

A Survey of the Reproductive Activities at some *Gyps* Vulture Nests in Kanha, Bandhavgarh and Ranthambhore National Parks, India, in the 2002/2003 breeding season

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INTRODUCTION

Three south Asian *Gyps* vulture species (Oriental White-backed Vulture *G. bengalensis* (OWV), Long-billed Vulture *G. indicus* (LBV) and Slender-billed Vulture *G. tenuirostris*) are listed as critically endangered in the IUCN's Red Data Book (Birdlife International 2000). These birds were once one of the most numerically abundant groups of large raptors worldwide but, over the last decade, have undergone a population crash in parts of south Asia due to the widespread use of the non-steroidal anti-inflammatory drug, diclofenac (Oaks 2004 & this volume.). Adult and sub-adult mortality in OWV populations has been unusually high resulting in a 34 – 95% decline in local breeding populations in India, Nepal and Pakistan since 2000 (Prakash 1999; Virani *et al.* 2001, Gilbert *et al.* 2002; Cunningham *et al.* 2003; Prakash *et al.* 2003; Oaks *et al.* 2004).

Though some studies of south Asian *Gyps* species have been conducted (e.g. Ali & Ripley 1968; Grubh 1973, 1978, 1983; Prakash 1999), little published data exist for reproductive success of these birds and vast areas of the Indian subcontinent remain to be surveyed to determine their population and breeding status. These and other baseline information (e.g., mortality rates, age ratios) are vital for the development of scientifically sound conservation, recovery and management strategies for these species.

The aim of this study is to establish baseline demographic information on sub-populations of OWV and LBV at three Indian national parks, Kanha,

Bandhavgarh and Ranthambhore, as part of a long-term study of the biology of these birds. Here we report our findings for the 2002/2003 breeding season. This study is in its initial stages and the results by no means represent the entire areas of the selected reserves. Because of the drastic population crash which has occurred we felt it was important to report our early findings to the scientific community.

These parks were selected because: 1) vultures historically bred there, 2) vulture nest sites are relatively accessible and 3) little published data on the numbers of vultures and nests at present exists. Information collected from these study sites will significantly add to our current knowledge by providing a broader perspective about resident *Gyps* vulture sub-populations that presumably feed on carcasses of the many wild ungulates resident in these parks. This is in contrast to the majority of India's *Gyps* vultures that are sustained by predominantly consuming livestock carcasses (Grubb 1983). These results will help determine future changes in these sub-populations' numbers and reproductive status and the efficacy of conservation actions.

STUDY AREA AND METHODS

Surveys were conducted in India's Kanha, Bandhavgarh, and Ranthambhore National Parks (henceforth Kanha, Bandhavgarh and Ranthambhore). These parks are part of India's *Project Tiger* programme launched in 1973, where national parks were elevated to a higher protection status for the conservation of tigers *Panthera tigris* (Moulton & Hulsey 2002). All of the parks consist of a central "core" area, where agricultural activities are excluded. These are surrounded by a "buffer" area where subsistence agricultural activities and livestock grazing occur, but where the habitat is still relatively intact. Kanha and Bandhavgarh are located in the state of Madhya Pradesh, while Ranthambhore is in south-east Rajasthan State. Kanha (22°28.9' N, 80°62.5' E) lies in the Maikal Range, the eastern sector of the Satpura Hills. It covers an area of 1945 km² (core area = 940 km²) comprising four principal vegetation types – moist deciduous forest, dry deciduous forest, valley meadow and plateau meadow (Schaller 1967; Moulton & Hulsey 2002). The main tree species is Sal *Shorea robusta* where OWV usually build their nests. Bandhavgarh (23°68.1' N, 81°04.4' E) is 265 km north-east of Kanha. Bandhavgarh covers an area of 448 km² (core area = 105 km²) and consists of Sal forest with bamboo *Bambusa vulgaris*, open grasslands, and a number of rocky outcrops and plateaus that provide ideal nesting ledges for LBV and other cliff-nesting raptors. OWV nest in trees in farming areas adjacent to the park. Ranthambhore (25°97.2' N, 76°44.9' E) covers an area of 1334 km² (core area = 392 km²) and lies in south-east Rajasthan where the Vindhyas and Aravalli Hills converge. The terrain consists of hills with cliff faces, valleys and riverine forests. The dominant tree species is Dhok *Anogeissus pendula*, while Khair *Acacia catechu* is prevalent in the valleys.

The criteria of Postupalsky (1974) were followed, requiring a minimum of two visits per season to adequately determine breeding success. Failed breeding attempts prior to our initial visit and those initiated subsequent to the second were not included in our calculations. Nests were considered "active" if an egg

or nestling was present or if a vulture was observed crouching low on the nest as if incubating, and "occupied" if two adults were seen copulating on or next to a nest, or if an adult was seen arranging or bringing nesting material to a nest (an occupied site is where at least nest building behaviour is observed and an active site is where at least an egg is laid – i.e. all active nests are occupied, but not all occupied are active – see Postupalsky 1974 for criteria). All occupied nests were recorded and locations determined using a geographical positioning system (GPS). The initial survey occurred from 1 to 15 December 2002, when eggs of OWV and LBV had recently been laid or birds were still nest building. During this visit, we performed intensive nest searches by foot and/or vehicle. The second survey was conducted from 9 to 24 March 2003, when large nestlings of both species were present in the study nests. All marked nests were revisited and their occupants' reproductive outcome recorded. Additional nests, not discovered during the first visit, were noted but not included in the calculation of breeding success. A Chi square analysis (Sokal & Rohlf 1981) was used to compare differences in reproductive success between the species.

RESULTS

We located 15 occupied nests of OWV at Kanha in December 2002. Six of these had large nestlings in March 2003 (Table 1). Fifteen additional active nests were discovered in March when the trees were bare of leaves, improving conditions for their discovery. We estimated an overall population of approximately 100 individual OWV in the area surveyed. No LBV were observed at Kanha. At Bandhavgarh, we recorded breeding activities at 47 LBV nests in December 2002. This was a sub-sample of over 100 nests, most of which were inaccessible and difficult to see into. Of the 47 occupied nests, 27 had large nestlings in March 2003 (Table 1). Based on the numbers of vultures and nests observed at Bandhavgarh, we estimated a population of between 300 and 400 individual LBV. One dead LBV was observed near a nest.

Table 1. Reproductive values for Long-billed and Oriental White-backed Vultures in Kanha, Bandhavgarh and Ranthambhore National Parks, India during the 2002-2003 surveys

Colonies	Long-billed Vulture		Oriental White-backed Vulture	
	Occupied nests December 2002	Large nestlings Present March 2003	Occupied nests December 2002	Large nestlings Present March 2003
Kanha	-	-	15	6 (40.0%)
Bandhavgarh	47	27 (57.4%)	10	5 (50.0%)
Ranthambhore	35	27 (77.1%)	8	1 (12.5%)
Total	82	54 (65.9%)	33	12 (36.4%)

In the buffer area near Tala, a village adjacent to the boundary of Bandhavgarh, we recorded 10 occupied nests of OWV in December of which five produced large nestlings by March 2003 (Table 1). Five additional active nests were found in March 2003, bringing the tally of OWV nests at Tala to 15. Based on this, we estimated the population of OWV at Tala to be between 30

and 50 birds. A tree containing one incubating adult on a nest, seen during December 2002, was felled, and the nest failed as a result.

Twenty-seven of the 35 occupied nests of LBV located in December 2002, at Ranthambhore, had large nestlings in March 2003 (Table 1). We were unable to estimate the population of LBV due to the terrain and inaccessibility of vulture sites. We found one dead LBV on a nest. One of eight nests of OWV we discovered was successful. We observed a flock of 30 adult OWV soar over the park in December and counted at least 15 perched on various trees in the park in March 2003. We found fresh feathers and scavenged body parts of three OWV in December.

Overall breeding success of OWV and LBV at all three parks was 36.4% and 65.9% respectively (Table 1). There was a statistically significant difference, between the two species ($X^2 = 8.36$ $p = 0.004$), in the proportion of occupied nests where large young were produced.

DISCUSSION

This study is the first attempt to collect and document reproductive information on *Gyps* vultures in Kanha, Bandhavgarh and Ranthambhore. Though the data are few, some comparisons must be made. In both species there was a wide range of levels of success. LBV produced more large nestlings per occupied site than OWV and there was no overlap in the proportion of nestlings fledged from occupied sites between species, when all of the nesting areas are considered individually.

At Bandhavgarh and Ranthambhore we found approximately five times as many nests of LBV as OWV, probably because both areas had many cliff faces suitable for LBV nesting and roosting. The lack of cliffs at Kanha most likely explains why LBV were not present there. Breeding success of OWV at Kanha and Bandhavgarh was comparable to OWV breeding populations in Pakistan's Punjab Province (Gilbert *et al.* 2002). It was, however, unusually low for the species at Ranthambhore. This may be due to local amplification of the mortality factor extirpating populations of this species in the Indian subcontinent, although other ecological or behavioural factors cannot be ignored (e.g. predation pressure of nestlings may vary between the species, the species may be foraging in separate areas, making them differentially vulnerable to mortality factors) nor the relatively small sample size for that site. Breeding numbers of OWV at Ranthambhore have declined since the 1999/2000 season, when MZV estimated a population size of *ca.* 100 birds and recorded 25 active nests during an exploratory visit in April 2000. During that period, MZV also observed eight dead and one moribund OWV in the park.

The fledging success at these sites (Table 1) is within or above the range of values observed in *Gyps* vultures elsewhere (e.g. Benson 2000; Borello & Borello 2002). Low breeding success observed in populations of OWV in the Punjab Province, Pakistan, was a result of high adult mortality (Gilbert *et al.* 2002). Breeding success of LBV was almost double that of OWV. Higher breeding success in LBV suggests that adult mortality in this species may not be as high as that observed in OWV populations. LBV populations occurring in Ranthambhore and Bandhavgarh, which presumably feed on wild ungulates

within the parks, may not be exposed to factors affecting OWV foraging in agricultural areas where domestic livestock is the main food. Livestock carcasses containing high residues of the anti-inflammatory drug, diclofenac, is causing unusually high mortalities of OWV in Pakistan (Oaks *et al.* 2004). Generally, OWV in the Punjab Province of Pakistan forage at relatively short distances (< 25km) from their breeding colonies (MB, unpublished data). If vultures nesting or roosting within protected national parks in India forage at similar distances, then some birds may be protected from exposure to agricultural chemicals or drug-contaminated carcasses in the surrounding farming areas. The LBV carcass we discovered at Ranthambhore was on a cliff on the park boundary, the interface with agricultural areas. The OWV nests, in that park, where nesting activities have ceased, are also close to the park boundary. These birds may be more exposed to agricultural chemicals and drug-contaminated carcasses than LBV, nesting in more central areas of the park. There is general consensus among resident naturalists at Ranthambhore and Bandhavgarh that populations of LBV are not affected to the same degree as those of OWV. If this is true, then both species of vultures may be partitioning food supplies, with LBV mainly feeding on wild ungulates within the park and OWV feeding on domestic livestock in the surrounding agricultural areas. This and other factors (e.g. size of conservation areas where birds nest and forage, each species adapted to feeding on specific internal organs of carcasses that contain varying degrees of contamination, socio-economic standards of the farming communities surrounding the conservation areas, i.e. purchasing power to afford veterinary drugs, human densities in agricultural areas surrounding conservation areas, vulture emigration/immigration) will be considered as this study progresses. We are continuing to monitor nests in Kanha, Bandhavgarh and Ranthambhore and areas adjacent to these reserves.

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REFERENCES

- ALI, S & S.D. RIPLEY 1968. *Handbook of the birds of India and Pakistan*. Vol. 1. Oxford University Press, London.
- BIRDLIFE INTERNATIONAL 2000. *Threatened Birds of the World*. Lynx Edicions, Barcelona.
- BENSON, P. C. 2000. Causes of Cape Vulture *Gyps coprotheres* mortality at the Kransberg colony: a 17 year update: 77-86. In *Raptors at Risk*. Chancellor, R. D. & Meyburg, B. -U. (Eds.). WWGBP/Hancock House.
- BORELLO, W.D. & R.M. BORELLO 2002. The breeding status and colony dynamics of Cape Vulture *Gyps coprotheres* in Botswana. *Bird Conservation International* 12: 79-97.
- CUNNINGHAM, A.A., V. PRAKASH, D. PAIN, G.R. GHALSASI, A.H. WELLS. G.N. KOLTE, P. NIGHOT, M.S. GOUDAR. S. KSHIRSAGAR & A. RAHMANI 2003. Indian vultures: victims of an infectious disease epidemic? *Animal Conservation* 6: 189-197.

- GHIMIRE, S.N. 2000.** A checklist of birds and mammals recorded during a Naturetrek tour to lowland Nepal, February 2000. Unpublished report. B Bird Conservation Nepal, Katmandu, Nepal.
- GILBERT, M., M.Z. VIRANI, R.T. WATSON, J.L. OAKS, P. BENSON, A.A. KHAN, S. AHMED, J. CHAUDHRY, M. ARSHAD, S. MAHMOOD & Q.A. SHAH 2002.** Breeding and mortality of Oriental White-backed *Gyps bengalensis* in Punjab province, Pakistan. *Bird Conservation International* 12: 311-326.
- GRUBH, R.B. 1974.** The ecology and behaviour of vultures in the Gir Forest. Ph.D. diss., University of Bombay, Bombay.
- GRUBH, R.B. 1978.** Competition and co-existence in griffon vultures: *Gyps bengalensis*, *G. indicus* and *G. fulvus* in Gir Forest. *Journal of the Bombay Natural History Society* 75: 810-814.
- GRUBH, R. B. 1983.** The status of vultures in the Indian subcontinent: 107-112. In *Vulture biology and management*. Wilber, S. R. & Jackson, J. A. (Eds.). Berkeley: University of California Press.
- MOULTON, C. & E.J. HALSEY 2002.** *Kanha Tiger Reserve: portrait of an Indian National Park*. Mumbai: Vakils, Feffer & Simons PVT. LTD.
- OAKS, J.L., M. GILBERT, M.Z. VIRANI, R.T. WATSON, C.U. METEYER, B.A. RIDEOUT, H.L. SHIVAPRASAD, S. AHMED, M.J.I. CHAUDHRY, M. ARSHAD, S. MAHMOOD, A. ALI & A.A. KHAN 2004.** Diclofenac residues as the cause as vulture population decline in Pakistan. *Nature* 427: 630-632.
- POSTUPALSKY, S. 1974.** Raptor reproductive success: some problems with methods, criteria and terminology. Reprinted from *Management of Raptors. Proceedings of the Conference on Raptor Conservation Techniques*, Fort Collins, Colorado, 22-24 March, 1973 (Part 4). F.N. Hamerstrom, Jr., B.E. Harrell, and R.R. Olendorff, (Eds.), Raptor Research Report No. 2, pp 21-31.
- PRAKASH, V. 1999.** Status of vultures in Keoladeo National Park, Bharatpur, Rajasthan with special reference to population crash in *Gyps* species. *Journal of the Bombay Natural History Society* 96: 365-378.
- PRAKASH, V., D.J.PAIN, A.A. CUNNINGHAM, P.F. DONALD, N. PRAKASH, A. VERMA, R. GARGI, S. SIVAKUMAR & A.R. RAHMANI 2003.** Catastrophic collapse of Indian White-backed *Gyps bengalensis* and Long-billed *Gyps indicus* vulture populations. *Biological Conservation* 109: 381-390.
- SCHALLER, G. 1967.** *The deer and the tiger: a study of wildlife in India*. Chicago University Press, Chicago.
- VIRANI, M., M. GILBERT, R. WATSON, J. L. OAKS, P. BENSON, A.A. KHAN, J.B. GIRI & H.S. BARAL 2001.** Asian Vulture Crisis Project: Field results from Pakistan and Nepal for the 2000-2001 field season. In reports from the workshop on Indian *Gyps* Vultures: 133. Katzner, T. and Parry-Jones, J. (Eds.) 4th Eurasian Congress on Raptors, p 133, Sevilla Spain. September 2001. Document can be downloaded from: <http://www.nbpce.co.uk/ivr2001.htm>

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