Breeding records and recent population trends of Himalayan Griffon (*Gyps himalayensis* Hume) in Himachal Pradesh, India

M.L. Thakur

Himachal Pradesh State Biodiversity Board,
Department of Environment, Science and Technology
Shimla-171 002 (HP), India
Email: mlthakur75@gmail.com

ABSTRACT

A total of 14 nesting colonies of Himalayan Griffon (*Gyps himalayensis*) have been reported from Bilaspur, Mandi, Solan, Shimla and Sirmour districts of Himachal Pradesh. Numbers of occupied nests in these sites increased from 49 in 2009-2010 to 64 in 2010-2011 and 69 in 2011-2012. The number of nests in each nesting site varied from three to six between 2009-2012. High, steep and inaccessible cliffs with suitable ledges, on the elevated part of small valleys around human settlements have been used as nesting sites. Counts of individuals conducted at Taradevi nesting site revealed that in addition to the adults and immatures, this site has been used by the individuals of nearby nesting colonies as a staging/roosting site. Moreover, during the course of present study spread over three breeding seasons i.e. 2009-2010 to 201-2012, a new colony (a single nest) has been built by a pair of Himalayan Griffon some 500 m away from the parent Taradevi colony. This observation together with an increase in number of occupied nests from 49 to 69 indicates the population of Himalayan Griffon in Bilaspur, Mandi, Solan, Shimla and Sirmour districts of Himachal Pradesh at least remained relatively stable between the three years despite potential threats to this and related species particularly in South Asia. This provides a valuable benchmark for future monitoring.

Key words: Breeding records, Himalayan Griffon, Himachal Pradesh

{Citation: M.L. Thakur. Breeding records and recent population trends of Himalayan Griffon (*Gyps himalayensis* Hume) in Himachal Pradesh, India. American Journal of Research Communication, 2014, 2(3): 141-152} www.usa-journals.com, ISSN: 2325-4076.

INTRODUCTION

The Himalayan Griffon (*Gyps himalayensis* Hume) is an endemic vulture that breeds in the Himalayas from western Pakistan to eastern Assam, normally between 600 and 2500 m asl (Ali and Ripley, 1983). Despite extensive research on vultures elsewhere in the Indian sub-continent (Pain *et al.,* 2003; Oaks *et al.,* 2004; Shultz *et al.,* 2004; Johnson *et al.,* 2006; Green *et al.,* 2007; Prakash *et al.,* 2007) little is known about the breeding biology of the Himalayan Griffon (Naoroji, 2006; Virani *et al.,* 2008) and this study was initiated in October 2009, to establish baseline information on the breeding status of Himalayan Griffons in Himachal Pradesh. Information on the location and number of breeding colonies, and the number of breeding pairs at these sites was collected for elucidation of breeding status.

Gyps Vultures are obligate scavengers, feeding primarily on the carcasses of large ungulates and nesting and roosting, often colonially, on cliffs or in trees. They use energetically economical soaring flight to travel long distances from nests and roosts in search of carcasses (Houston, 1974; Ruxton and Houston, 2007). *Gyps* vultures are believed to have evolved in parallel with large herds of migratory ungulates, feeding on the remains of sick, injured and depredated individuals (Houston, 1983). These birds were once one of the most numerous groups of large raptors worldwide, and are sustained mainly by feeding on domestic livestock carcasses (Newton, 1979).

Four species of vultures occurring in South Asia, Oriental White-backed Vulture *Gyps bengalensis,* Long-billed Vulture *Gyps indicus,* Slender-billed Vulture *Gyps tenuirostris* and Red-headed Vulture *Sarcogyps calvus* are at high risk of global extinction and are listed as Critically Endangered, the highest threat category by IUCN, because of rapid population declines within the last decade in the Indian subcontinent. The Egyptian Vulture *Neophron percnopterus* has been categorised as Endangered and the Cinereous Vulture *Aegypius monachus* has been placed under Near Threatened category. The Himalayan Griffon *Gyps himalayensis* has been categorized as of 'least concern' (IUCN, 2007) despite the fact that it is known to be susceptible to diclofenac poisoning (Das *et al.,* 2011), and some vigilance on this is called for (Virani *et al.,* 2008; Acharya *et al.,* 2009) which may lead to this being upgraded. This population decline for many of these species has been attributed mainly to the use of non-steroidal anti-inflammatory drug (NSAID) diclofenac (Oaks *et al.,* 2004; Shultz *et al.,* 2004; Green *et al.,* 2004, 2006). Other environmental changes are also thought to have adverse effects on the population of vultures. Food shortage (Pain *et al.,* 2003; Cambodia Vulture Conservation Action Plan, 2005), caused by the burial or burning of carcasses to

reduce the nuisance and health risks may have also contributed to their decline in some areas. Other reasons believed to be responsible for the decline are decreased breeding efficiency, infectious diseases, general environmental pollution etc. (Oaks *et al.*, 2004; Shultz *et al.*, 2004; Cambodia Vulture Conservation Action Plan, 2005; Johnson *et al.*, 2006; Green *et al.*, 2007; Prakash *et al.*, 2003, 2007; Pain *et al.*, 2003, 2008; Cuthbert *et al.*, 2011; Das *et al.*, 2011). Recently, Hall *et al.* (2011) have suggested that La Niña events had a latent impact on Indian Vulture populations in western Rajasthan.

STUDY AREA AND METHODOLOGY

The study has been conducted in the state of Himachal Pradesh which lies in the Northwest Himalaya between $32^0 22' 40''$ to $33^0 12' 40''$ N and $75^0 45' 55''$ to $79^0 04' 20''$E and encompasses an area of 55673 sq. km.

Keeping in view the large study area, topography and climatic conditions of the state, studies were started on breeding status of Himalayan Griffon in different zones of Himachal Pradesh based on a modified stratified random sampling technique (Snedecore and Cochran, 1993). The technique was slightly restricted, sampling only the road connected parts of the State, so potentially introducing some bias as areas without road connectivity were not included under the present investigation. There are 9 national highways with total length of 1,208 km, 19 state highways with total length of 1,625 km and 48 major district roads with total length of 1969 km (HPPWD, 2009-2010).

These major roads along with small village roads account for some 30,000 km motorable roads in the State. Around 15,000 km road length has been traveled in various parts of Bilaspur (Bilaspur, Ghumarwin, Jukhala and Naina Devi), Chamba (Chamba, Chawari, Dalhousie and Sihunta), Hamirpur (Bamsan, Bhoranj, Hamirpur, Naduan and Sujanpur Tihra), Kangra (Baijnath, Bhawarna, Dehra Gopipur, Fatehpur, Kangra, Nagrota Bagwan, Nagrota Surian, Nurpur, Palampur, Panchrukhi, Shahpur and Thural), Kinnaur (Kalpa Nichar, Pooh and Sangla), Kullu (Banjar, Kullu and Manali), Mandi (Balh, Dharampur, Janjehli, Joginder Nagar, Karsog, Pandoh, Sandhole, Sarkaghat and Slapper, Sunder Nagar), Shimla (Dhammi, Jubbal, Kotkhai, Mashobra, Narkanda, Rampur, Rohru, Shimla and Theog), Sirmour (Baru Sahib Nahan and Rajgarh) and Solan (Arki, Kandaghat, Kasauli, Kunihar and Solan) districts. Normally areas above 600 m (normal distribution range of Himalayan Griffon) were surveyed by traveling by roads (Figure 1) and the methodology

was standardized sufficiently that the effort in both years was similar, so any increase observed does not reflect a change in sampling effort. The numbers of observation hours were kept constant for each nesting site throughout the study period.

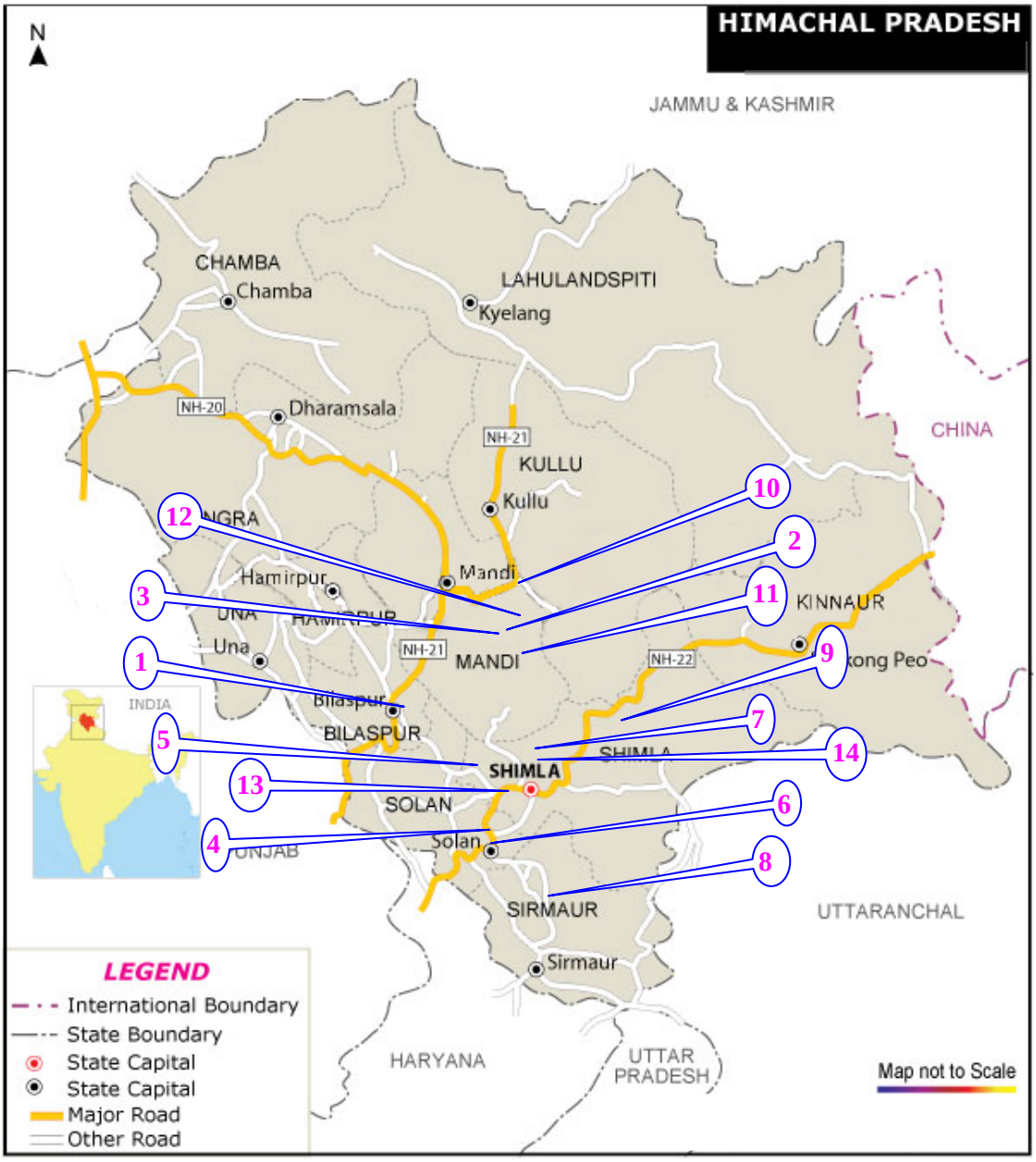

Figure 1: Map of Himachal Pradesh showing nesting sites of Himalayan Griffon.
(Original map source: www.mapsofindia.com, downloaded on August 02, 2012 at 14:30 hrs IST)

Breeding sites:

1. Bandla	2. Banwali	3. Dera	4. Kandaghat
5. Kalihatti	6. Karol	7. Khatnol	8. Kheri
9. Nag jubbar	10. Panarsa	11. Rehri	12. Shikari Devi
13. Taradevi	14. Thailla		

Individuals of Himalayan Griffon in flight and feeding groups on carcasses especially during breeding season were followed with binoculars which gave a clear indication of the direction and height of their nesting sites which were then visited. In addition, presence of whitewash on steep cliffs due to excreta deposition was a clear indication of the nesting sites of this species. Then each site was observed with the help of 10x40 Nikon binoculars and a Fujinon 60 S super field scope. For each site, a whole day has been spent observing the nesting site so as to avoid any error in counting of the individuals. Any nest with egg or with young was referred to as active nest, whereas, the term 'occupied nest' was assigned when only fresh droppings were observed. First survey was conducted during October 2009 but it was considered preliminary because it was mainly concerned with recording of nesting colonies in different parts of Himachal Pradesh. Each of the nesting sites were then monitored every two months (during breeding period i.e. from November to April/May) to determine the number of successful nests. Taradevi nesting site near Shimla was monitored fortnightly for the population status and breeding activities.

RESULTS

During the course of present study a total of 14 breeding colonies of Himalayan Griffon have been reported from different bio-geographic zones of Himachal Pradesh. Number of occupied nests in these sites increased from 49 in 2009-2010 to 64 in 2010-2011 and 69 in 2011-2012. Number of nests in each nesting site varied from two to six (Table 1). Breeding in small groups of two to six pairs is apparently typical of the species. Some fluctuations in age class ratio have been noticed during the present study, with more immature birds recorded in the months of November and May (Table 2). This fluctuation in the ratio of immature to adults points towards migration of immature birds to lower altitudinal areas in winters which is a well documented feature of the species (Virani *et al.*, 2008). It has also been reported that in large nesting colonies like Bandla, Kalihatti, Karol, Khatnol, Shikari Devi and Taradevi the nests were distributed in two or more groups (Table 1, Figure 1).

Table 1: Ecological details and breeding sites of Himalayan Griffon in Himachal Pradesh

S.No.	Locality, nearest Village/City (District)	Distance to the nearest village/city (Latitude and Longitude)	Total number of nests in 2010-2011 [in 2009-2010]	Number of nests in 2011-2012	Details of Nesting site
1.	Bandla, Bilaspur town (Bilaspur)	5 km (31° 19' 49" N 76° 47' 54" E Alt. 1152 m)	6 (distributed at 3 places, in groups of 2 each) [6 (2+2+2)]	7 (2+3+2)	Nesting colony situated on a steep rocky hill. A large area of Bilaspur town and villages around Govind Sagar lake are clearly visible from the nesting areas.
2.	Banwali, Rohanda (Mandi)	4 km (31° 27' 28" N 77° 03' 05" E Alt. 2611 m)	4 [3]	3 (2+1)	Nesting colony situated on a steep rocky hill. Many villages are visible from the site.
3.	Dera, Rohanda (Mandi)	3 km (31° 26' 49" N 77° 01' 14" E Alt. 1847 m)	3 [2]	1	Nesting colony situated on a steep rocky hill and a large number of villages visible from the nesting areas
4.	Kandaghat, Solan town (Solan)	10 km (30° 59' 28" N 77° 06' 09" E Alt. 1708 m)	4 [3]	5 (2+3)	Nesting colony situated on the steep rocky area on the side of NH 22, some 500 m above the road. Some small villages of Kandaghat are clearly visible from the area.
5.	Kalihatti, Ghanahatti (Shimla)	24 km (31° 09' 55" N 77° 01' 46" E Alt. 1542 m)	5 (distributed at 2 places, in groups of 3+2) [3 (2+1)]	3 (2+1)	Nesting colony situated on the steep rocky area on the side of NH 88, some 700 m above the road. A large area of Kunihar and Arki areas are visible from the area.
6.	Karol, Solan town (Solan)	4 km (30° 55' 55" N 77° 06' 02" E Alt. 1759 m)	6 (distributed at 2 places, in groups of 3+3) [5 (4+1)]	8(5+3)	Nesting colony (on a rocky cliff) situated near a small village on Karol hill, overlooking Solan town and many small villages.
7.	Khatnol, Khatnol village (Shimla)	1.5 km (30° 11' 01" N 77° 15' 54" E Alt. 1962 m)	6 (distributed at 3 places, in groups of 2+2+2) [5 (2+2+1)]	8 (5+2+1)	Nests situated below Shalli temple, behind Khatnol village on a big rocky cliff. A few villages of Sunni tehsil of Shimla are visible from the site.
8.	Kheri, Baru Sahib (Sirmour)	2 km (30° 47' 06" N 77° 17' 21" E Alt. 842 m)	3 (distributed at 2 places, in groups of 2+1) [2 (1+1)]	1	Nesting site situated on a steep gorge of a small tributary of Giri river. A few villages of Giri valley visible from the site.
9.	Nag jubbar, Matiana (Shimla)	10 km (31° 11' 16" N 77° 24' 31" E Alt. 1974 m)	4 [3]	6	Nesting colony situated on the steep cliff. A few villages in Matiana villages are visible from the nesting area.

10.	Panarsa, Panarsa village (Mandi)	3 km (31° 47' 34" N 77° 12' 09" E Alt. 1463 m)	3 [2]	2	Nesting site situated on steep slopes of a rocky areas on the periphery of Kullu valley supporting thick human settlements.
11.	Rehri, Karsog (Mandi)	7 km (31° 25' 28" N 77° 13' 33" E Alt. 2028 m)	4 [3]	5	Nesting site situated on the cliff on a hill surrounding the Karsog valley. Villages of Karsog valley are clearly visible from the site.
12.	Shikari Devi, Janjehli (Mandi)	7 km (31° 30' 26" N 77° 10' 44" E Alt. 2667 m)	6 (distributed at 2 places, in groups of 4+2) [5 (3+2)]	8 (5+3)	Nesting colony situated on a cliff below Shikari temple. Only a few villages of Janjehli valley are visible from the site.
13.	Taradevi, Shimla town (Shimla)	5 km (31° 03' 50" N 77° 07' 59" E Alt. 1877 m)	7 (distributed at 2 places, in groups of 6+1) [5 (single group)]	8 (7+1)	Nesting colony situated on a solid rocky cliff, around 400 m above the NH 22. A very large number of villages of Kunihar, Arki, Kandaghat and Kasauli area visible from the site.
14.	Thailla, Khatnol (Shimla)	15 km (31° 09' 09" N 77° 17' 03" E Alt. 1428 m)	3 [3]	4	A steep rocky slope in the gorge of a hill stream used by these birds as nesting site. Only a few villages of Sunni tehsil of Shimla district are visible from the site.
	Total		**64 [49]**	69	

Table 2: Population trends of Himalayan Griffon in Himachal Pradesh

Period	Adults		Immatures		Ratio of Immatures/adults
	Total Individuals	Average (Total/number of sites*)	Total Individuals	Average (Total/number of sites)	
Dec. 2009	148	10.57	63	4.5	0.43
Feb. 2010	159	11.36	51	3.64	0.32
Apr. 2010	130	9.29	76	5.43	0.58
Nov. 2010	146	10.43	89	6.36	0.61
Jan. 2010	160	11.43	63	4.5	0.39
Mar. 2011	182	13	69	4.93	0.38
May. 2011	171	12.21	114	8.14	0.67
Nov. 2011	194	13.86	129	9.21	0.66
Jan. 2011	205	14.64	82	5.86	0.40
Mar. 2012	169	12.07	61	4.36	0.36
May. 2012	211	15.07	129	9.21	0.61

* Number of sites=14

Fortnight counts of individuals conducted at Taradevi nesting site revealed that in addition to the adults and immatures this site was used by individuals of nearby nesting colonies as staging/roosting site, as evidenced by i) number of individuals at this nesting colony varied from 15 to 58 during the periods of count (number of nests 7), ii) nesting sites at Kandaghat, Kalihatti, Karol, Khatnol and Thailla are not far off (less then 4-5 km aerial distance) from the Taradevi nesting colony and iii) a number of times, during evening hours (1600 to 1700 hrs IST) individuals vultures from Taradevi colony have been seen heading towards above listed nesting sites. Moreover, during the course of the present study spread over two breeding seasons i.e. 2009-2010 to 2011-2012, a new colony (a single nest) was initiated by a pair of Himalayan Griffon some 500 m away from the parent colony most probably to avoid over crowding. This observation together with increase in number of occupied nests from 49 (2009-2010) to 69 (2011-2012) suggests population stabilization of Himalayan Griffon in Himachal Pradesh although further years data are required to support this.

DISCUSSION

Population trends in this species are unlike the situation of the other three breeding *Gyps* vultures found in India (*G. bengalensis*, *G. tenuirostris* and *G. indicus*) which have declined precipitously over the last decade as a result of their feeding on diclofenac-contaminated livestock carcasses (BirdLife International, 2010). Johnson *et al.* (2006) have demonstrated that Himalayan Griffon is genetically closely related to other *Gyps* species so may be similarly sensitive to diclofenac, and this was confirmed by Das *et al.* (2011) who reported that like other four species of *Gyps* vultures, Himalayan Griffon is also susceptible to diclofenac poisoning. Virani *et al.* (2008) suggested that differences in foraging behaviour and relatively lower use of diclofenac in highland regions of Himalayas could be the reasons for a lower degree of exposure of Himalayan Griffon to diclofenac-contaminated livestock carcasses but Acharya *et al.* (2009) in Nepal have elucidated that young Himalayan Griffons which migrate to the lowland areas, were highly likely to be subject to diclofenac poisoning during their periods spent there. The present study like Virani *et al.* (2008) and Acharya *et al.* (2009) also pointed towards migration of immatures to lowland areas, therefore, a close watch on the population, of Himalayan Griffon is warranted and more temporal and age class ratio

data is needed. Simultaneously, the migration pattern of immature Himalayan Griffon might be likely to be changing due to reduced competition for food from other congener species of *Gyps* genus. Green *et al.* (2006) reported that intestine, kidney and liver have the highest diclofenac concentrations as compared to muscles therefore viscera feeding *Gyps* species may be more prone to diclofenac poisoning as compared to muscle feeding ones.

Breeding in small groups of two to six can be correlated with lower availability of food due to a low population of wild ungulates in hilly areas of Himachal Pradesh due to which this griffon species has to depend on domesticated animals for their food and has to travel to large distances in search of carcasses. Similar breeding behaviour has also been reported by Naoroji (2006) in Nepal Himalaya who elucidated that this species is less gregarious than other *Gyps* vultures occurring in the Indian subcontinent.

ACKNOWLEDGMENTS

I am thankful to the Chairman, Department of Biosciences, Himachal Pradesh University, Shimla, for encouragements, and for providing necessary facilities.

Thanks are also due to the Department of Science and Technology (Ministry of Science and Technology, Govt. of India), New Delhi, for providing the financial assistance under SERC-FAST Track Scheme (No. SR/FT/LS-068/2008).

I am also grateful to Mr. Ramesh Kataria, Assistant Professor (Zoology), Govt, College Kullu, Mr. Viveka Nand Sharma, Assistant Professor (Zoology), Govt. College Joginder Nagar and Dr. Sanjay Narang, Assistant Professor (Zoology), Govt. College Chaura Maidan, Shimla for accompany during some of the field trips.

REFERENCES

ACHARYA, R., CUTHBERT, R., BARAL, H.S. AND SHAH, K.B., 2009. Rapid population declines of Himalayan Griffon *Gyps himalayensis* in Upper Mustang, Nepal. *Bird Conservation International*, 19: 99-107.

ALI, S. AND RIPLEY, S.D., 1983. *Handbook of the Birds of India and Pakistan*. Oxford University Press, Delhi, 737 pp.

BIRDLIFE INTERNATIONAL, 2010. *Asian vulture populations have declined precipitously in less than a decade*. <www.biodiversityinfo.org/casestudy.php?r=state &id=95>.

CAMBODIA VULTURE CONSERVATION ACTION PLAN, 2005. <www.birdlife.org/...vulture.../cambodia_vulture_action_plan_04_05.pdf>.

CUTHBERT, R., TAGGART, M.A., PRAKASH, V., SAINI, M., SWARUP, D., UPRETI, S., MATEO, R., CHAKRABORTY, S.S., DEORI, P. AND GREEN, R.E., 2011. Effectiveness of Action in India to Reduce Exposure of *Gyps* Vultures to the Toxic Veterinary Drug Diclofenac. *PLoS ONE,* 6 (5): e19069.

DAS, D., CUTHBERT, R.J., JAKATI, R.D. AND PRAKASH, V., 2011. Diclofenac is toxic to the Himalayan Vulture *Gyps himalayensis*. *Bird Conservation International,* 21: 72–75.

GREEN, R.E., NEWTON, I., SHULTZ, S., CUNNINGHAM, A.A., GILBERT, M., PAIN, D.J. AND PRAKASH, V., 2004. Diclofenac poisoning as a cause of vulture population declines across the Indian subcontinent. *Journal of Applied Ecology,* 41: 793-800.

GREEN, R.E., TAGGART, M.A., DAS, D., PAIN, D.J., KUMAR, C.S., CUNNINGHAM, A.A. AND CUTHBERT, R., 2006. Collapse of Asian vulture populations: risk of mortality from residues of the veterinary drug diclofenac in carcasses of treated cattle. *Journal of Applied Ecology,* 43: 949-956.

GREEN, R.E., TAGGART, M.A., SENACHA, K.R. , PAIN, D.J., JHALA, Y. AND CUTHBERT, R., 2007. Rate of decline of the Oriental White-backed Vulture *Gyps bengalensis* population in India estimated from measurements of diclofenac in carcasses of domesticated ungulates. *PloS One,* 2 (8): e 686.

HALL, J.C., CHHANGANI, A.K., WAITE, T.A. AND HAMILTON, I.M., 2011. The impacts of La Niña-induced drought on Indian Vulture *Gyps indicus* populations in Western Rajasthan. *Bird Conservation International,* doi:10.1017/S0959270911000232.

HOUSTON, D.C., 1974. Food searching in Griffon Vultures. *East African Wildlife Journal*, 12: 63-77.

HOUSTON, D.C., 1983. The adaptive radiation of Griffon Vultures. In: *Vulture biology and management* (eds. S.R. Wilbur & J.A. Jackson). University of California Press: Berkeley and Los Angeles.

HPPWD, 2009-2010. <http://hppwd.gov.in/SH%20&%20MDRs.htm>.

IUCN. IUCN Red List of threatened species, 2007. <http://www.iucn.org>

JOHNSON, J.A., LERNER, H.R.L., RASMUSSEN, P.C. AND MINDELL, D.P., 2006. Systematics within *Gyps* vultures: a clade at risk. *BMC Evolutionary Biology*, 6: 65.

NAOROJI, R., 2006. *Birds of prey of the Indian subcontinent*. Om Books International, New Delhi, India, 692 pp.

NEWTON, I., 1979. *Population ecology of raptors*. T. and A.D. Poyser, Berkhamsted, U.K., 399 pp.

OAKS, J.L., GILBERT, M., VIRANI, M.Z., WATSON, R.T., METEYER, C.U., RIDEOUT, B., SHIVAPRASAD, H.L., AHMED, S., CHAUDHRY, M.J.I., ARSHAD, M., MAHMOOD, S., ALI A. AND KHAN, A.A., 2004. Diclofenac residues as the cause of vulture population decline in Pakistan. *Nature*, 427: 630–633.

PAIN, D.J., BOWDEN, C.G.R., CUNNINGHAM, A.A., CUTHBERT, R., DAS, D., GILBERT, M., JAKATI, R.D., JHALA, Y.D., KHAN, A.A., NAIDOO, V., OAKS, J.L., PARRY-JONES, J., PRAKASH, V., RAHMANI, A., RANADE, S.P., BARAL, H.S., SENACHA, K.R., SARAVANAN, S., SHAH, N., SWAN, G., SWARUP, D., TAGGART, M.A., WATSON, R.T., VIRANI, M.Z., WOLTER, K. AND GREEN, R.E., 2008. *The race to prevent the extinction of south Asian vultures*. BirdLife International, United Kingdom.

PAIN, D.J., CUNNINGHAM, A.A., DONALD, D.F., DUCKWORTH, J.W., HOUSTON, D.C., KATZNER, T., PARRY-JONES, J., POOLE, C., PRAKASH, V., ROUND, P. AND TIMMINS, R., 2003. Causes and effects of temporospatial declines of *Gyps* vultures in Asia. *Conservation Biology*, 17 (3): 661-671

PRAKASH, V., GREEN, R.E., PAIN, D.J., RANADE, S.P., SARAVANAN, S., PRAKASH, N., VENKITACHALAM, R., CUTHBERT, R., RAHMANI, A.R. AND CUNNINGHAM, A.A., 2007. Recent changes in populations of resident *Gyps* vultures in India. *Journal of Bombay Natural History Society*, 104: 129-135.

PRAKASH, V., PAIN, D.J., CUNNINGHAM, A.A., DONALD, P.F., PRAKASH, N., VERMA, A., GARGI, R., SIVAKUMAR, S. AND RAHMANI, A.R., 2003. Catastrophic collapse of Indian White-backed *Gyps bengalensis* and Longbilled *Gyps indicus* Vulture populations. *Biological Conservation*, 109: 381-390.

RUXTON, G.D. AND HOUSTON, D.C., 2004. Obligate vertebrate scavengers must be large soaring fliers. *Journal of Theoretical Biology*, 228: 431-436.

SHULTZ, S., BARAL, H.S., CHARMAN, S., CUNNINGHAM, A.A., DAS, D., GHALSASI, D.R., GOUDAR, M.S., GREEN, R.E., JONES, A., NIGHOT, P., PAIN, D.J. AND PRAKASH, V., 2004. Diclofenac poisoning is widespread in declining vulture populations across the Indian subcontinent. *Proceedings of Royal Society of London*, B (Supplement) 271 (Suppl 6): S 458–S 460.

SNEDECORE, G.W. AND COCHRAN, W.G., 1993. *Statistical Methods*. Oxford and IBH Publ. Co., New Delhi, 593 pp.

VIRANI, M., GIRI, J.B., WATSON, R. AND BARAL, H.S., 2208. Surveys of Himalayan Vultures (*Gyps himalayensis*) in the Annapurna Conservation Area, Mustang, Nepal. *Journal of Raptor Research*, 42 (3):197-203.