

The Status and Decline of Vultures in the provinces of Punjab and Sind, Pakistan; a 2003 update

Martin Gilbert, J. Lindsay Oaks, Munir Z. Virani, Richard T.
Watson, Shakeel Ahmed, Muhammad Jamshed Iqbal
Chaudhry, Muhammad Arshad, Shahid Mahmood, Ahmad Ali,
Rehman Mahmood Khattak and Aleem Ahmed Khan

INTRODUCTION

Concerns that populations of south Asian *Gyps* vulture species were in decline were first raised by Prakash (1999) following his studies in Keoladeo National Park, Rajasthan, India. Similar declines and local extinctions were soon reported across a wider area of India (Prakash & Rahmani 1999; Prakash 2003), with declines also recorded in Nepal and Pakistan (Virani *et al* 2001; Gilbert *et al.* 2002). At present populations of three species have been affected, Oriental White-backed Vulture (OWBV) *Gyps bengalensis*, Long-billed Vulture (LBV) *G. indicus* and the Slender-billed Vulture *G. tenuirostris*, prompting the IUCN to list all three as "Critically Endangered" (Birdlife International 2000, 2001). A comprehensive review of the long-term status and decline of resident *Gyps* species in south-east Asia and the Indian Subcontinent is given in Pain *et al.* (2003). The recent rapid declines in population were due to unsustainably high rates of mortality (Prakash 1999; Gilbert *et al.* 2002; Pain *et al.* 2003)

Visceral gout has been a consistent feature in dead vultures examined in India, Nepal and Pakistan (Cunningham *et al.* 2001; Virani *et al.* 2001; Oaks 2001; Gilbert *et al.* 2002). The condition occurs as a consequence of severe renal dysfunction, where a reduction in renal filtration leads to an increase of blood uric acid levels (Lumeij 1994). Uric acid precipitates form a white chalky or paste-like coating over the surface of visceral organs (particularly the liver and heart), with deposits through many tissues. Visceral gout is not considered specific to any particular disease, but can occur subsequent to many

infectious and non-infectious processes that lead to renal dysfunction. Recent evidence has convincingly demonstrated that visceral gout in vultures in Pakistan is caused by diclofenac, a non steroidal anti-inflammatory drug (NSAID) commonly used in livestock across the subcontinent (Oaks *et al.* 2004). Vultures were found to be highly sensitive to the nephrotoxic effects of this drug, and died within 36-58 hours of ingesting toxic doses.

Attempts to quantify the Asian vulture decline have been complicated by the lack of pre-decline data on population size in these formerly abundant species (notable exceptions include Galushin 1971, and Prakash 1999). The Peregrine Fund's Asian Vulture Crisis Project established three primary study sites at OWBV colonies in Pakistan's Punjab province in 2000. Site descriptions, breeding biology and mortality over the 2000/01 breeding season were presented for two of these sites in Gilbert *et al.* (2002). This paper aims to provide a more complete account of the breeding numbers at all known colonies in the Punjab and Sind provinces of Pakistan. This information is intended as a benchmark against which the success of future restoration programmes for these species can be measured. Additional information will be presented on vulture mortality and the incidence of visceral gout of birds examined at each of these colonies.

METHODS

Surveys were conducted between December 2000 and May 2003 in the Punjab province of Pakistan. In February and March 2003, the districts of Sukkur, Khairpur, Sanghar, Umer Kot and Thar Parkar were surveyed in Sind province. The number and activity of all vulture nests encountered was recorded. All dead vultures located were collected, aged and carefully disposed of to prevent double counting. In cases where decomposition of dead vultures was not significantly advanced, carcasses were opened to assess the presence or absence of visceral gout.

Three 'primary' colonies were monitored on a continuous basis through the study period. Due to the large numbers of birds breeding at primary colonies during the 2000/01 season it was not possible to survey all nests with equal intensity. For this reason these colonies were further subdivided into intensive transects, non-intensive transects and peripheral sites to clearly differentiate study effort within the sites. All other colonies were termed 'secondary' colonies and were surveyed less frequently (one to four times per year). Secondary colonies were located opportunistically or in response to reports by local people.

Research was concentrated at the primary study colonies of Dholewala (N30° 37.43' E70°54.39'), Toawala (30° 30.42' E71° 41.21') and Changa Manga (N31° 4.87' E74° 0.15') in Layyah/Muzaffaragargh, Khanewal/Muzaffaragargh and Kasur districts of Punjab province respectively. Dholewala and Toawala colonies consisted of linear plantations of sheesham *Dalbergia sisoo* and *Acacia* trees lining raised canal banks. Changa Manga is an extensive (5002ha) mixed forest plantation south-west of the city of Lahore. Intensive transects containing approximately 200 active nests were marked at each of these three sites during the first month of the study period. A detailed treatment of nest

surveys and intensive study transects are given in Gilbert *et al.* (2002). Nests in intensive transects were monitored on at least a weekly basis throughout the study period.

In Dholewala and Toawala we also established 'non-intensive' transects along which all nests were monitored on a monthly basis (except in Dholewala during the 2000/2001 breeding season, when non-intensive transects were only surveyed once). Remaining nests in the immediate vicinity (~20km) of primary colonies were termed 'peripheral sites' and were surveyed on a monthly basis after November 2001. In Changa Manga, areas of forest not included within the intensive study transect were termed 'non-transect forest' and were surveyed twice in February 2001 and April 2003.

RESULTS

Breeding activity was observed for three species during the course of this study (OWBV, LBV and Egyptian Vulture), and mortality was recorded in three species (OWBV, LBV and Eurasian Griffon).

Oriental White-backed Vulture *Gyps bengalensis*

We monitored breeding OWBVs at three primary and 14 secondary study colonies in Punjab province (Figure 1 and Figure 2), and 12 sites in Sind province (Tables 1, 2 and 3). Empty nests probably built by this species were recorded at two additional sites in Punjab (Head Trimu, and Head Panjinad) visited during May 2001 (the post-fledging period). In Sind province empty nests showing signs of recent use were observed at Nimla Village (2) in Thar Parkar district, Ghosloo (2) and Siar (2) in Umer Khot district, Mankoor (2), Bhurrao (3) and Jafrao (2) in Sanghar district visited during March 2003. Older empty nests were recorded at Khinsir (2) in Thar Parkar, and Shikarboo (3) in Umer Kot district. All nests were observed in trees, primarily sheesham *Dalbergia sisoo* in the Punjab, and kandi *Prosopis cinerea* in Sind province.

A decline in the number of active nests was recorded at each of the primary study colonies from the 2000/01 to the 2002/03 breeding seasons (Table 1). Total declines in the number of active nests between the 2000/01 and 2002/03 breeding seasons were 87.4, 33.9 and 95.5% along the intensive transects at Dholewala, Toawala and Changa Manga respectively. Numbers of active nests along the non-intensive transects also declined by 60.0 and 32.1% at Dholewala and Toawala respectively and by 96.8% within non-transect forest at Changa Manga. The total decline in active nests along the non-intensive transects at Dholewala is considered an underestimate as these transects were only surveyed on one occasion during December 2000 (corresponding to late incubation). This figure does not take account of active nests obscured by foliage that would have been detected during visits later in the season, nor does it consider active nests that would have failed earlier during incubation. Annual declines accelerated between seasons at each primary study site during the three years of study (from 38.6 to 79.5% at the Dholewala intensive transects, 10.9 to 25.9% at Toawala, and 75.3 to 81.6% at Changa Manga).

Evidence of population declines is not available for 11 of the secondary colonies as they were only visited on a single occasion during the breeding

season. The timing of visits can greatly affect the number of active nests encountered, thus a single count of 26 active nests at Dinga Nalla on 6 April 2001 would greatly underestimate the true number at eggs laid in October and November. A further seven nests were recorded containing either a dead nestling or adult confirming their activity at an earlier stage in the season. Although it was not possible to confirm a reduction in breeding pairs, the number of successful nests recorded in April (containing a late-stage nestling) in Dinga Nalla declined from 26 in 2001, to 15 in 2002 and 5 in 2003. Similarly, declines in active nest counts were recorded in Katora Forest from 102 in December 2001 to 5 in May 2002, and Lawrence Gardens, Lahore from 12 in October – December 2000 to 1 in May 2002. While suggestive of a decline, this should be viewed with caution, as May corresponds to the fledging period and a proportion of successful nests may have been vacant due to the fledging of the occupant.

Dead OWBV were recovered at 12 of the Punjab colonies surveyed (Table 5). We collected 1303 dead adult, subadult and juvenile OWBV from November 2000 – May 2003. The majority of dead vultures were collected from the primary study colonies where effort was greatest, with 473, 236 and 132 dead adults and subadults collected at Dholewala, Toawala and Changa Manga respectively. Effort at Changa Manga concentrated on the intensive transects, with only infrequent surveys of the wider forest, whereas intensive transects, non-intensive transects and peripheral areas were surveyed more frequently at Toawala and Dholewala. Dead juveniles were collected at 8 sites, with the majority recorded in the weeks immediately post fledging in late April and May.

The only dead OWBV recorded in the breeding sites in Sind was a single dead nestling at Jeothar, Umer Kot district. The low number of dead OWBV located in Sind may relate to the smaller size of these colonies, and not to any true disparity in mortality rate. Five dead OWBV were reported from four sites in Thar Parkar district during August 2002 (Suleman Khan, Game Watcher, Sind Wildlife Dept., Nagar Parkar *pers comm.*). Bones and feathers from an adult OWBV were collected near Mayo village, Thar Parkar on 10 March 2003.

Visceral gout was recorded at 6 of 7 sites where fresh carcasses were available for post mortems. It was more frequently recorded in adults and subadults 84.6% (n=259) than juveniles 24.4% (n=123), and nestlings 22.2% (n=27). The difference in observed frequency of visceral gout in adults and subadults, juveniles and nestlings is highly significant ($\chi^2 = 151.727$, $df = 2$, $P < 0.001$). The prevalence of visceral gout in adult and subadults examined in Toawala (77.4% n=93) was marginally lower than Dholewala (89.6% n=134) and Changa Manga (87.5% n=16), but this difference was not significant ($\chi^2 = 0.408$, $df = 2$, $P = 0.816$).

Long-billed Vulture *Gyps indicus*

Surveys of suitable habitat within Thar Parkar district, Sind province from 9 to 15 March 2003 located 183 active nests where either a nestling or an egg was observed. In addition single adults were observed perched within 89 nest cavities, and adult pairs within 18 (Table 4). An unknown proportion of these nest sites may have contained small chicks that could not be observed from the

ground. No activity was recorded at a further 385 cavities and ledges large enough to accommodate vulture nests. Feather remains from a single *G. indicus* of unknown age were recorded in the Kharunjhar Hills on 14 March 2003; cause of death could not be determined.

Eurasian Griffon *Gyps fulvus*

A single dead adult Eurasian Griffon was collected from Toawala colony on 17 May 2001. Unfortunately, this bird had been dead for some weeks, and so the cause of death could not be determined. A second carcass of this species was recovered beneath the cliffs at Tenaza Dam, Attok district, Punjab on 20 May 2001, but it was not possible to determine the cause of death due to the activity of scavengers. A pelvis thought to be of this species was also recovered at this site on 20 May 2001, representing a further individual.

Egyptian Vulture *Neophron percnopterus*

Active nests were recorded at five locations in Thar Parkar district, Sind province from 13 to 17 March 2003. One of these nests contained two eggs, and single nestlings were recorded in the remaining four. A further 16 nests were observed with a single adult in attendance, but activity could not be confirmed. Three additional nests attributed to this species were located in Thar Parkar district, but no activity was observed. Of the 24 nests recorded, 20 were built on kandi trees *Prosopis cineria*, with the remainder on cliff faces. Four active and two empty nests were located at Jasay Kapar in Sanghar District on 13 March 2003. No dead Egyptian Vultures were recorded during the study.

Egyptian Vultures were noticeably absent from all intensively studied sites in the southern Punjab. Punjab records were limited to 116 (93 adults and 23 subadults) recorded in Dina, Mirpur district on 11 February 2001, and a single adult observed in flight over the Lahore – Multan trunk road between Khanewal and Mian Channun on 10 June 2001.

DISCUSSION

We observed high mortality and rapid declines in OWBV numbers in widely distributed colonies over three consecutive breeding seasons. Annual rates of decline accelerated at all three primary study sites between 2000 and 2003. Declines at the Toawala colony have been consistently lower than at Dholewala and Changa Manga. This could either be due to immigration of birds into Toawala over the study period offsetting mortality losses, or could indicate that mortality at this site has been comparatively lower than the other sites. Mortality rates recorded at Toawala have also been consistently lower than at Dholewala and Changa Manga (Gilbert *et al. in prep*), supporting the latter of these hypotheses and suggesting that exposure to the mortality agent may vary geographically. This possibility warrants further study, especially a need for quantitative data describing mortality and population dynamics at colonies over even wider areas of the subcontinent that may reveal other areas of low or even no mortality among *Gyps* vultures.

Figure 1. Primary ■ and secondary ⊕ OWBV study colonies in Punjab province, and LBV study colonies ● in Thar Parkar district, Sind province, Pakistan. Sind province shaded dark grey, Punjab province shaded light grey. Districts of Thar Parkar, Sanghar and Sukkur in light hatch, and Umer Kot in dark hatch.

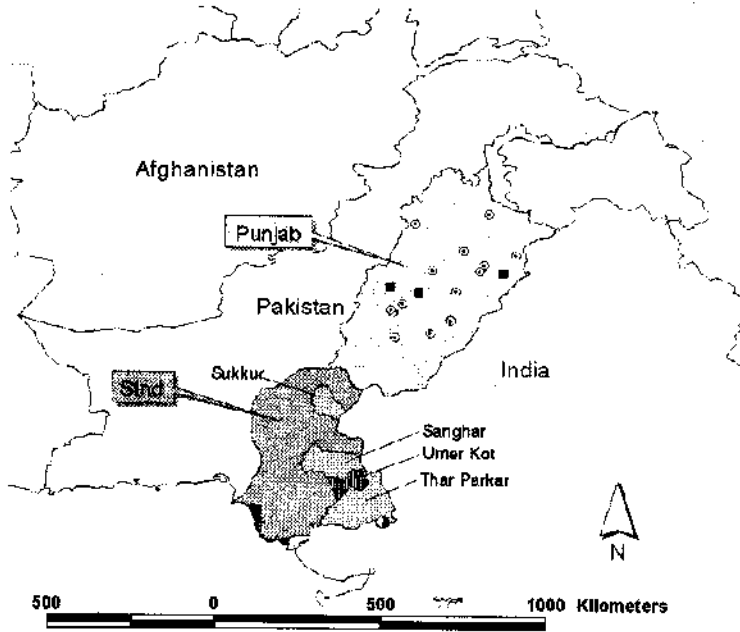


Figure 2. Primary ■ and secondary ⊕ OWBV study colonies in Punjab province, Pakistan.



Table 1. Active nest numbers and percent declines of *Gyps bengalensis* at primary study colonies, Punjab province Pakistan.

	Active nests in 2000/01	Active nests in 2001/02	Active nests in 2002/03	Annual Decline (%) 2000/01-	Annual Decline (%) 2001/02-	Total Decline (%) 2000/01-
Dholewala intensive transects ¹	†246	151	31	38.6	79.5	87.4
Dholewala non-intensive transects ²	*176	186	70	(-6.3)	62.4	(60.0)
Dholewala peripheral sites ³	NA	252	73	NA	71.0	NA
Toawala intensive transects ¹	†230	205	152	10.9	25.9	33.9
Toawala non-intensive transects ²	†215	187	146	13.0	21.9	32.1
Toawala peripheral sites ³	NA	183	100	NA	45.4	NA
Changa Manga intensive transects ¹	†198	49	9	75.3	81.6	95.5
Changa Manga non-transect forest ⁴	581	NA	21	NA	NA	96.8

¹ "intensive" transects were surveyed at least once weekly during the breeding season (October-May)

² "non-intensive" transects were surveyed once monthly during the breeding season (October-May)

³ "peripheral" sites cover nests along surrounding roads and villages, surveyed once monthly from November 2001 to present.

⁴ "Changa Manga non-transect forest" refers to surveys conducted during February 2001 and April 2003 of the whole forest excluding intensive transects.

† Estimated active nests at laying, extrapolated from active nest count during mid to late incubation using daily nest failure rate for remaining period of breeding season.

* Active nest number recorded during a single visit in December 2000, representing an underestimate of true value. NA = Not Available.

Comparative data recording declines in other *Gyps* colonies in the Indian subcontinent are limited to Keoladeo National Park, Rajasthan, in the north-west region (Prakash 1999). Nesting pairs at Keoladeo National Park decreased from 353 in 1987/88 to 20 in 1998-99. No active nests were recorded in either the 1999/2000 or the 2000/01 season (Prakash 2003). The largest inter-season decline of 83.3% recorded in Keoladeo between the 1996/97 and 1997/98 is comparable with those recorded in Changa Manga (81.6%) and Dholewala (79.5%) between the 2001/02 and 2002/03 seasons. It is particularly worrying to note that the OWBV is now extinct as a breeding species within Keoladeo, and considering the comparable rate of declines at Dholewala and Changa Manga we might expect these colonies to disappear completely in the next one to three years.

Visceral gout was recorded at six of seven sites where birds were available for examination, and was recorded over three years. No seasonal peaks in the incidence of visceral gout were observed. Visceral gout was recorded in 6 of 8 dead birds (comprising 7 LBV and one OWBV) found in the field in Rajasthan and Maharashtra provinces, India (Cunningham *et al.* 2003), and two adult OWBV at Koshi Tappu Wildlife Reserve, Nepal (Virani 2001). The wide geospatial and temporal distribution of visceral gout cases in this study, along with reports of the condition in India and Nepal, suggests that a single primary agent is responsible for the decline in vultures across their subcontinent range.

Table 2. OWBV *Gyps bengalensis* active nest numbers at secondary study colonies in Punjab province, Pakistan

	Location	Date	Active nests	Successful nests	Failed nests
Dinga Nalla 2000/01	N30°0.03' E70°57.74'	Apr 2001	33	26	7+
Dinga Nalla 2001/02	N30°0.03' E70°57.74'	Nov 2001- Apr2002	38	15	19
Dinga Nalla 2002/03	N30°0.03' E70°57.74'	Jan-Apr 2003	23	5	3
Burala Branch Canal	N31°16.92' E73°26.88'	Mar 2001	50	NA	NA
Bhangar Nalla	N30°4.34' E70°55.71'	Jan 2001	3	NA	NA
Cheniot	N31°40.78' E72°54.84'	Feb 2001	15	NA	NA
Chichawatni	N30°32.9' E72°41.01'	Feb 2001	106	NA	NA
Head Islam	N29°48.04' E72°32.66'	Feb 2001	114	NA	NA
Head Panjinad	N29°18.95' E71°2.1'	May 2001	0 (38 Empty)	NA	NA
Head Trimu	N31°7.15' E72°2.73'	May 2001	0 (189 Empty)	NA	NA
Katora Forest 2000/01	N29°46.33' E72°32.65'	Dec 2001	102	NA	NA
Katora Forest 2000/01	N29°46.33' E72°32.65'	Feb 2001	92	NA	NA
Katora Forest 2001/02	N29°46.33' E72°32.65'	May 2002	5	NA	NA
Kupi Plantation	N31°6.92' E73°19.93'	Mar 2001	33	NA	NA
Lal Sahanra	N29°26.16' E71°59.33'	Dec 2001	10	NA	NA
Muzafagargh area (north)	N30°13.23' E71°13.63'	May 2001	16	NA	NA
Muzafagargh area (south)	N29°59.45' E71°10.66'	Feb 2001	18	NA	NA
Rasool Barrage	N32°41.82' E73°34.17'	Feb 2001	45	NA	NA
Lawrence Gdn, Lahore 2000/01	N31°34.02' E74°19.02'	Oct-Dec 2000	12	NA	NA
Lawrence Gdn, Lahore 2001/02	N31°34.02' E74°19.02'	May 2002	1	NA	NA
Kundian Forest	N32°20.98' E71°37.15'	Jan 2003	35	NA	NA

NA = NOT AVAILABLE

Oaks *et al.* (2004) showed a 100% correlation between visceral gout and residues of the pharmaceutical diclofenac in vulture tissues, with vultures dying of other causes testing negative. Of the 259 adult vultures examined in this

study, visceral gout was found in a majority (84.6%), indicating that diclofenac toxicity is the primary cause of death in this age class. Detailed examination of 14 vultures without visceral gout confirmed a cause of death for 8, including trauma, intestinal foreign bodies, lead poisoning, organophosphate poisoning, and gunshot (Oaks *et al.* 2004).

Table 3. OWBV *Gyps bengalensis* active nest numbers at secondary study colonies in Sind province, Pakistan

	District	Date	Active nests
Khinsar Village	Thar Parkar	Mar 2003	1 (+2 old)
Dhoorgadro Village	Thar Parkar	Mar 2003	2
Nimla Village	Thar Parkar	Mar 2003	0 (2 empty)
Pubban Village	Thar Parkar	Mar 2003	2
Karkatoba Village	Thar Parkar	Mar 2003	3
Jummo Summo Toba	Thar Parkar	Mar 2003	3
Sukhwar	Thar Parkar	Mar 2003	1
Shikarboo	Umer Kot	Mar 2003	8 (+3 old)
Jeothar	Umer Kot	Mar 2003	1 (+1 failed)
Ghosloo	Umer Kot	Mar 2003	1 (+2 empty)
Siar	Umer Kot	Mar 2003	0 (2 empty)
Ranakhdar Toba	Sanghar	Mar 2003	4
Mankoor	Sanghar	Mar 2003	0 (2 empty)
Bhurrao	Sanghar	Mar 2003	0 (3 empty)
Jafrao Toba	Sanghar	Mar 2003	2 (+2 empty)
Sukkur Barrage	Sukkur	Mar 2003	15

NB: Due to the security situation in these border areas it was not possible to record latitude-longitude positions for these sites.

During the study period 370 dead juveniles were recovered across eight sites; however, visceral gout was recorded far less frequently in this age class (24.4% n=123). Survival rates in juvenile *Gyps* vultures are typically lower than those of adult birds (Sarrazin 1994). Studies of Cape Vultures *G. coprotheres* in Africa have recorded high first year mortality rates of 50 to 83% (Houston 1974; Piper *et al.* 1981). Therefore we might expect the incidence of visceral gout to be lower in this age group due to a higher 'background' mortality rate. It is also possible that ethological or ecological factors may play a role in reducing the exposure of juvenile OWBV to diclofenac. Diclofenac does not distribute itself evenly through the tissues of treated animals, with concentrations in kidney tissue significantly higher than in muscle (Oaks *et al.* 2004). Studies of the closely related African White-backed Vulture *Gyps africanus* have shown that birds prefer to feed inside the carcass and that adults

tend to feed earlier, and juveniles either feed later or remain longer at carcasses (Mundy 1982). Therefore it is conceivable that behavioural interactions at carcasses may prevent younger vultures from feeding on tissues where diclofenac concentrations are highest.

Table 4. Long-billed Vulture *Gyps indicus* confirmed active nest numbers at secondary study colonies in Thar Parkar district, Sind province, Pakistan

	Location	Date	Confirmed active nests	Only adults observed
Sardhara Nulla	N24°20.86' E70°44.47'	9 th March 2003	1	3
Bodesar Hills	N24°25.85' E70°44.19'	11 th March 2003	?	13
Atlisar chashma	N24°22.52' E70°43.91'	11 th March 2003	?	3
Nagar Hills front	N24°22.13' E70°43.9'	11 th March 2003	?	8
South Karunjhar hills	N24°20.42' E70°45.81'	12 th March 2003	14	20
Near Valarya spring	N24°20.27' E70°46.11'	12 th March 2003	4	1
Near Bhalara hills	N24°19.63' E70°46.5'	12 th March 2003	24	10
Vidya Hills	N24°19.5' E70°46.03'	12 th March 2003	13	0
Gamaywala Hills	N24°19.48' E70°45.93'	12 th March 2003	2	1
Adimondani Hills	N24°20.47' E70°45.51'	13 th March 2003	1	0
Tarvat Ka Jhalla	N24°20.22' E70°45.78'	13 th March 2003	2	4
Piprywala Spring Hills	N24°19.98' E70°45.99'	13 th March 2003	2	3
Andharia Hills	N24°19.87' E70°46.20'	13 th March 2003	37	19
Pakhera Hills	N24°19.86' E70°46.38'	13 th March 2003	1	0
Maya Dam Hills	N24°20.69' E70°45.06'	14 th March 2003	7	5
Pipliwala Hills	N24°20.89' E70°44.93'	14 th March 2003	4	0
Karkawala Hills	N24°19.98' E70°45.99'	13 th March 2003	?	11
Chorwala Pasa Hills	N24°20.87' E70°44.78'	14 th March 2003	2	0
Satlakiwala Hills	N24°20.31' E70°44.16'	14 th March 2003	3	1
Gardara Hills	N24°19.98' E70°44.11'	14 th March 2003	7	7
Kharajara Hills	N24°19.73' E70°44.42'	14 th March 2003	25	4
Sengra dam Hills	N24°19.75' E70°44.98'	14 th March 2003	5	0
Pantia Hills	N24°20.63' E70°43.80'	15 th March 2003	10	4
Rathawala Hills	N24°21.38' E70°43.96'	15 th March 2003	6	0
Mangri Hills	N24°21.31' E70°44.21'	15 th March 2003	2	1

Table 5. Incidence of visceral gout and mortality among adult/subadult and juvenile OWBV *Gyps bengalensis* at breeding colonies within Punjab province Pakistan from Dec 2000 – May 2003. A = Adult, SA = Subadult (one year post fledging to adult), Juv = Juvenile (fledging to one year), Nstd = Nestling. NA = Not Available. n = number of necropsy examinations performed on birds where body condition was sufficient to identify presence/absence of visceral gout Dholewala Area, Toawala Area and Changa Manga Area refer to the combined totals for all birds within intensive transects, non-intensive transects and peripheral sites.

	No. of dead adult and subadults	No. of dead juveniles	No. of A/SA with visceral gout (n)	Incidence of A/SA with visceral gout (%)	No. of Juv		Incidence of Juv		No. of Nstd		Incidence of Nstd	
					with visceral gout (n)	visceral gout (%)	with visceral gout (n)	visceral gout (%)	with visceral gout (n)	visceral gout (%)	with visceral gout (n)	visceral gout (%)
Dholewala Area	473	127	120 (134)	89.6	16 (34)	47.1	6 (17)	35.3				
Toawala Area	236	133	72 (93)	77.4	12 (77)	15.6	0 (10)	0.0				
Changa Manga Area	132	74	14 (16)	87.5	2 (11)	18.2	NA	NA				
Dinga Nalla	27	8	7 (7)	100.0	NA	NA	NA	NA				
Katora Forest	20	1	5 (5)	100.0	NA	NA	NA	NA				
Kundian Forest	19	0	NA	NA	NA	NA	NA	NA				
Kupi Plantation	1	0	NA	NA	NA	NA	NA	NA				
Chitchawatni	4	0	NA	NA	NA	NA	NA	NA				
Lal Saharra	0	6	NA	NA	NA	NA	NA	NA				
Head Trimu	3	12	0 (1)	0.0	0 (1)	0.0	NA	NA				
Head Islam	10	9	NA	NA	NA	NA	NA	NA				
Burala Branch Canal	8	0	1 (1)	100.0	NA	NA	NA	NA				
TOTAL	933	370	219	85.2	30	24.4	6	22.2				

The discovery of a large population of LBVs in the Thar Parkar district of Sind province, represents the largest breeding population ever recorded in Pakistan and will be important for the conservation of the species across its entire range. Breeding records for this species in Pakistan are sparse. Roberts (1991) describes this species as a "rare resident" with 3, 6 and 16 nests recorded at three colonies in Thar Parkar. However, he also cites a report that LBVs were "quite numerous" around the Kharunjhar Hills in Thar Parkar (December 1980). It is therefore unclear whether the large population located during this study represents a true increase in numbers or is a result of improved coverage.

The LBV breeding colony in Thar Parkar district was only surveyed once during this study, so it is not possible to make an assessment of population trends. However, it is noteworthy that only 43% of the available potential nest sites recorded showed signs of occupancy, so it remains possible that this colony may be in decline. The single dead LBV recorded during the survey is also difficult to interpret. The remains of dead vultures can be quickly scattered by other scavenger species, so it is also difficult to assess mortality pressure during a single visit. Further surveys of the Thar Parkar population will be carried out in future breeding seasons to determine breeding success and population status of this important colony.

Roberts (1991) describes the Egyptian Vulture as "locally common" and "extremely widespread and adaptable". This contrasts markedly with the infrequency of records of this species during the period of this study. He states that in "...the Indus Plains the species is rarely encountered away from large towns, but varying numbers congregate around slaughterhouses and rubbish dumps...". Despite surveying many such sites during the course of this study, records of Egyptian Vultures were limited to just two sightings in Punjab province. In adjacent areas of north-west India this species continues to be commonly encountered in large numbers (pers. obs.). No evidence for declines were noted in Keoladeo National Park, nor during counts made in 1991-93 and 1999-2000 across 12 Indian national parks (Prakash 1999, 2003). While the Egyptian Vulture appears to have declined in the Pakistan Punjab, this does not appear to have been mirrored across the subcontinent, so is likely to be unrelated to the devastating declines that have affected *Gyps* species.

PRIORITIES FOR FURTHER STUDY

1. The lower rates of decline recorded at Toawala and the suggestion that mortality rate may vary geographically highlights the need for studies of population dynamics at *Gyps* colonies over a wider area of the subcontinent. In the face of the complete extinction of vultures in many sites, it will be increasingly important to identify areas where mortality is less severe.
2. The current lack of understanding about the foraging range and behaviour of vultures in the Indian subcontinent needs to be addressed. Studies should focus on the foraging range of *Gyps* vultures using tagging or telemetry methods to determine if colonies in large protected areas or areas where diclofenac is not used may be safe from contamination. Studies on feeding

behaviour at the carcass may reveal behavioural reasons for apparent signs of differential susceptibility to diclofenac among vulture species.

3. In view of the dramatic population declines of LBV that have been reported in India, the large populations recorded in the Thar Parkar region of Sind province, Pakistan, are of great significance. Studies assessing the population dynamics and mortality of these populations are a priority

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Martin Gilbert, Munir Z. Virani &
Richard T. Watson
The Peregrine Fund
5668 West Flying Hawk Lane
Boise, ID 83709
USA

J. Lindsay Oaks
Department of Veterinary Microbiology
and Pathology
Washington State University
Pullman, WA 99164-7040
USA

Shakeel Ahmed, Muhammad Jamshed Iqbal Chaudhry, Muhammad Arshad, Shahid Mahmood, Ahmad Ali, Rehman Mahmood Khattak, and Aleem Ahmed Khan.³
The Ornithological Society of Pakistan
Zoology Division
Institute of Pure and Applied Biology
Bahauddin Zakariya University
Multan
Pakistan