalayan Griffon's survival. During our survey, only two carcasses were observed, and most of the Himalayan Griffons were observed near carcasses and Egyptian Vultures in the dumps. Although 375 livestock had been reported to have deceased in the 165 surveyed households within a 5-year period, approximately 90% of the respondents said they bury carcasses. The reported carcasses burial practice in our study is apparently higher than other

parts of Nepal (e.g., 60% in Baitadi: Karmacharya 2011; 22% in Rampur: Baral & Gautam 2007). Carcass burial campaign by local government authorities was ongoing in the study area during the study, for preventing the spread of diseases, which explains the increased carcass burying practices in the area. Local people should be encouraged to dump disease free carcasses in a safe place (far from water sources and human settlements) because although, most of pathogens are killed in the digestive tract of vultures except the high resistant pathogens, there are chances of disease spread through passive route like feet or feather of vultures (Houston & Cooper 1975).

Besides carcass burying activity, vultures have become victim of deliberate or unintentional poisoning of carcasses not only in Nepal (e.g., at Dang: Republica 2011; at Nawalparasi: The Himalayan Times 2014), but also more widely (e.g., in Canary Island: Donázar et al. 2002; in Africa: Monadjem et al. 2004; in Spain: Hernández & Margalida 2009; in Myanmar: Hla et al. 2010; in Cambodia: Clements et al. 2013). The death of vultures due to poisoned carcass reported from the area might be repeated in the future, particularly for killing of feral dogs and cats, if not addressed.

Ramechhap is one of the diclofenac free zones of Nepal (BCN 2011). Despite the ban on diclofenac from the country in 2008, informal discussions with veterinary personnel reveal that local people still prefer to use diclofenac with the belief that it is cheap and more effective than other NSAIDs. With this concept, diclofenac is still available illegally in different regions of Nepal especially those connected with India (e.g., in Lumbini: Paudel 2008; Nawalparasi: Subedi 2008). Our study area has recently improved trade links with the lowlands (Terai) through roads, therefore, there is possibility of illegal importation of NSAIDs, harmful to the vultures in the study area. In addition, the illegal use of human diclofenac in cattle is still a serious potential threat (Cuthbert et al. 2016). There might be less chance of the illegal use of human diclofenac, however, as most users bought the medicine for cattle from veterinary shops and we did not find diclofenac in these shops. Nevertheless, recent research has found nimesulide as a further potential threat to vultures (Cuthbert et al. 2016), and we found nimesulide being sold for veterinary purpose in the study area. The NSAIDs poisoning in vulture is difficult to detect due to late effects of NSAIDs (up to 48 hours in case of diclofenac: Swan et al. 2006), and the diclofenac poisoning was unnoticed for several years until 2004 (Green et al. 2004; Oaks et al. 2004; Shultz et al. 2004). As NSAIDs

poisoning can go undetected and can severely impact the vultures, the availability of nimesulide for veterinary purpose in the study area should be taken up seriously and immediately.

Despite the limitations in the sample size in small area, our study helps to understand the human relations with vultures in the eastern mid-hills of Nepal. Successful vulture conservation programme should include creation of a long term survival environment for vultures with involvement of the people in all of its range areas along with its ecological aspects. Our study suggests that people with neutral attitudes towards vulture is significant. The number of Egyptian Vultures and Himalayan Griffons observed during the transect survey may provide benchmark for the vultures in the area. Although, the rate of decline of the Egyptian Vulture and Himalayan Griffon as well as other *Gyps* vultures have been slowed down or may be reversed to some degree (Prakash et al. 2012; Galligan et al. 2014; Paudel et al. 2016), these vultures are highly susceptible to any threat due to their low density. In addition, use of nimesulide for veterinary purposes has arisen as potential threats for vultures in the study area. Therefore, assessment on availability of nimesulide and its safety for vultures; and further studies as well as conservation activities on gap areas such as eastern mid-hill should be conducted for effective conservation.

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Appendix 1. Questionnaire for Local People

Your participation for this survey is voluntary. You will neither be rewarded nor be penalized for not answering the question. The survey is for people's perception towards the vulture conservation. This questionnaire is only for academic purpose and the information of this survey will be used for academic purpose only. Your name and other information regarding your identity will be kept confidential.

Name of the respondent:

Age:

Gender:

Village:

VDC, ward no:

Socio-economic condition

Occupation:

Education:

House type:

Agricultural Land:

Total family member:

1. Are you native of this area?

a. Yes b. No

If no, from where have you migrated?

.....

2. How many livestock do you have?

Cow

Buffalo.....

Goats.....

Others.....

3. Within 5 years, have your livestock died?

a. Yes b. No

If yes, how many livestock have died?

.....

4. If any livestock die, what will you do?

a. bury b. Sell c. Throw d. If other, please specify.....

5. When your livestock become sick, will you check-up by veterinary doctor/ JTA?

a. Yes b. No

If yes, will you give medicine to them?

a. Yes b. No

From where do you buy medicine?

a. Government veterinary Shop b. Private veterinary shop

c. Human medical shop d. Others (specify):

6. Have you ever seen vulture in your area?

a. Yes b. No

If yes, how long ago have you seen vulture?

.....

7. Do you think the vulture ugly?

a. Yes b. No c. No idea

8. Do you think vultures are of bad sign?

a. Yes b. No c. No idea

9. Have you noticed the decline in the number of vulture in the area?

a. Yes b. No c. No idea

If yes, what do you think the cause for decline of vulture?

.....

10. Have you ever killed vulture?

a. Yes b. No

11. Have you ever used the vulture parts as medicines?

a. Yes b. No

If yes, which parts are used for medicines and for what disease?

.....

12. Do you believe the vultures have important role in the environment?

a. Yes b. No c. No idea

If yes, what type of role?

.....

13. Do you think vultures should be conserved?

a. Yes b. No c. No idea

If yes or no, why?

.....

Remarks (If any):

Appendix 2. Questionnaire for the Veterinary Medical and Agro vet Shop

Your participation for this survey is voluntary. You will neither be rewarded nor be penalized for not answering the question. The survey is for availability of NSAIDs for livestock treatment. This questionnaire is only for academic purpose and the information of this survey will be used for academic purpose only. Your name and other information regarding your identity will be kept confidential.

Name of the Shop:.....

Name of the Owner:.....

1. Do you sell medicines containing diclofenac from your stores?

a. Yes b. No

If yes, what is the price range of the medicine?

.....

2. The selling of medicines containing diclofenac have banned from Nepal. Do you know about that?

a. Yes b. No

If yes, do you know the reason?

.....

3. Do you sell medicines containing meloxicam from your store?

a. Yes b. No

If yes, what is the price range of the medicine?

.....

4. From when have you started selling meloxicam medicines?

.....

5. Do the people come to buy medicines as prescribed by the veterinary doctor/ JTA?

a. Yes b. No

6. Do you have any experience of people complaining about the effectiveness of meloxicam in their livestock?

a. Yes b. No

If yes, what are the complaints about?

.....

7. What are the medicines you are currently selling under NSAIDs? Are you selling nimesulide, ketoprofen, pyroxicam, etc?

.....

8. Have you used diclofenac for human use for veterinary purpose?

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Remarks (If any)

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