FORKTAIL 26 (2010): 117–120

Rapid decline of the Bearded Vulture *Gypaetus barbatus* in Upper Mustang, Nepal

RAJU ACHARYA, RICHARD CUTHBERT, HEM SAGAR BARAL and ANAND CHAUDHARY

We assessed the status of the Bearded Vulture *Gypaetus barbatus* between 2002 and 2008 in Upper Mustang, Nepal. Regular monitoring of four transect lines indicate a rapid decline of the species over the study period, with the number of individuals recorded per day and per kilometre falling by 73% and 80%, respectively. The use of the veterinary drug diclofenac could lie behind this decline, as the species's range overlaps with those of other vulture species known to be affected by diclofenac. A regular monitoring programme to assess the status of Bearded Vulture population is urgently needed, along with assessment of its population trends over a wider area. If ongoing declines on a wider geographic scale are observed, then the conservation status of this species should be reassessed.

INTRODUCTION

The Bearded Vulture or Lammergeier *Gypaetus barbatus* is a territorial cliff-nesting accipitrid vulture whose diet mainly consists of bone remains from wild and domestic ungulates (Hiraldo *et al.* 1979, Margalida *et al.* 2007). Its range in Asia includes the mountains of Afghanistan, Baluchistan, Tibetan Plateau, Mongolia and throughout the Himalayas from the extreme north-west across to Arunachal of India in east (Kaul & Ahmed 1992, Ferguson-Lees & Christie 2001). In addition, it occurs in the mountainous regions of Europe, North Africa, East Africa and southern Africa (Brown 1997, Margalida *et al.* 2003, Hirzel *et al.* 2004, Gil *et al.* 2009).

Although the Bearded Vulture is threatened within its range in Europe, the species is listed as Least Concern by BirdLife International owing to its common occurrence in other areas of the world (BirdLife International 2009). The Bearded Vulture is a resident species in Nepal (Grimmett *et al.* 2000), which holds one of the largest populations in the world (Gil *et al.* 2009). It is recorded in almost all protected areas in the country's mountains (IUCN Nepal 2008) and its status there has been described as 'fairly common to common' (Grimmett *et al.* 2000) including at our study area, Upper Mustang (Suwal 2003).

Owing to catastrophic population declines of three resident *Gyps* vulture (White-rumped *G. bengalensis,* Indian *G. indicus* and Slender-billed Vultures *G. tenuirostris*) in South Asia in the last decade, these species, once very common in the region, are all now classified as Critically Endangered (BirdLife International 2001, Green *et al.* 2006). The use of veterinary diclofenac is the major reason for the decline (Oaks *et al.* 2004). Diclofenac is a non-steroidal anti-inflammatory (NSAID) drug commonly used to treat pain and inflammation in livestock in India, Pakistan and Nepal (Green *et al.* 2004, Shultz *et al.* 2004). It is not known whether diclofenac is affecting other vulture species and scavenging birds in the region. However, numbers of Red-headed Vultures *Sarcogyps calvus* and Egyptian Vultures *Neophron percnopterus* have also recently undergone rapid declines in India (Cuthbert *et al.* 2006a). Evidence from studies suggests that, in addition to diclofenac, vultures and other scavenging birds are susceptible to a range of other NSAIDs (Cuthbert *et al.* 2006b). Acharya *et al.* (2009) described the rapid decline of Himalayan Griffon *Gyps himalayensis* over the period 2002–2005 in the high Himalaya region of Nepal. Bearded Vultures share the same habitat with other vultures, although their status has not been studied in Nepal until now. This study aims to fill these gaps and explore the situation and trends of Bearded Vulture populations in Upper Mustang, Nepal.

STUDY AREA

Upper Mustang (28°50′23″N 83°47′38″E to 29°11′56″N 83°59′21″E), with an area of 2,667 km², covers the northern half of Mustang District (Ale 2002) (Fig. 1). The northern border of the study area extends up to the Tibetan border, an autonomous region of the People's Republic of China. The area contains seven Village Development Committees (VDCs)—Chuksang, Ghemi, Charang, Lomanthang, Chosyar, Chunup and Surkahang—and includes 33 Buddhist settlements with a total population of about 6,100 people (Shah 2001). Local people depend on seasonal livestock farming, agriculture and winter trade for their livelihoods.

The Upper Mustang area (including the Upper Kaligandaki valley) is located in the arid, trans-Himalayan zone, which receives 132 mm of rain per year. This unique marginal land lies between the east and west Himalayan Tibetan Plateau, within the Hindu Kush. The area is known to be rich in globally significant flora and fauna owing to the steep geophysical topography of the area, and is recognised as a biodiversity hotspot by Conservation International (under the Eastern Himalayan Landscape) (Biodiversity Hotspots 2009).

METHODS

Bearded Vultures were surveyed along predetermined walked transects for 24, 22, 22 and 17 days in 2002, 2004, 2005 and 2008, respectively, during July and August. The transects were along the main trails used by local people in the area, to ensure easy demarcation for future monitoring. All vultures identified within 500 m on both sides of the transect line were recorded. Vultures observed beyond 500 m in each survey year were ignored. Distances were determined by visual estimation, a distance of 500 m being marked out on the ground prior to each survey to familiarise the observer with the observation distance. The linear distance of transects covered per day

varied depending on settlement, altitude and climate. The transects were walked between 08h00 and 17h00 (roughly 7 hours/day) of each survey day.

The possibility of repeated counting of the same individuals on the same day and subsequent days cannot be ruled out. However, error due to this bias should not affect the estimated trends, because similar biases were present in all study years, although fewer birds in subsequent years may result in fewer repeat counts. More survey days were covered in the first year (2002) than in the following years (2004, 2005 and 2008). Results are presented on a per day and per kilometre basis.

Four transects, totalling 188 km in length, were covered in all four survey years. These were located as follows: Transect 1, north–south from Jomsom to Lomanthang via Nichung (89 km); Transect 2, Lomanthang to Samjung and back (18 km); Transect 3, Lomanthang to Jomsom (64 km); and Transect 4, east–west from Lomanthang to Yara and back (17 km). Ordinary least squares regressions were fitted against the natural logarithm of numbers for each transect and for the total combined counts (Table 1). The estimated annual multiplicative rate of increase (*D*) was estimated from the fitted regression line.

All the pharmaceutical veterinary product information was obtained from three shops located in villages (Jomsom, Kobhang and Marpha) and the Livestock Development Centre in the district headquarters.

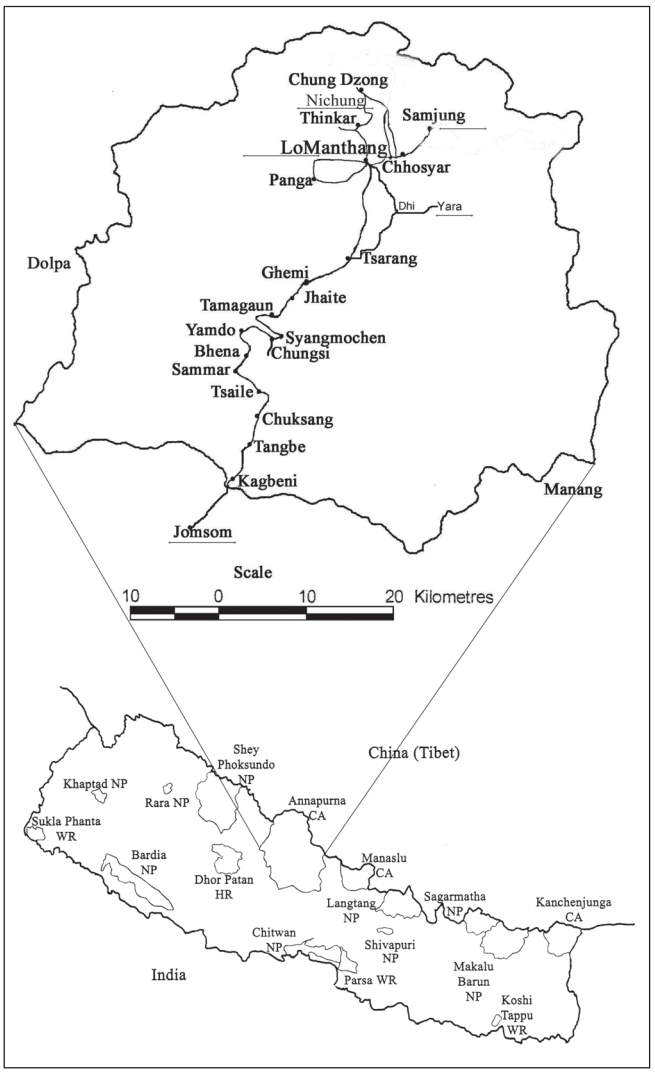

Figure 1. Map showing the Bearded Vulture study area. Texts with underline are the major location from where either transect started or ended. Source: Baral & Heinen 2007, NTNC/ACAP.

RESULTS

During the surveys a total of 67, 49, 21 and 13 Bearded Vulture were recorded in the years 2002, 2004, 2005 and 2008, respectively (Table 1). In 2002, 2.79 birds were recorded per day and 0.35 birds in a km² area. Similarly, in 2004, 2.23 birds were recorded per day and 0.26 birds in a km² area. This fell to 0.95 birds per day and 0.11 birds per km² in 2005. The decline of birds continued in 2008, with records of just 0.76 birds per day and 0.07 birds per km² (Table 1). Between 2002 and 2008, the number of Bearded Vultures recorded per day and per kilometre declined by 73% and 80 %, respectively. Of the four main transects statistically significant declines over the period 2002–2008 were observed in Transect 1 and in Transect 4, with declines of 96% and 64%, respectively. A statistically significant decline was observed for the total numbers of birds along on all four transects combined, with an estimated multiplicative decline rate of 25.0% a year (Table 1).

During the study, 47 agro-veterinary pharmaceutical products were recorded in local shops and the District Livestock Development Centre. Among the most commonly displayed products were anti-helminthic medicines (six compounds for treating internal and three

Table 1. Total numbers of Bearded Vulture recorded in four different transects of Upper Mustang, Nepal, and total numbers for all transects combined along with estimated birds/day and birds/km². Regression statistics indicate the *F* value, degrees of freedom and *P* value, with the estimated annual multiplicative rate of decline (*D*) from the fitted regression line.

Year	Number of days surveyed	Total number recorded along transect	Birds/day in transect	Birds/km² in transect	Transect 1	Transect 2	Transect 3	Transect 4
2002	24	67	2.79	0.35	45	11	3	8
2004	22	49	2.23	0.26	35	4	4	6
2005	22	21	0.95	0.11	13	0	3	5
2008	17	13	0.76	0.07	2	4	4	3
Regression statistics	–	$18.86_{1,2}$ $P < 0.05$	$9.48_{1,2}$ $P = 0.091$	$17.14_{1,2}$ $P = 0.053$	$27.93_{1,2}$ $P < 0.05$	$1.33_{1,1}$ $P = 0.454$	$1.00_{1,2}$ $P = 0.423$	$982.5_{1,2}$ $P < 0.01$
D	–	*25.0%*	*20.6%*	*24.6%*	*42.1%*	*13.5%*	*+3.9%*	*15.2%*

for external parasites), antibiotics (6), and antiseptics (3). During the period of observation only one veterinary painkiller and anti-inflammatory drug for the treatment of livestock was found, the NSAID Voviram bolus, which contains sodium diclofenac as the active ingredient.

DISCUSSION

The investigation was limited by its study period (2002–2008) and was based only in Upper Mustang, so extrapolation of the population trend for the whole country is difficult. However, it is alarming that a substantial decline (73%) of the species was found in the survey in this remote region of the Himalayas. Surveys of Bearded Vultures from an adjacent area of Nepal (two villages are overlapped) in 1995 recorded 76 Bearded Vultures at a rate of 0.38 birds/km² and 5.1 birds/day (Gil *et al.* 2009). These records are similar to those observed in the first year of this study in 2002 (Table 1), suggesting that this frequency of occurrence is more typical than the low rates observed by the end of our study.

Veterinary pharmaceutical medicines are commonly available in the Mustang district. One of them is diclofenac, but as noted above some other NSAIDs are also harmful to vultures. The Himalayan Griffon and Bearded Vulture were found to be sharing habitat and roosting sites in China (Katzner *et al.* 2004). Our team also observed sharing of roosting sites by these two species outside the study area (28°39′24.9″N 83°39′53.6″E in Kunjo VDC, 2,500 m a.s.l. in 2005). Bearded Vultures are primarily bone-eaters, so it is unlikely they feed on the carcass as well (Xirouchakis & Nikolakakis 2002, Margalida *et al.* 2007). However, with the collapse of resident *Gyps* vultures and decline in Himalayan Griffons from the same area (Acharya *et al.* 2009) it is possible that Bearded Vultures are now able to access and feed on soft tissues from which previously they would have been excluded. It is not known if diclofenac residues remain within bones of treated animals, although residues of diclofenac are known to be passed into feathers and hair (N. Richards pers. comm.). Although the Bearded Vulture is mainly a resident and non-migratory species (Grimmett *et al.* 2000, Besten 2004), it has been observed flying with other vulture species near the carcass of an Ox *Bos indicus* in a lowland area of Nepal (Chansu, Sildujure VDC, Kaski, 1,100 m a.s.l., in 2001; RA pers. obs.). In addition to this, it was also recorded 305 m. a.s.l. at Mugling, Nepal (Fleming *et al.* 1984) and near sea level in Gujarat (Thakker 2005). The movements of Bearded Vultures depend on food availability (Xirouchakis & Nikolakakis 2002) and they feed in close proximity with lowland vultures when sharing food with them; hence, diclofenac could be one of the reasons for its decline.

Along with diclofenac, other toxic substances (fungicides, herbicides and pesticides) could have similar or compounding effects on the decline of the Bearded Vulture population in the area. It has already been observed that poisoning was the principal reason for non-natural mortality during the steep decline of the population of Bearded Vulture in Europe (Hiraldo *et al.* 1979, Margalida *et al.* 2008). In addition, virtually all local people within the study area believe that Bearded Vulture intestines make an effective treatment for diarrhoea. The practice is also common in Tibet (Ghyacho Bista, local homeopathy doctor in Upper Mustang, pers. comm.). Similarly, in Mustang it is believed that anyone who takes chicks from the nest of a vulture becomes more prosperous. Such beliefs suggest that exploitation of this bird may still occur in this area and in Tibet. Understanding the extent of this additional threat is a priority.

In Europe and Africa, Bearded Vultures have declined massively in the last two decades (Ferguson-Lees & Christie 2001), with the European Alps most prominently affected by these declines. Shooting and climatic variability were considered the most significant causes (Mingozzi & Esteve 1997, Hirzel *et al.* 2004, Margalida *et al.* 2008). Different intentional and unintentional poisoning practices were the most problematic factors in the conservation of Bearded Vultures in Europe during 1955–2002 (Margalida *et al.* 2008). The species is recovering with the help of an international reintroduction project (after introduction in 1986) (Mingozzi & Esteve 1997, Margalida *et al.* 2003, Hirzel *et al.* 2004). The rate of recovery was 5% per annum in the Spanish Pyrenees (Margalida *et al.* 2003). The restoration practices for Bearded Vulture in the European Alps were very expensive, costing about €1 million for every young bred and reared in captivity until the moment of the release (Frey 1998). Such a programme would be a huge undertaking within Nepal, although vulture conservation breeding centres have been established in the country in order to safeguard the Nepal's critically endangered *Gyps* vultures.

Further monitoring and understanding the cause of the decline are the next crucial steps for determining conservation actions for the Bearded Vulture in Nepal. If these declines are in fact found in any other areas of Nepal and throughout the Himalayan region, then the conservation status of the Bearded Vulture would need to be urgently reassessed. Furthermore, immediate steps should be taken to conserve it, in case it follows the same course as *Gyps* vultures in South Asia. Regular investigation of the population is essential in the long term to determine the real status of the species throughout its range.

ACKNOWLEDGEMENTS

We are most grateful to the National Trust for Nature Conservation / Annapurna Conservation Area Project (NTNC/ACAP), Nepal, Royal Society for the Protection of Birds (RSPB), UK and Bird Conservation Nepal (BCN) for financial support towards carrying out the study. We appreciate Surendra Gautam, Yadav Ghimirey, Antoni Margalida and Barnaby Letheren for their critical input while finalising this paper. We would like to thank all the staff at Friends of Nature, NTNC/ACAP Lomanthang, Jomsom, Sikles and the people of Upper Mustang. Also the direct and indirect support of many people during the entire period of study has been invaluable.

REFERENCES

Acharya, R., Cuthbert, R., Baral, H. S. & Shah, K. B. (2009) Rapid population declines of Himalayan Griffon *Gyps himalayensis* in Upper Mustang, Nepal. *Bird Conserv. Internat.* 19: 99–107.

Ale, S. B. ed. (2002) Upper Mustang Biodiversity Conservation Project Status Brief (NEP/99/G35; NEP/99/021). King Mahendra Trust for Nature Conservation, Nepal.

Baral, N. & Heinen, J. T. (2007) Resources use, conservation attitudes, management intervention and park-people relations in the Western Terai landscape of Nepal. *Environ. Conserv.* 34: 64–72.

Besten, J. W. D. (2004) Migration of Steppe Eagles *Aquila nipalensis* and other raptors along the Himalayas past Dharamsala, India, in autumn 2001 and spring 2002. *Forktail* 20: 9–13.

Biodiversity Hotspots (2009) Himalaya Biodiversity hotspot. Available at www.biodiversityhotspots.org/xp/hotspots/himalaya.

BirdLife International (2001) *Threatened birds of Asia*. Cambridge, UK: BirdLife International.

BirdLife International (2009) Data zone species accounts. Available at www.birdlife.org/datazone.

Brown, C. J. (1997) Population dynamics of the Bearded Vulture *Gypaetus barbatus* in southern Africa. *Afr. J. Ecol.* 35: 53–63.

Cuthbert, R., Green, R. E., Ranade, S., Saravanan, S. S., Pain, D. J., Prakash, V. & Cunningham, A. A. (2006a) Rapid population declines of Egyptian Vulture *Neophron percnopterus* and Red-headed Vulture *Sarcogyps calvus* in India. *Anim. Conserv.* 9: 349–354.

Cuthbert, R., Parry-Jones, J., Green, R. E. & Pain, D. J. (2006b) NSAIDs and scavenging birds: potential impacts beyond Asia's critically endangered vultures. *Biology Letters* 3: 90–93.

Ferguson-Lees, I. J. & Christie, D. A. (2001) *Raptors of the world*. London: Christopher Helm.

Fleming, R. Sr., Fleming, R. Jr. & Bangdel, L. (1984) *Birds of Nepal*. Third edition. Kathmandu: Nature Himalayas.

Frey, H. (1998) Estimation of the costs for captive bred bearded vultures within the framework of the European bearded vulture project. *Bearded Vulture Reintroduction into the Alps Annual Report* 75–77.

Gil, J. A., Diez, O., Lorente, L., Baguena, G., Cheliz, G. & Ascaso, C. (2009) *On the trail of the Bearded Vulture (Gypaetus barbatus): world distribution and population*. Fundación para la Conservación del Quebrantahuesos.

Green, R. E., Newton, I., Shultz, S., Cunningham, A. A., Gilbert, M., Pain, D. J. & Prakash, V. (2004) Diclofenac poisoning as a cause of vulture population declines across the Indian subcontinent. *J. Appl. Ecol.* 41: 793–800.

Green, R. E., Taggart, M. A., Das, D., Pain, D. J., Kumar, C. S., Cunningham, A. A. & Cuthbert, R. (2006) Collapse of Asian vulture populations: risk of mortality from residues of the veterinary drug diclofenac in carcasses of treated cattle. *J. Appl. Ecol.* 43: 949–956.

Grimmett, R., Inskipp, C. & Inskipp, T. (2000) *Birds of Nepal*. Delhi: Oxford University Press.

Hiraldo, F., Delibes, M. & Calderon, J. (1979) *El quebrantahuesos*. Madrid: ICONA (*Monogr.* 22).

Hirzel, A. H., Posse, B., Oggier, P. A., Crettendand, Y., Glenz, C. & Arlettaz, A. (2004) Ecological requirements of reintroduced species and the implications for release policy: the case of the Bearded Vulture. *J. Appl. Ecol.* 41: 1103–1116.

IUCN Nepal (2008) Biodiversity of Nepal. Available at www.iucnnepal.org.

Katzner, T. E., Lai, C. H., Gardiner, J. D., Foggin, J. M., Pearson, D. & Smith, A. T. (2004) Adjacent nesting by Lammergeier *Gypaetus barbatus* and Himalayan Griffon *Gyps himalayensis* on the Tibetan Plateau, China. *Forktail* 20: 94–97.

Kaul, R. & Ahmed, A. (1992) Pheasant studies in north-east India – 1, Arunachal Pradesh: a report. Jamnagar: Peter Scott Trust.

Margalida, A., Garcia, D., Bertran, J. & Heredia, R. (2003) Breeding biology and success of the Bearded Vulture *Gypaetus barbatus* in the eastern Pyrenees. *Ibis* 145: 244–252.

Margalida, A., Mañosa, S., Bertran, J. & García, D. (2007) Biases in studying the diet of the Bearded Vulture. *J. Wildlife Mgmt* 71: 1621–1625.

Margalida, A., Heredia, R., Razin, M. & Hernandez, M. (2008) Source of variation in mortality of the Bearded Vulture *Gypaetus barbatus* in Europe. *Bird Conserv. Internat.* 18: 1–10.

Mingozzi, T. & Esteve, R. (1997) Analysis of historical extirpation of the Bearded Vulture *Gypaetus barbatus* (L.) in the western Alps (France-Italy): former distribution and causes of extirpation. *Biol. Conserv.* 79: 155–171.

Oaks, J. L., Gilbert, M., Virani, M. Z., Watson, R. T., Meteyer, C. U., Rideout, B. A., Shivaprasad, H. L., Ahmed, S., Chaudhry, M. J. I., Arshad, M., Mahmood, S., Ali. A. & Khan, A. A. (2004) Diclofenac residues as the cause of vulture population decline in Pakistan. *Nature* 427: 630–633.

Shah, K. B. (2001) Upper Mustang Biodiversity conservation project. Research Report series 4.

Shultz, S., Baral, H. S., Charman, S., Cunningham, A. A., Das, D., Ghalsasi, G. R., Goudar, M. S., Green, R. E., Jones, A., Nighot, P., Pain, D. J. & Prakash, V. (2004) Diclofenac poisoning is widespread in declining vulture populations across the Indian subcontinent. *Proc. R. Soc. London B (Suppl.)* 271: S458–S460.

Suwal, N. R. (2003) Ornithological survey Upper Mustang. Research report submitted to Upper Mustang Biodiversity Conservation Project, King Mahendra Trust for Nature Conservation.

Thakker, P. S. (2005) Bearded Vulture in Great Rann of Kachchh. *Flamingo* 3(2): 9.

Xirouchakis, S. & Nikolakakis, M. (2002) Conservation implication of the temporal and spatial distribution of Bearded Vulture *Gypaetus barbatus* in Crete. *Bird Conserv. Internat.* 12: 269–280.

Raju Acharya, Friends of Nature, P.O.Box, 23491, Sundhara, Kathmandu, Nepal. Email: rajuhugu_13@yahoo.com
Richard Cuthbert, Royal Society for the Protection of Birds, The Lodge, Sandy, Bedfordshire SG19 2DL, UK
Hem Sagar Baral, Himalayan Nature, P.O. Box 10918, Kathmandu, Nepal
Anand Chaudhary, Bird Conservation Nepal, P.O. Box 12465, Lazimpat, Kathmandu, Nepal