REPORTS FROM THE WORKSHOP:

<u>CONSERVATION OF *GYPS* VULTURES IN ASIA</u>

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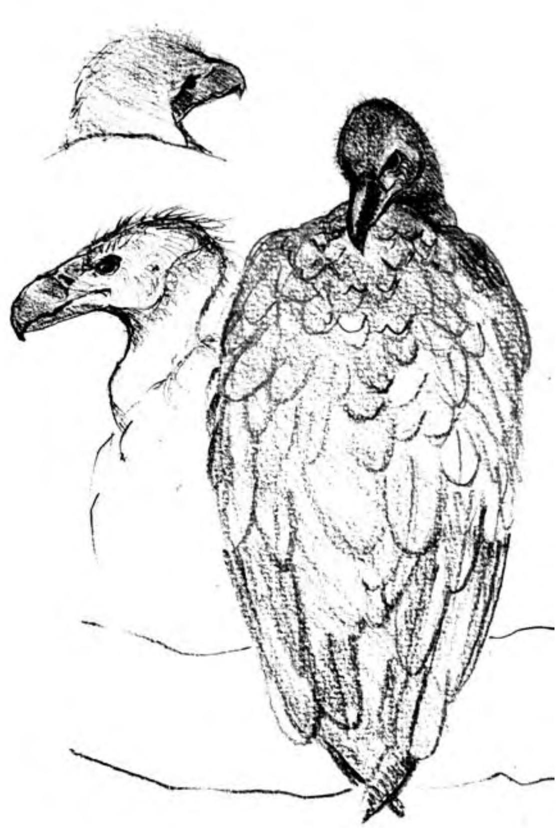

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PREFACE

The following reports are from the workshop "**Conservation of *Gyps* vultures in Asia,**" held at the September 2002 North American Ornithological Conference in New Orleans, Louisiana, USA. A similar event was held last year at the Raptor Research Congress in Seville, Spain. The goals of the 2002 workshop were to:

(a) present new research and results into the cause and extent of vulture decline in Asia;
(b) address the status of ongoing and proposed conservation efforts in response to the situation;
(c) bring this issue to the attention of North American ornithologists.

These reports summarize the talks given at the workshop and the discussion which followed.

Speakers at the workshop addressed many components of vulture decline throughout Europe, Asia, and Africa, the status of the captive population in Europe, and potential effects of spread of mortalities.

Munir Virani of the Peregrine Fund first discussed his ongoing intensive population monitoring at 3 declining vulture colonies in Pakistan and similar studies in Nepal. In both areas vulture populations are declining quickly, Munir and his field crew are finding hundreds of dead birds every year, and reproduction is poor.

Debbie Pain of the Royal Society for Protection of Birds then spoke to the scope of vulture decline in India, possible causes of decline, and potential spread of the mortality agent from India. Researchers in India have observed catastrophic and ongoing population declines. Although they have not yet identified a causative agent for vulture mortality, they are pursuing several leads and they are beginning to address spread of disease.

Lindsay Oaks of Washington State University also spoke on the pathology of vulture decline. Although he also has not yet identified a cause for mortalities, his work shows that many of the classical toxicants often associated with avian mortality are not important to vulture decline.

Campbell Murn of the Hawk Conservancy addressed the status of the European captive population of white-backed vultures. This population, while never extensive, has declined in recent years, and extensive management is required to maintain its viability.

Todd Katzner of Arizona State University discussed the status of vulture populations in central Asia and possible routes of spread of a mortality agent. Vulture populations in Kazakhstan have declined since the break-up of the Soviet Union, although no sick birds have been observed.

Alexander Gavashelishivili of the Georgian Center for the Conservation of Wildlife, then spoke on vulture populations in the Caucasus. Researchers in Georgia have not observed illness but have witnessed vulture population declines; in recent years these have been concurrent with declines in the numbers of livestock.

Finally, Mark Anderson, of the Department of Agriculture, Land Reform, Environment and Conservation in South Africa, addressed the status of vultures in Africa and the potential impacts of vulture decline there. Mark outlined the current status of vulture in Africa, spoke to the importance of monitoring populations, and suggested monitoring programs and protocols.

After these presentations, there was a useful discussion section that brought out several new ideas and prospects for collaborative work to benefit vulture conservation.

The workshop and these reports were financially supported by The National Birds of Prey Centre, UK, and The Hawk Conservancy, UK, as well as the NAOC. In addition to thanking the organizers of the NAOC, we thank all of our speakers for their participation and willingness to prepare these proceedings as well as the participants who attended the workshop and discussion, and Keith Bildstein, who assisted with editing the final document.

We hope that the workshop and these reports will be one step along the road to eventual recovery of *Gyps* vultures in east Asia.

Todd Katzner
Jemima Parry-Jones

Table of Contents

BREEDING AND MORTALITY OF ORIENTAL WHITE-BACKED VULTURES *GYPS BENGALENSIS*: SUMMARY OF RESULTS OF A TWO-YEAR STUDY IN PAKISTAN AND NEPAL (2000/2001 & 2001/2002)

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INTRODUCTION

Vultures have performed important ecological, traditional and aesthetic functions throughout the Indian subcontinent. These functions are now threatened following a precipitous decline of vulture populations in excess of 92% throughout India since the early 1990s (Prakash et al., in press). An unprecedented sequence of events that include a crash of populations of at least three species of *Gyps* vultures (*Gyps bengalensis*, *G. indicus* and *G. tenuirostris*), large scale gout-related vulture mortalities and observations of sick and dying vultures throughout India, suggests an etiology of a highly infectious nature, or poisoning from a widely-used chemical compound throughout the Indian subcontinent. The cause of the gout-related vulture mortalities remains unknown to date, and all three Gyps species have been listed as critically endangered by Birdlife International's Red Data Book (Birdlife International 2001).

Conservation interventions for species in jeopardy demand a basic understanding of their natural history before effective recovery plans can be implemented. The largest known populations of Oriental White-backed Vultures (*G. bengalensis*) occur in the Indus plains of Pakistan's Punjab Province. The Peregrine Fund, along with in-country partners the Ornithological Society of Pakistan, Bird Conservation Nepal and others, have been working to understand the population dynamics of Asian *Gyps* vultures to determine the cause and extent of vulture mortality in south Asia since October 2000. Systematic monitoring and diagnostic programs have been in place for two breeding seasons, quantifying vulture productivity and mortality in colonies spaced widely across the subcontinent. This paper summarizes the results of breeding and mortality of populations of Oriental White-backed Vultures at three sites in Pakistan and one site in Nepal over a two-year period.

STUDY AREA

Two Pakistan study sites are at Dholewalla (DW) and Toawala (TW). Both are located along the canals of the Indus river system and comprise a linear canal bund planted with Sheesham trees Dalbergia sisoo. Land-use at both DW and TW is mainly agricultural (cotton, wheat and mangoes) and livestock rearing. The third site further northeast, Changa Manga, (CM) is a large mixed-forest plantation approximately 30 km from the Indian border.

Organophosphorous compounds are extensively used throughout the study sites to fight cotton pests while synthetic pyrethroids and nitrile compounds are used to fight wheat pests and as broadleaf weed controls respectively. In Nepal, our study sites are at the Koshi Tappu Wildlife Reserve and the Annapurna Range of the Himalayas.

METHODS

Since the 2000/2001 breeding season, we have plotted and recorded numbers of active Oriental White-backed Vulture nests at our study sites. From a sub-sample, we have followed the fate of nesting activity throughout two breeding seasons (October to June 2000/2001 and 2001/2002) to determine breeding success. We also collected and removed sick and dying vultures to measure mortality rates. Sick and freshly dead vultures were autopsied to establish presence of visceral gout and tissue samples collected for histo-pathological, microbiological and toxicological analysis (see Oaks et al., 2002 in this report).

RESULTS

Pakistan: In Pakistan we located 2430 active nests in 2000/2001 and 778 active nests in 2001/2002 seasons of Oriental White-backed Vulture at all three sites collectively. Numbers of breeding pairs decreased by ~80% at CM, ~40% at DW and ~15% at TW between seasons. We also collected 668 and 468 dead vultures during the two breeding seasons respectively. Annual adult mortality rates increased from 19% to 27% at CM, from 11% to 14% at DW and from 2% to 11% at TW between the two seasons. The ratio of active nests per dead vulture decreased from 3.6 to 1.6 over the two breeding season. Breeding success decreased from 57% to 43% at CM and from 62% to 35% at DW. At TW, breeding success increased from 54% to 72%. Prevalence of visceral gout amongst adults and sub adults remained high at ~80%.

Interviews with 168 farmers at our study sites in Pakistan in 2002 showed that spraying of organophosphate, pyrethroid and nitrile compounds on cotton and wheat was intensive and recurrent. The use of organophosphate pesticides in Pakistan has increased significantly over the last decade. Pesticide storage and disposal practices are poor, resulting in run-offs into water systems and a high level of exposure to both humans and animals. Our diagnostic studies have not so far established a link between gout in vultures and agricultural pesticides used in the region (see Oaks et al, 2002 this report).

Nepal: At Koshi Tappu, Nepal, we observed a significant decrease in numbers of breeding Oriental White-backed Vultures (67 nests in 2001 to 12 nests in 2002). Only two out of nine active nests in 2002 successfully produced fledglings, while sightings of the sympatric Slender-billed Vultures in the area were rare (only two birds seen). Five active Himalayan Vulture *Gyps himalayensis* nests were located in the Annapurna Range. Numbers of this species appear to have remained stable over the last two decades (Sagar et al, in prep).

DISCUSSION

High adult mortality and a corresponding decrease in numbers of active nests throughout the study sites indicate that these populations are in rapid decline. The differential mortality rates and correlated population declines among sites imply that the mortality factor affects vultures at the three sites at different rates. The decline of vultures in India has coincided with an almost three-fold increase in the use of pesticides in the region over the last decade (Nair 1999). Previously common resident raptors such as White-eyed Buzzards (*Butastur teesa*) and Blackshouldered Kites (*Elanus caeruleus*) are now rarely encountered in the Punjab Province, suggesting that *Gyps* vultures may not be the only genus in decline. Temporal and spatial clusters of dead vultures have been located indicating a point source of exposure. This finding, combined with high pesticide use in the region may suggest a contaminant, but is also consistent with a highly infectious disease agent. Despite the current political situation in south Asia, The Peregrine Fund and their in-country partners are committed to understanding the cause of vulture mortalities in the region. More information about the Asian Vulture Crisis Project can be found at www.peregrinefund.org

ACKNOWLEDGMENTS

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Prakash V., D.J. Pain, A.A. Cunningham, P.F. Donald, N. Prakash, A. Verma, R. Gargi, S. Sivakumar, and A.R. Rahmani 2002. (In Press) Catastrophic collapse of Indian white-backed *Gyps bengalensis* and long-billed *Gyps indicus* vulture populations. Biological Conservation.

VULTURE DECLINES IN INDIA: PATTERNS, CAUSE(S) AND SPREAD

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SURVEYS AND PATTERNS OF DECLINE

Populations of two of India's commonest griffon vultures (genus *Gyps*) have declined by >90% during the last decade (Prakash et al. 2003). Both affected species, the Indian White-Backed and Long-Billed Vultures (*Gyps bengalensis* and *G. indicus*), were once very common in India, but now they are listed as critically endangered by the IUCN (BirdLife International 2000).

Dr Vibhu Prakash, Principal Scientist of the Bombay Natural History Society, first highlighted the problem. His initial findings at Keolodeo National Park, Rajasthan, (Bharatpur) showed a 96% decline in numbers of *G. bengalensis* and a 97% decline in *G. indicus* between 1985 and 1999 (Prakash 1999). Although little long term monitoring had been carried out elsewhere in India, vulture declines were being reported across the country during the 1990s. Consequently, BNHS ran nationwide vulture surveys in 2000, covering all parts of India except the South, where there were historically low densities of vultures. Surveys took place in protected areas, such as national parks, in areas adjacent to protected areas (within a 25 km radius), and unprotected areas. More than 11,000 km of road transects were driven using standard methods to survey vultures, and more than 6000 of these were exact repeats of road surveys carried out between 1991/93 under a BNHS raptor survey programme funded by the US Fish and Wildlife Service. In the 1991/93 counts however, only birds in groups of 5 or more were counted as vultures were so numerous. All individuals were counted in the 2000 surveys; thus any declines recorded would be underestimates.

Data were also collected on presence or absence of vultures at carcasses, and several carcass dumps previously visited for vulture recording were revisited. Flocks of perched birds were scanned and the proportion with 'drooping necks' recorded. An additional source of data came from questionnaires sent to >5000 wildlife experts (forestry officials, ornithologists etc.). Respondents were asked to indicate trends in vulture numbers and carcass disposal methods between 1990 and 2000.

The results of the surveys showed that massive declines occurred in both species over a 7-10 year period. The total number of *G. bengalensis* counted along the same 6000 km of road transects fell from ~ 21,000 to less than one thousand between 1991/93 and 2000; a 96% decline. *G. indicus*, fell from ~6500 to ~ 500 birds, a decline of 92%. Declines occurred in all regions surveyed, but were highest in the North of India. Declines did not differ between protected and unprotected areas, and, whilst there were some regional differences, overall declines exceeded 90% in all areas.

Gyps indicus is now generally considered to comprise 2 separate species, *G. indicus* and *G. tenuirostris* (Rasmussen & Parry 2000). Although *G. tenuirostris* and *G. indicus* were not separated during our surveys, most of the *G. indicus* recorded in the East region will have been *G. tenuirostris*. As declines of *G. indicus* were of a similar order irrespective of region, we conclude that the two species have probably declined to a similar extent.

Counts at carcass dumps were consistent with findings from road transects where we also observed massive declines in vulture numbers. Many livestock carcasses were seen during the road transects, but the majority had only crows and feral dogs feeding on them. The proportion of perched birds observed with 'neck-drooping varied regionally, and, for *G. bengalensis* was highest in the north. Dead birds were not counted systematically during the surveys, but unusually high numbers of both adult and juvenile dead birds have been recorded near colonies during the declines.

Full details of all of the survey methods and results are presented in full in Prakash et al. 2003.

CAUSE(S) OF THE DECLINES

Historically, many factors have been responsible for local vulture declines particularly poisoning and persecution. The declines in India result from elevated adult and juvenile mortality, and low breeding success (Prakash 1999; Prakash et al. 2003). Our data suggest that food supplies do not limit vulture numbers. Specifically, less than 5% of livestock carcasses recorded during the surveys had attendant vultures, and 80% of questionnaire respondents indicated that dumping of livestock carcasses in the open remains the major form of disposal. The widespread and rapid pattern of declines, i.e. in all areas irrespective of habitat or protection status suggest that persecution through shooting or poisoning, whilst important at a local scale, are unlikely to have caused the declines. The epidemiology of the declines is best explained by the introduction and widespread use (i.e. nationwide) of a contaminant, or an infectious disease.

Whilst pesticides and other chemicals are used throughout India, there is currently little evidence for the introduction, or change of use of any particular contaminant. Whilst populations of some other scavengers appear to have declined in recent decades (e.g., see Prakash et al. 2003), this has been to a far lesser degree than *Gyps* vultures, and widespread mortality of these species has not been reported. Indeed, some scavengers appear to be increasing because of the vulture declines. In neighbouring Pakistan, also now experiencing high mortality and dramatic declines in vultures at some colonies, vulture tissue analyses did not find toxic concentrations of any of a wide range of contaminants (Virani et al. 2001; Oaks et al. 2001). These factors, along with the lack of a pattern in declines between protected and unprotected areas, or agricultural and non-agricultural regions, suggest that contaminants are less likely to have caused the declines than infectious disease.

Diagnostic investigations of vulture mortality in India were initiated in 1999, and have been underway since 2000 (Cunningham et al. 2001) with funding from the Darwin Initiative for the Survival of Species (project website: www.vulturedeclines.org). Approximately 30 carcasses have been examined in detail so far, including individuals of both *G. indicus* and *G. bengalensis*. Many of the birds found dead have evidence of severe renal and visceral gout. Although renal gout is often attributed to kidney disease, in these cases the gout has been extensive and acute (or peracute) - i.e., occurring only a few hours (or less) before death. This condition is, therefore, apparently a response of the primary disease and not the disease itself and is most likely due to terminal dehydration of the affected bird,. The carcasses examined so far have been in varying states of nutritional fitness, with some of the birds having substantial amounts of body fat. This is probably an indicator of the period from becoming sick to death of individual birds - a time that is likely to have a degree of variance.

Apart from gout, there has been remarkably little to see at gross post mortem examination of the affected vultures. This is true also for the histopathological studies (whereby tissues are examined at the cellular level using light microscopy). One finding of note, however, is that many birds examined so far have varying degrees of vasculitis, or inflammation in the blood vessels. In addition, gliosis has been found in the brain of some birds; this is brain inflammation and is likely to be a response to a virus. All of the limited histological signs observed so far are consistent with a viral insult.

Although these findings are tantalising, they do not yet identify the cause of the agent killing the vultures. Work is on-going both (1) specifically aimed at identifying a viral cause of the disease, as suggested by the diagnostic investigation so far, and (2) broadly aimed at identifying any possible cause of the birds' demise - infectious or non-infectious. We are keeping our diagnostic minds as open as possible because, although our findings indicate viral involvement, this may not be the case or, if so, it may only be part of the story.

However, given the epidemiology of the declines, and limited histopathological information supporting an infectious (possibly viral) a etiology; infectious disease does appear to be the most likely explanation for the declines.

SPREAD OF THE PROBLEM

The international implications of this problem are very concerning, and similar declines are already occurring in neighbouring Pakistan and Nepal (Virani et al. 2001). As an infectious disease appears to be affecting three species of griffon vulture (*G. indicus*; *G. tenuirostris*; *G. indicus*), it is conceivable that it will spread to other griffon species, and both the migratory Himalayan and Eurasian griffons may already have been exposed. Unusually large numbers of juvenile *G. fulvus* have been wintering in north-western India over the last 2 years and the breeding origins of these birds are unknown. We plan to satellite track birds this winter to help establish most likely routes by which a disease could pass into the Middle East, Africa and Europe.

The ranges of species of the *Gyps* genus overlap from India through central Asia and the Middle East to South Africa and Western Europe. *Gyps* species are known to travel widely and it is conceivable that a disease that affects all *Gyps* vultures could spread from South Asia throughout the old world. All BirdLife Partners in *Gyps* range states have been made aware of the problem and encouraged to monitor vultures in their areas. In May 2000 a workshop was run in Kenya to plan vulture monitoring and conservation (Bennun & Virani 2001), and a workshop is being held in Bulgaria in October 2002.

A wide ranging programme of work is currently underway or planned to investigate (1) the cause(s) of the decline, (2) options for the recovery of sick vultures, (3) routes and rates of spread of a potential infectious disease, (4) the human and wildlife health impacts of vulture declines, (5) management options to limit the spread and/or impacts of vulture declines.

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DIAGNOSTIC INVESTIGATION OF VULTURE MORTALITY PUNJAB PROVINCE, PAKISTAN 2000-2002

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We initiated a veterinary diagnostic investigation into the causes of death of Oriental White-Backed Vultures (*Gyps bengalensis*) in the Punjab Province of Pakistan in November, 2000. Data from field studies at three study sites (Changa Manga in the Kasur District, Toewala in the Khanewal District, and Dholewala in the Laiah District) indicated high adult mortality rates of 11-27%. Approximately 76% of the dead adult and sub adult vultures examined grossly (n = 215) had renal failure manifested as visceral gout. During the study period, a total of 66 vultures of all ages were collected and necropsied in detail. Of these, 56 (36 with gout, 20 without gout) were in adequate post mortem condition for diagnostic testing, and samples from these cases were exported to the USA for analysis. The 20 cases without gout included most of the nestling and juvenile vultures, and a cause of death was grossly apparent for all but 8 of these cases and include trauma, gunshot, and lead poisoning. Histopathology, virology, electron microscopy, bacteriology and toxicology testing therefore focused on the 36 gout cases and the 8 undiagnosed non-gout cases.

The most significant histopathologic lesions were those of avian visceral gout: acute tubular necrosis and uric acid tophi associated with necrosis and a mild heterophilic inflammation in the kidneys, liver, spleen, and other tissues. Lesions compatible with a primary infectious disease of the kidneys or other organs were not consistently apparent. Various other lesions were noted (e.g., enteritis, meningitis, arteriolitis, tracheitis, hepatitis, cardiomyopathy), but these were generally mild and not consistently present.

We have not identified a significant pathogen that is associated with gout. Virus isolation from the kidney, spleen, lung, and intestine has been negative. In one vulture, a new species of mycoplasma was isolated, but additional testing did not find a correlation between this agent and the presence of gout. Negative stain electron microscopy on intestinal contents has not detected viruses or other potential disease agents. Bacteriology has not identified any obligate pathogens or opportunistic pathogens in a pattern consistent with disease. Polymerase chain reaction assays for infectious bronchitis virus, avian influenza virus, and West Nile Virus were negative.

Toxicology has also been negative. Toxic or deficient levels of arsenic, cadmium, copper, iron, manganese, molybdenum, lead, mercury, and zinc were not detected in any birds. A number of vultures were found to have non-food items in their ventriculus (pottery, wood, glass, nails, metal). However this behavior is common in the African *Gyps spp*. and thus is unlikely to be a sign of nutritional deficiency. Organochlorine pesticide residues were detected in fat but were at non-toxic levels in the brain. Probable organophosphate poisoning was detected in one gout case.

The testing performed to date has not identified a common, underlying cause of renal disease or visceral gout in Oriental white-backed vultures. Additional testing for infectious and toxic causes of renal failure in the Pakistani vultures is ongoing.

THE EUROPEAN ENDANGERED SPECIES PROGRAMME (EEP) FOR THE INDIAN WHITE-BACKED VULTURE *GYPS BENGALENSIS*: CURRENT STATUS AND FUTURE POTENTIAL

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ABSTRACT

At present there are fewer than 20 captive Indian White-backed Vultures (*Gyps bengalensis*) in zoological collections within Europe. Historical breeding success for this population has been limited to approximately 15 birds over a period of 30 years. Population growth was positive from the 1950s to a peak of 37 individuals in 1989, whereupon a negative trend has continued to the present population of 14. To address these issues, and in response to significant population declines of wild *Gyps bengalensis*, the Falconiformes Taxon Advisory Group (FALTAG) of the European Association of Zoos and Aquaria (EAZA) has initiated an European Endangered Species Programme (EEP) for the species. The EEP has several aims: 1) to coordinate existing captive specimens into a managed breeding programme; 2) to increase the captive population size; 3) to minimise the effects inherent to small populations; 4) to instigate an international studbook for the species; 5) to develop additional links with *in situ* conservation efforts. There is also potential for this *ex situ* population to act as a disease-free control population, and as a satellite population to compliment and assist any conservation breeding efforts in the Indian sub-continental region.

INTRODUCTION

The significant population decline of wild Indian White-backed Vultures (*Gyps bengalensis*) and Long-billed Griffons (*Gyps tenuirostris* and *G. indicus*) is well-known (Prakash 1999, Parry-Jones 2001, Prakash 2001, Virani *et al*. 2001). Several organisations have focused efforts on discovering the cause of this decline, and the associated impacts on populations that remain in the wild.

Concurrent with these efforts, the Falconiformes Taxon Advisory Group (FALTAG) of the European Association of Zoos and Aquaria (EAZA) three years ago began to discuss the initiation of a conservation breeding programme. EAZA is the world's largest zoo association in terms of members, and across this membership, different animal taxa are represented by a Taxon Advisory Group. Species in need of cooperative management are subject to managed programmes that are referred to as European Endangered Species Programmes (EEPs). The FALTAG acts to facilitate the effective management of diurnal raptors within EAZA member institutions.

The *G. bengalensis* EEP is primarily aimed at enlarging the current population held in European zoos. Although the current captive population in this region is small, it is an important group for the purposes of comparison with wild populations.

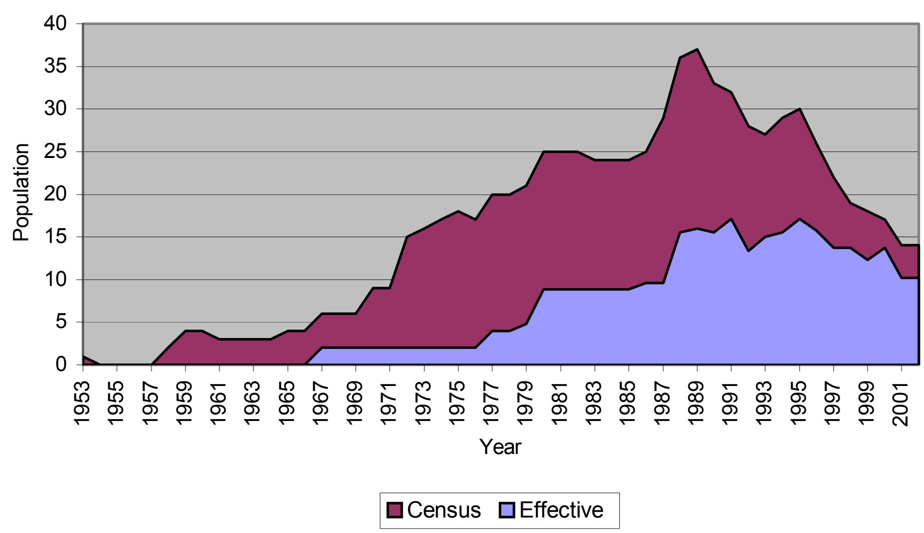
Apart from outlining the history and current status of the *G. bengalensis* population in Europe, the primary aim of this presentation is to publicise the existence of the EEP programme. Additionally, the potential contribution of this population to conservation efforts will also be discussed.

GYPS BENGALENSIS IN EUROPE

Indian White-backed Vultures were present in European zoological collections in the 1950s (W. Ludwig, pers. comm., S. Stadler, pers. com.), and have since existed largely as an additional vulture species in zoological collections. Over recent decades the conservation efforts of European zoos have focused on regionally local species such as the Cinereous (*Aegypius monachus*), Bearded (*Gypaetus barbatus*) and Eurasian Griffon Vulture (*Gyps fulvus*). As a result, these other vulture species have received more attention in terms of coordinated breeding and management.

A consequence of this bias towards other vulture species is that the number of *G. bengalensis* bred in zoos has been limited. Despite a peak census population of 37 specimens in 1989, and consistently more than 30 specimens during the late 1980s and early 1990s, there are records for only 15 specimens bred in European zoos. Figure 1 illustrates the historical population within European zoos, and highlights the low effective population size (Ne). A low Ne is a feature of populations that have either a skewed sex ratio, or not all animals actively breeding. Most populations have an Ne smaller than the census population, and it is the difference between the two (referred to as a discount ratio) that has a significant effect on the rate at which a population can grow.

Figure 1: Population size of *Gyps bengalensis* in European Zoos: 1953 - 2002



Longevity for *G. bengalensis* can exceed 40 years (M. Kaiser, pers. comm.), although it is currently unknown the maximum age at which birds will breed successfully. Maximum age at reproduction is also of consequence to future demographic structure.

It is an unfortunate coincidence that the captive population of *G. bengalensis* began to decline approximately at the same time as wild populations (Fig. 1). Since 1995 mortalities representing approximately 40 % of the population have occurred, and included the most successfully reproductive specimens.

PROGRAMME ESTABLISHMENT AND THE CURRENT POPULATION STATUS

From 1999 onwards, following declines of both wild and captive populations, the FALTAG stressed the need for the development of a managed breeding programme (EEP) for *G. bengalensis* held in European zoos. The aim of the EEP is to build a self-sustaining population of *G. bengalensis* that preserves the current level of genetic diversity. A further aim is to reduce the deleterious factors inherent to small populations. The EEP was approved in June 2002.

The current EEP population of *G. bengalensis* consists of 14 birds. Of this total, there are eight males, four females and two birds of unknown sex. The skewed sex ratio reduces the Ne, whilst the discount ratio is exacerbated by the fact that two birds are imprinted and currently unreceptive to the prospect of breeding. The genetic makeup of the population is unknown, and this will be an obstacle to future breeding recommendations. One half of the living population can be confirmed as captive bred, whilst the remainder have an unknown birth type, and therefore an unknown parentage. Where birth location is known, paternity is occasionally uncertain due to the regular keeping of this species in a colony group.

In summary, the current status of *G. bengalensis* in European zoos is relatively poor; many birds are of unknown origin, there is a skewed sex ratio and imprinted birds are currently unsuitable for breeding. Addressing these issues was a major reason for the establishment of an EEP.

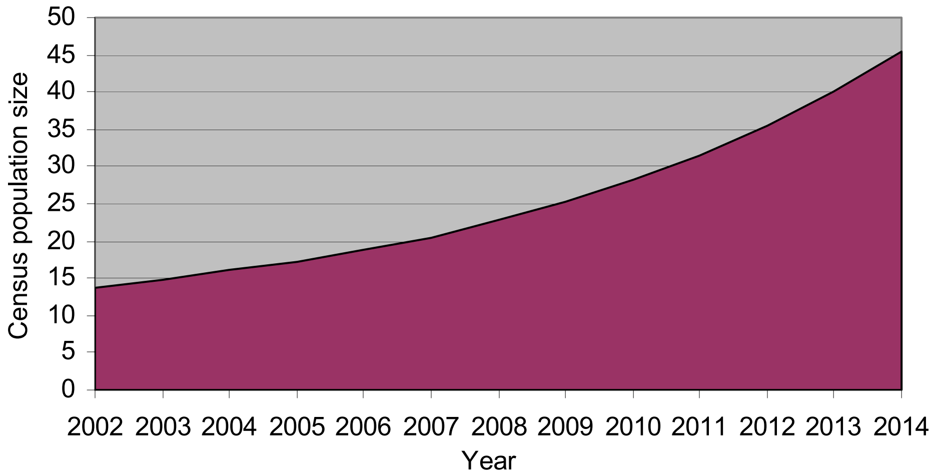
PROJECTIONS

Even with a rate of reproduction higher than historical levels, the European population will remain in a precarious state for at least 10 years. Several problems are inherent to small populations, such as lowered genetic diversity, genetic drift and an increased susceptibility to the impacts of stochastic events (Franklin & Frankham 1998, Lacy 1987). Although the genetic diversity of a population cannot be increased without immigration, other risks can be alleviated or reduced by increasing population size and distributing animals to separate locations. It is ill-advised to consider a captive population secure and/or viable before the census size has exceeded 50 animals. Figure 2, showing a simple projected population growth curve calculated with regard to several basic assumptions, highlights that the captive *G. bengalensis* population will not reach this size for at least 15 years.

A positive aspect for the EEP is that all birds in the programme are mature and potentially capable of breeding. Although *G. bengalensis* have bred previously in European zoos, breeding rates of co-generic vultures have occurred at higher rates and more regularly (Minnemann, 1984, Schlee 1988). However, some *G. bengalensis* colonies have bred very well in the past (Horstmann pers. comm., Sliwa pers. comm.). It is therefore not unrealistic to expect improved breeding rates for the current EEP population once efforts are focused on the remaining birds.

Without the cooperation of zoological collections holding this species, the EEP is likely to be ineffective. A concerted effort is also required to collate husbandry, reproductive and veterinary information into a format that is accessible to all participants. Such information will also be relevant to captive management facilities in the Indian sub-continental region.

Figure 2: Projected census population of *Gyps bengalensis* within the EEP (European) population: 2002 - 2014



Assumptions:
* Hatch success rate range: 50 %
* Balanced sex ratio for recruited animals
* Breeding begins at age 4 years.
* Annual mortality rate: 2 %
* No neonate mortality
* All adults breeding
* All animals of known sex

CONTRIBUTION OF THE EEP POPULATION

There are several potential roles for an *ex situ* population. Traditionally an *ex situ* population acts as a ‘safety net’, occasionally providing propagated offspring to re-introduction programmes. The EEP population, however, is not likely to contribute birds for release programmes. The need for, or efficacy of, such programmes is at best debatable. However, like many other species of conservation concern, the EEP population can provide benefits to conservation efforts via fund-raising potential, educational programmes and awareness of the public at large. Co-generic species held in greater numbers within European zoos, such as *G. fulvus*, can be also used to highlight current conservation efforts for *G. bengalensis*.

The *ex situ* population can also function as a satellite population, apparently unaffected by the factors causing wild population declines. Relevant studies can potentially reveal valuable information for wild populations. Whilst the EEP population is not an experimental population, there are opportunities to utilise this *ex situ* resource in the context of comparative studies centred upon the investigation of wild population declines.

The future success of the *G. bengalensis* EEP is reliant on the participation of up to 6 zoological collections that are dedicated to the propagation and maintenance of the species. These collections are yet to be identified, but without this cooperation, there is little that the EEP will offer. However, given an active species committee and proactive collection managers, it is expected that a viable population can be maintained for the coming decades.

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CONSERVATION STATUS OF GRIFFON AND OTHER VULTURES IN CENTRAL ASIA

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INTRODUCTION

Vulture populations worldwide are threatened, and many have shown dramatic distributional changes, some to the point of near-extinction. Causative agents for these trends include pesticide use, lead poisoning, habitat loss, changes in livestock populations, and direct persecution by humans. Alarmingly, an unknown mortality agent in India has recently caused population declines so severe that they may result in the extinction of two or more species (Holden 2000, Risebrough and Virani 2000, Prakash et al. 2002). These declines are massive and sudden; researchers report finding hundreds of dead birds at a colony in a single breeding season (Virani 2002, these proceedings).

There is almost no knowledge about the conservation status of vultures and vulture populations in the former Soviet Union. Calls for regional monitoring programs have become more urgent in light of evidence that the population decline in nearby India is spreading to neighboring regions (Virani et al. 2001).

We surveyed southeastern Kazakhstan to assess the current distribution, population and conservation status of Griffon and other vultures. Species encountered included: Cinerous Vultures (*Aegypius monachus*), Eurasian and Himalayan Griffon Vultures (*Gyps fulvus*, *G. himalayensis*), Bearded Vultures (*Gypaetus barbatus*), and Egyptian Vultures (*Neophron percnopterus*). The goals in this research were first, to document the locations of vulture nests and colonies for use in future studies, second, to compare historical records of colonies with their current size and status, and third, to look for signs of population decline or disease, particularly in Gyps vultures. We also conducted preliminary surveys in Qinghai province, central China, to evaluate vulture breeding in this area.

If the mortality agent currently killing vultures in India and Pakistan can also impact other Gyps species, it is likely to spread throughout the range of this genus. Therefore, we also discuss possible routes of spread of this mortality agent through Asia and the middle east to identify areas particularly suitable for monitoring potential disease spread.

METHODS

We surveyed for vultures in mountainous areas of south-east Kazakhstan by (a) visiting known vulture colonies and nests; (b) evaluating maps and searching areas with suitable breeding (cliff) habitat, and (c) conducting an annual transect survey in a mountainous valley heavily used by foraging vultures. We focused our efforts primarily on Griffon and Black Vultures but we also recorded other species as encountered.

Few vulture colonies in Kazakhstan are identified in literature. However, two are described in the mountains near Almaty, and we visited both and compared current status with historical records. Our transect was established in the upper valley of the Assy river, a region which has historically supported high numbers of livestock. In August 2000-2002 we surveyed the length of the valley, stopping at 5 km intervals to locate, count, and identify vultures observed in 15 minutes periods.

RESULTS

Eurasian Griffon vultures were the most frequently encountered species. In total, we identified at least six vulture colonies. Breeding occurred at 5 of the six sites, and was successful at 4. We encountered two types of griffon vulture colonies: (a) colonial groupings (Usek, Karatau, Chilik) on large cliff faces, with numbers of adult birds ranging from ~8 to ~40; and (b) more dispersed settings along river valleys or on small cliffs (Karatau, Charin, Temirlik, Kokpek).

Historical records exist for Usek and Chilik. Populations at Usek appear to be about 25% of what they were 10 years ago. The number of nests at Chilik was 50% of that described 10 years ago, and Himalayan Griffons, which used to be the only birds breeding there, make up less than 50% of the current population. In both cases, observations of local livestock herders corroborate these declines.

We observed neither dead vultures nor any obvious or regular signs of illness seen in *Gyps* vultures in south Asia. We documented successful breeding by Cinerous Vultures at 8 separate nests. Four of these were in a semi-colonial group, the first such setting ever found in Kazakhstan. However, other recently active sites were no longer used. Bearded vultures successfully bred at 9 nests.

Data from transect surveys are similar from each of the three years of the study, and are not sufficient to infer population change.

DISCUSSION

Field Research: Griffon vulture populations in Kazakhstan have undergone recent declines, but the cause of these declines is unknown. The massive recent social and economic changes in central Asia have been accompanied by similarly large changes in agriculture and in the use and numbers of livestock. These disruptions are likely to have severely impacted vulture populations. Although breeding was documented at many sites, reductions in the number of breeding individuals at colonies were also apparent. Populations of other vulture species in Kazakhstan are stable, but are apparently vulnerable to swift local declines.

There is presently no evidence that the mortality agent killing vultures in India and in surrounding countries is impacting vultures in Kazakhstan. However, in light of the recent population declines of these species, the likelihood that these declines will continue, and the potential threat from anthropogenic effects and unknown mortality agents, close monitoring of all of these populations is important.

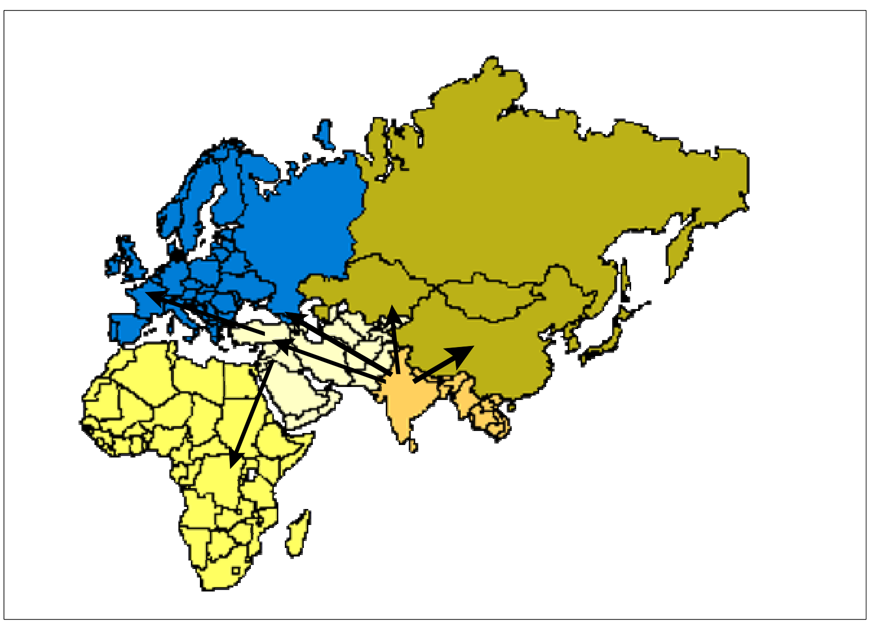
Potential Routes of Spread: There is concern that the agent killing vultures on the Indian sub-continent may be infectious, and other species in the genus *Gyps* could therefore be susceptible. If this is true, the effects on vulture populations worldwide would be severe. To evaluate possible routes of spread of the mortality agent through Asia and the middle east, we overlaid the ranges of Eurasian and Himalayan Griffon Vultures (Ferguson-Lees et al. 2001) on a map of the land-forms of Eurasia (Raisz 1960). We assumed that vultures would be found predominantly near mountain ranges within their geographic range.

Using this approach, we identified four primary potential routes where spread of any potentially infectious mortality agent might be most easily noted (Fig. 1). The first route would be across the Himalaya and into Tibet and other regions of central China, through the eastern part of the range of the Himalayan Griffon. A second potential route would be north from India and Pakistan, into eastern Afghanistan, western China, and the states of former Soviet central

Asia, via the Karakoram, the Hindu Kush, the Pamirs and the Tien-Shan. This area encompasses a zone of overlap between Eurasian and Himalayan Griffon Vultures. A third potential route of spread would be through western Afghanistan and northern Iran, into the Caucasus and mountainous regions of Turkey. Finally, a fourth route of potential spread could be through southern Iran, along the Makran and the Zargos, into the Arabian Peninsula and the middle east. Eurasian griffons are the only species breeding along each of these last two routes.

This estimation of these routes is based on evidence of range overlap and potential vulture habitat, and as such it may contain some uncertainty. Regardless, if a mortality agent is to spread, it would do so along these routes. It is therefore crucially important that vulture populations in these areas be monitored carefully. We are currently developing monitoring programs for central China and for the northern parts of central Asia, and others are currently monitoring vultures in the Caucasus (Gavashelishivili, these proceedings) and in some parts of the Arabian Peninsula (Foulds, personal communication). However, there is an urgent need for development of monitoring programs along other parts of routes #3 and #4 in Iran and Afghanistan, or, if those programs exist, for coordination of these efforts with other vulture researchers.

Figure 1. Potential routes of spread of the mortality agent causing death of *Gyps* vultures.



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VULTURES IN GEORGIA

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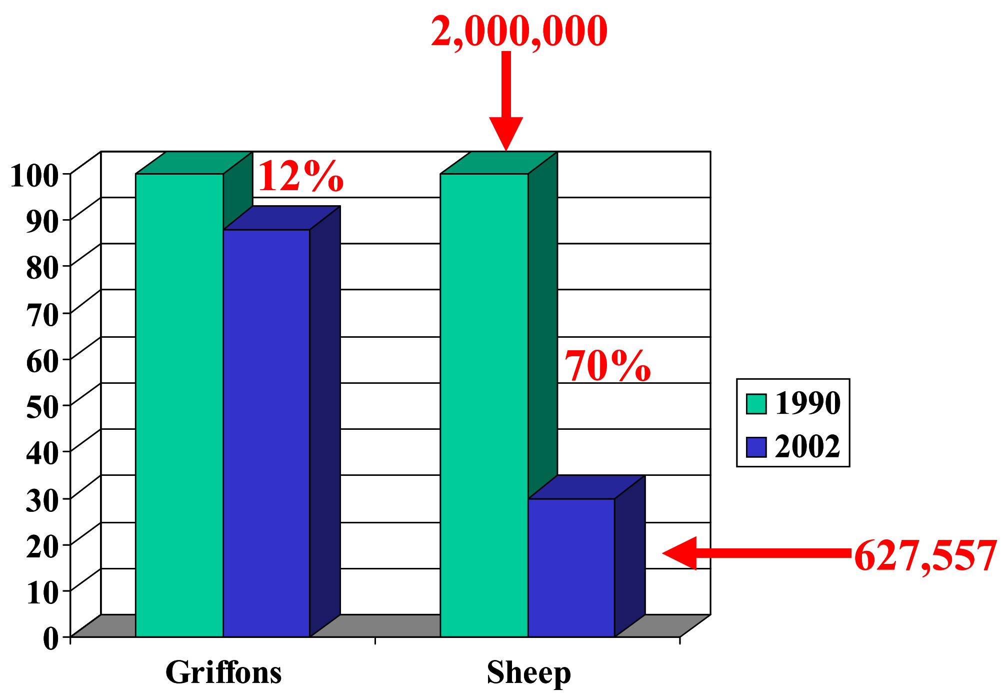
Georgia, in the Caucasus in the former Soviet Union, is a mountainous country of about 70,000km^2. About 40% of the country is woodland, 30% is developed, and 30% is rangeland. This habitat diversity supports a relatively large number of breeding vultures of many species, including Bearded (*Gypaetus barbatus*; 22-25 pairs), Cinereous (*Aegypius monachus*; 20-30 pairs), Egyptian (*Neophron percnopterus*; 140-150 pairs) and Eurasian Griffon (*Gyps fulvus*; 70-75 pairs).Survey data collected over the past 10 years in Georgia and adjoining areas in neighboring countries showed that in contrast to Egyptian Vulture , Bearded, Griffon and Cinereous Vultures occur only in areas that are undeveloped by humans, but which hold supplies of livestock and other potential prey animals. The surveys also showed that locations of nests of Bearded Vultures and the home range of a breeding Bearded Vulture marked with a radio-satellite transmitter in Kazbegi District were significantly correlated with the range of wild caprines (*Capra cylindricornis*, *C. caucasica* and *C. aegargus*), while those of Griffon and Cinereous vultures were significantly correlated with the year-round ranges of livestock . In addition, in the wintertime Griffon and Cinereous Vultures are very rare in summer-range grazing areas, but are commonly seen there in summertime. All this suggests that carcasses of caprines and probably other wild animals are a primary dietary item for most Bearded Vultures, whereas Griffon and Cinereous vultures feed mainly on dead livestock. However, there are two areas with breeding Bearded Vultures, where livestock is pastured year-round, and caprines do not occur. Two scenarios in the breeding success of Griffon Vultures support the importance of livestock. First, in lowland breeding grounds (at 200-800 m elevation) where large numbers of wintering livestock are found into the early nesting period (from hatching to fledging), but which are moved to distant pastures for up to 5 months (May through September), only <50% of the griffon vulture pairs fledge young. Second, in highland breeding grounds (1300-5000 m elevation) where Griffon Vultures start their breeding season in the presence of small numbers of year-round livestock, whose numbers then increase greatly in May with the arrival of summering livestock, the number of pairs that hatch chicks is much less than that in the lowland breeding site, but ~ 100% of hatchlings fledge.

In the Caucasus, including Georgia, the size and location of livestock pasture areas changes seasonally due to movement of livestock to provide pasture. These movements can be among settled areas (villages and towns), can vary as herdsmen seek snow-free pasture, and good grazing, wintering in the dry lowlands and summering in highlands ranges.

While the populations of Egyptian and Bearded Vultures remain stable, numbers of breeding pairs of the other vultures have declined over the past 10 years (Cinereous Vultures by a few pairs; Griffon Vulture by 12%). In all likelihood this decline is not linked to the notorious Indian population declines, as we've never witnessed or heard of any mass death cases or observed such signs of the mysterious mortality agent. Rather, the decline in Cinereous Vultures has resulted from the loss of some of their nesting habitat (the bird nests on top of low trees such as juniper situated in rugged areas) at the hands of shepherds whereas that of Griffons is likely to have to do with dramatic changes in sheep numbers (see Fig. 1) since the breakup of the USSR. In Soviet times sheep were well subsidized.

Figure 1. Relationship of proportional change in Griffon vulture populations and sheep numbers in Georgia.



THE DEMISE OF VULTURES IN SOUTHERN ASIA: RESEARCH AND CONSERVATION RECOMMENDATIONS FOR AFRICA

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ABSTRACT

During recent years vultures, especially the *Gyps* species, have all but disappeared from parts of southern Asia. Although no conclusive evidence has yet been provided, it has been suggested that an infectious disease has been responsible for the mortalities. It is possible that a disease factor could eventually spread to vultures in Africa, due to the continuous and overlapping ranges of *Gyps* vultures, their nomadic and migration habits, their social behaviour, and the interaction of these birds at carcasses, bathing and drinking places and even at breeding colonies. Africa without vultures would be unimaginable; especially because of the important ecological role these birds play, both in natural and urban environments. We propose various actions that should be undertaken in Africa in order to detect a potential disease in vultures. Even if factors other than disease have been responsible for the mortalities of vultures in southern Asia, a more extensive vulture monitoring programme in Africa would still be beneficial.

ASIAN VULTURE CRISIS

During the past decade vulture populations have collapsed in south-east Asia, with as many as 100,000 *Gyps* vultures dying in India alone (Satheesan 1999). Mortalities have been recorded across many parts of India, Pakistan and lowland Nepal (Virani et al. 2001; Prakash et al. 2002). Unfortunately few data are available to provide quantitative evidence of the decline in numbers, with the most cited example being the unprecedented collapse of the Indian White-backed Vulture *Gyps bengalensis* and Long-billed Griffon *Gyps indicus* populations at Keoladeo National Park in India during the past decade (Prakash 1999). The cause of the vulture deaths in southern Asia is unknown, although various theories have been proposed. These include: (1) lack of food due to improved hygiene and disposal of carcasses (Satheesan 1999, Thiollay 2001), (2) air force/aviation intervention to reduce vulture air-strikes (Satheesan 1999, 2000, 2001; Thiollay 2001), (3) pesticides (Prakash 1999, Anon. 1999), (4) direct or secondary poisoning (Satheesan 1999, 2000, 2001; Thiollay 2001; Anon. 1999), (5) human persecution (Satheesan 1999, 2000, 2001; Thiollay 2001), (6) environmental factors (such as global warming), or (7) an infectious disease (Prakash 1999, Anon 1999, Cunningham 2000, Risebrough 2000, Risebrough and Virani 2000, Prakash et al. 2002).

Currently the "infectious disease hypothesis" is viewed by many as the most likely explanation for the observed mortalities (Prakash et al. 2002). This is because: (1) high mortalities have been observed in all age classes, (2) the decline has been observed over a relatively large geographical area during a short time, (3) there appears to be no shortage of food as animal carcasses are left uneaten, (4) there are few records of mass poisoning events, (5) the deaths and declines are largely restricted to the *Gyps* genus (Thiollay 2001); (6) sick and dead vultures have been found with the same clinical signs throughout southern Asia, and (7) initial necropsies and histo-pathological analyses have identified a possible infectious disease agent (Cunningham 2000). The infectious disease hypothesis may also be supported by the fact that social vultures and not solitary raptors have exhibited the drastic decline (a disease would spread more rapidly in social birds). Although there have also been numerous counter-arguments against the "infectious disease hypothesis" (Satheesan 1999, 2001), there is still no unequivocal evidence to support any of the other hypotheses.

Our concern, as African raptor biologists and conservationists, is that, if the mortality factor is a disease, it may spread westward and thus affect vultures in the Middle East, Europe and Africa (Anderson and Mundy 2001). The Eurasian Griffon in particular is partially migratory (mostly juvenile birds) and although little is known about its movements between Asia, Europe and Africa, there is a potential for disease transmission by nomadic and migratory birds. Both the Eurasian Griffon and Egyptian Vulture migrate to and from Europe and Africa (Mundy et al. 1992).

THE VULTURES OF AFRICA

Eleven vulture species occur in Africa, and of these seven are endemic to the continent (Table 1). Some species, such as the Cape Griffon, have a very localised range, while others such as the African White-backed Vulture occur throughout sub-Saharan Africa, apart from desert and forested areas (Mundy et al. 1992). The Eurasian Griffon has a limited distribution in Africa, although it previously had a much greater breeding distribution (including the Atlas Mountains; Mundy et al. 1992). In Africa, the Cinereous Vulture is nearly extinct and definitely absent as a breeding species (Mundy et al. 1992). Numerically, the African White-backed Vulture, Hooded Vulture and Palm-nut Vulture are the most common vultures in Africa (Table 1). Only two African species are listed in the IUCN "Red List of Threatened Species" (Stattersfield & Capper 2000): the Cape Griffon and the Lappet-faced Vulture, although the Cinereous Vulture is classified as near threatened (Table 1). African vultures are exposed to many anthropogenic threats including habitat destruction, a reduction in food availability, inadvertent killing during "problem-animal" control campaigns (poisons, gin traps, etc.), electrocution on electricity pylons, nest disturbance, and harvesting for traditional medicine (Anderson 2000). However, the severity of these impacts across the continent has not been comprehensively evaluated.

THE POSSIBILITY OF THE TRANSMISSION OF AN INFECTIOUS DISEASE TO AFRICAN VULTURES

Gyps vultures (and not other genera) have suffered the largest population decline in southern Asia, leading to the suggestion that the disease factor (if there is a disease factor) could be specific to this genus. If so, it is conceivable that an infectious disease could ultimately be transmitted from Indian vultures to Eurasian Griffons in the Middle East and Europe to Cape Griffons in South Africa (Vickery 2000, Anderson and Mundy 2001). Although the breeding distribution of *Gyps* vultures is not continuous, there are definite overlaps in their foraging ranges across Africa (Mundy et al. 1992). Long range movements have also been recorded. For example, the recent record of Rüppell's Griffons in South Africa (Snyman et al. 1994, Snyman 1999) is an approximately 1500 km southerly extension of this species' known range. Recently an African White-backed Vulture ringed in Kimberley in South Africa was recovered (after being poisoned) near Etosha National Park (Namibia), 1426 km away (Oschadeus 2002). The interaction between the different species is not limited to their use of similar habitats and their association at carcasses, but also to inter-breeding, such as between Rüppell's Griffons and Cape Griffons (Scott 1991, Snyman 1999, Borello 2001).

Although resident in many parts of Africa, the Egyptian Vulture is also a regular migrant with thousands flying into North and north-eastern Africa each autumn, departing the following spring. Migrant Egyptian Vultures enter Africa at four points: across the Straits of Gibraltar to Morocco, across the Straits of Sicily to Cap Bon in Tunisia, through Eilat and Suez at the northern end of the Red Sea (and across the Gulf of Suez); and across the Bab al Mandab Straits to Djibouti (Mundy et al. 1992). It has been estimated that up to 10,000 Egyptian Vultures migrate into Africa each year

It is however the Eurasian Griffon which is the more likely to introduce an infectious disease to African vultures. Although a significant reduction in the African breeding population has taken place (leading to its extinction as a breeding species in Tunisia and Egypt and probably in Morocco), thousands fly into Africa each year for the northern winter. These birds have been noted as far south as coastal Senegal and south-western Mali in the west (Mundy et al. 1992) to Ethiopia (Vittery 1983) and Kenya in the east (Clark 2001). There is extensive overlap with the range of the Rüppell's Griffon. As with the Egyptian Vulture, the Eurasian Griffon has four potential points of entry into Africa. However, no passage occurs between Sicily and Tunisia, and at Bab al Mandab, and the vultures, mainly young birds, enter into Africa from Gibraltar and Israel. In only eight days of a 34-day observation period in mid-October to mid-November 1993, an astounding 2160 "mostly juvenile" griffons were observed crossing over into Morocco at the Straits of Gibraltar (Griesinger 1996). Nothing is documented about the migratory Eurasian Griffon's biology, movements and interaction with other species when in Africa (Mundy et al. 1992).

IMPLICATIONS OF AN AFRICAN VULTURE POPULATION CRASH

Throughout their range, in both the new and old world, vultures fulfill an important ecological role, and their absence could cause ecological imbalances. In India and Pakistan, vultures eat cattle carcasses which, because of Hindu and Muslim beliefs, are not consumed by humans. Without the natural disposal of carcasses by vultures, the number of rotting animals would increase along with feral dogs as their scavengers. Some communities in India (Zoroastrians) and Tibet (Tibetan Buddhists) use vultures to dispose of human corpses (Houston 1990, Satheesan 1998, Mackenzie 2000). In Africa vultures keep natural and man-made habitats free of carcasses, waste and even human excrement (Mundy et al. 1992). An absence of vultures could result in the spread of diseases, some of which could affect humans. Vultures and other birds also have important ecotourism value, with bird-watching being one of the fastest growing pastimes in many countries (Turpie and Ryan 1998).

CURRENT VULTURE RESEARCH, MONITORING AND CONSERVATION INITIATIVES IN AFRICA

In Africa, the focus area of current vulture research and monitoring is in southern Africa and East Africa (Uganda and Kenya). There are no known vulture projects currently underway in any other African countries. In light of the possible arrival of an infectious disease, monitoring would put us in position to detect an impending population crash. In southern Africa, vulture monitoring is currently conducted at several key sites for Cape Griffons, African White-backed Vultures and Lappet-faced Vultures (Anderson and Mundy 2001). Although this monitoring varies from intensive monthly surveys, such as at Kransberg, the largest Cape Griffon breeding site, to bi-annual monitoring during the breeding season of smaller colonies, these data will enable researchers to determine population trends and in some cases reproductive success.

In southern Africa, the Endangered Wildlife Trust's (EWT) Vulture Study Group has, for three decades, run an effective and extensive awareness campaign, with the focus being on the

Cape Griffon, a southern African endemic. During recent years the EWT's Poison Working Group has conducted toxicological examinations of many vulture carcasses, especially those suspected to have succumbed to poisons.

In Kenya , Rüppell's Griffons are being monitored at three colonies: Poror (in Maralal), Ololokwe (in Samburu), and Hell's Gate (near Naivaisha), and haemotology and blood biochemistry has been studied in African White-backed Vultures (Gatome 2002). A potential problem in Kenya is that the breeding season is not synchronous, with birds breeding throughout the year, and this makes monitoring difficult. In Uganda, a monitoring program has been proposed (Pomeroy, personal communication) and regular vulture surveys at carcasses is being considered. In addition, as part of a study to determine the role vultures play in ungulate disease outbreaks, a number of birds will also be marked with patagial wing tags. We are currently also exploring the possibility of initiating monitoring programmes in Zimbabwe, Zambia, Tanzania and Ethiopia.

PROPOSED RESEARCH AND CONSERVATION INITIATIVES FOR AFRICA

If an infectious disease is responsible for the observed mortalities, the conservation and research communities in the Middle East, Europe and Africa need to start various initiatives without delay. The Asian Vulture Crisis has already received attention at vulture meetings at Vulture Study Group (VSG) workshops in South Africa in March 2001 and April 2002, in Uganda at Makerere University in April 2001 (Cooper et al. 2001) and in Kenya in May 2001 (Bennun and Virani 2001) and various responses have been proposed (Anderson and Mundy 2001, Bennun and Virani 2001, Virani et al. 2001). However, until the causal factor for the mortalities in Asian vultures has been determined, the focus in Africa should be on monitoring and the collection of baseline data on healthy birds. The problem is that very little monitoring is being conducted, especially in the northern areas, and it may therefore not be possible to detect population changes. Initiatives are currently being established in Uganda, Kenya and southern Africa to monitor vulture populations and to collect baseline data from healthy and sick birds (Bennun and Virani 2001). An African Vulture Monitoring Committee was also established in April 2002 to coordinate monitoring activities.

We suggest that the priorities for research/monitoring in Africa should be the following:

1. Collect baseline data on vulture populations throughout Africa, including Morocco, Egypt and Eritrea, which are known migratory routes for Eurasian Griffons. Monitoring sites should be established at key *Gyps* breeding localities throughout Africa. The African White-backed Vulture may be the most suitable for monitoring, because of its wide range across Africa (Mundy et al. 1992), but its habit of nesting in loose colonies and its loose attachment to these sites may make monitoring difficult. This monitoring programme should be simple, coordinated, systematic and cost-efficient.
2. Surveillance of the health of vultures, particularly *Gyps* species, by observations and non-invasive monitoring (laboratory examination of faeces, dropped feathers, etc.), opportunistic sampling (of dead vultures) and trapping live vultures for collection of blood samples and ectoparasites. Faeces should be examined for potential pathogens, parasites and viruses. Blood analyses should be conducted for intra- and extra-cellular hemiparasites, complete blood counts, serum chemistry panels, toxicology (especially heavy metals) and serology tests for antibodies to infectious diseases. Serum of both healthy and ill vultures should be collected for retrospective studies based on protocols recently established in southern Asia. In southern Africa, we propose that ten African

White-backed Vultures should be killed for full screening so as to arrive at a profile of a healthy bird. Perhaps the same could be done with Eurasian Griffons in Spain.

3. All vulture mortalities should be documented and post-mortem examinations conducted to link clinical symptoms to those observed in south Asia. Tissue samples should be taken and stored in formalin for histopathology and frozen at minus 80^{o}C for future microbiological and toxicological analyses. Epidemiological data should be collected.
4. The annual collection of a small sample of migrating Eurasian Griffons in Egypt or Israel during October could be considered for the monitoring of the introduction of possible pathogens into Africa.
5. The behaviour of vultures should be recorded, especially abnormal behaviour and "head-drooping" as related to environmental conditions, and documented.
6. An awareness programme (such as has been done by the VSG in southern Africa) should be implemented elsewhere in Africa. The main aims should be to improve the awareness of people about the important role of vultures and the potential impact of negative factors on their survival.

On the assumptions that (a) the *Gyps* vultures in the Indian subcontinent are dying from a virulent possibly new virus, and (b) that the virus will find its way into Africa with the migrating griffons, then what is to be done beyond all the proposed monitoring schemes? The standard method is to prevent affected (diseased) animals from coming into contact with clean (healthy) ones. Could we set up a "fire wall" against incoming Eurasian Griffons in the Suez area, i.e. shooting on sight all south-bound birds? During a two-month period this idea might be feasible to put into action, but unfortunately the vultures could shift their flying tracks according to the precise winds at the time, and over perhaps a 50 km or more width of the country. If nothing else, such a potentially "broad" front militates against such a plan being effective. Actually we see no preventative or curative action being possible, and see the likely situation the same as that consequent upon the invasion of Africa by the rinderpest virus in 1889 (Grove 1978). By 1898 the disease had reached the southern tip of Africa – in spite of cattle slaughters and fences. How much less possible would it be to halt the spread of a virus that invades by flying! Thus our only action – in the event of the Asian vulture virus (if it is a virus) arriving in Africa – would be to make an awareness campaign focusing on the likely results of such a virulent virus (D. Pain personal communication). These would include increased jackals *Canis* spp., increased incidence of rabies and other diseases, such as anthrax, and rotting carcasses covered in flies. It is unlikely that a vulture inoculation programme would be practical and feasible.

Establishing any vulture initiatives in Africa will be difficult, with the present logistic and financial problems in the region, including a scarcity of observers and political instability and safety issues. Establishing monitoring initiatives in the northern areas may be difficult and therefore the concern is that, should an infectious disease factor arrive in Africa, it may only be detected when it reaches East Africa or possibly even further south. Regardless of the uncertainties about the reasons for the observed mortalities and the numerous problems in establishing vulture research/monitoring projects in Africa, we believe that because of our relatively limited knowledge about Africa's vultures and the paucity of current projects, any new initiatives will be invaluable.

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Table 1. The estimated size of the populations of vultures in Africa, as well as their IUCN status.

Common name, IUCN status[2]	Scientific Name	Pairs/ Individuals	Estimated Population size[1]	Status in Africa
Egyptian Vulture	*Neophron percnopterus*	Pairs Individuals	7500 20,000 (excl. 10,000 migrants)	Widespread north of 5□S
Bearded Vulture	*Gypaetus barbatus*	Pairs Individuals	1650-2600 4600-7000	*G.b. meridionalis* is endemic; *barbatus* in North Africa
Cape Griffon (V)	*Gyps coprotheres*	Pairs Individuals	440012000	Localised endemic
Rüppell's Griffon	*Gyps rueppellii*	Pairs Individuals	11 000 30,000	Widespread endemic
Eurasian Griffon	*Gyps fulvus*	Pairs Individuals	100-150 pairs 440 (excl. 4000 migrants)	Localised breeding resident and visitor
African White-backed Vulture	*Gyps africanus*	Pairs Individuals	100000270000	Widespread endemic
White-headed Vulture	*Trigonoceps occipitalis*	Pairs Individuals	2600-4700 7000-12,500	Relatively widespread endemic
Lappet-faced Vulture (V)	*Torgos tracheliotos*	Pairs Individuals	30008000	Widespread near-endemic
Cinereous Vulture (LR-NT)	*Aegypius monachus*	Pairs Individuals	0 Vagrant (10 migrants?)	Vagrant in North Africa
Hooded Vulture	*Necrosyrtes monachus*	Pairs Individuals	75,000-125,000 200,000-330,000	Widespread endemic
Palm-nut Vulture	*Gypohierax angolensis*	Pairs Individuals	80,000 240,000	Widespread endemic

[1] From Mundy et al. (1992)
[2] Stattersfield & Capper (2000)

VULTURE WORKSHOP - SEPT 2002 NEW ORLEANS.
Convened and Chaired by Todd Katzner and Jemima Parry-Jones

The vulture workshop began with a number of papers given by those working on the decline of Gyps vultures in the Indian subcontinent. After the papers had been given, with the most up to date information available there was a question and suggestion period. If names were not known or recorded they have not been included.

DISCUSSION:

Nigel Collar of BirdLife International asked about the problems of a possible disease factor being passed to all the *Gyps* vultures. He asked about overlapping of ranges, and whether or not problem appeared to affect more than one *Gyps* species.

Debbie Pain answered that already the problem is affecting the now three species of resident vultures in India, and so whatever it was had effectively jumped species already. It was thought that problems may be occurring with *Gyps fulvus*, large and increasing numbers of which winter in India and utilize the carcass dumps previously used by high numbers of *Gyps bengalensis.* One *Gyps himalayensis* and one *Gyps fulvus* had been found dead in India.

She pointed out that all the *Gyps* species have ranges that overlap, right down to *Gyps coprotheres* in South Africa

Munir Virani said that with some support the Pakistan researchers thought that both *Gyps indicus* and *Gyps tenuirostris* seems stable, but only in tiny and probably vulnerable populations.

There is no monitoring of *Gyps fulvus* breeding colonies at this point.

Debbie Pain informed the workshop that 6 PTT's have been received from another project and funding is available. It is planned for these to be placed on six *Gyps fulvus* early in the New Year 2003. No one knows where the wintering birds go and this should give us all a better idea.

Judit Smits asked if the PTTs were going to be used on juveniles or adults, and if juveniles, do we know what the mortality rates are for juveniles.

Munir Virani suggested following the around 900 *Gyps fulvus* on the carcass dump to their roosting areas to check on neo-mortality.

Campbell Murn asked if we know if a potential disease factor could jump from *Gyps bengalensis* to *Gyps fulvus* considering the size difference. He suggested the *Gyps africanus* might be more susceptible considering its similarity of size to *Gyps bengalensis*, than perhaps *Gyps rueppellii*

Lindsay Oaks said that a species specific virus would not be affected by body size of the host species

Gary Bortolotti asked if anyone had used any existing captive birds and tested to see if there is any possibility of transmitting whatever is killing vultures to healthy specimens.

Munir Virani and **Lindsay Oaks** had done some work with injured nestlings, feeding them parts of dead donor vultures. All the birds had been fine for two months and all had then died, including the control birds.

Mike McGrady suggested that a healthy bird from Africa might be brought to Pakistan or India and tested to see if it too died if exposed to 'sick birds'.

Munir Virani suggested that really we need to find out if any of the *Gyps* fulvus wintering in India had died of gout.

Lexo Gavashelishivili said that no signs of serious mortality had been seen in vultures in Georgia at this time.

Mike McGrady said that two *Gyps* fulvus had died in Israel, but the cause at this time was not known.

Judit Smits asked how confident the speakers were that gout was a factor.

Lindsay Oaks said that gout appears to be a factor, but there are a multiple number of factors that can cause gout

Jemima Parry-Jones asked if control birds would be likely to point more towards the disease factor, rather than toxins.

Munir Virani said that it was hard to say, but that deaths in the wild population peaked at certain times.

Gary Bortolotti pointed out that toxins could be suppressing the immune system

Campbell Murn asked what was the likely route of exposure to toxins.

Munir Virani said that, like so many aspects of this study, there could be many different routes.

Todd Katzner asked if the cattle were treated with any chemicals or dips.

Lindsay Oaks said that really very little treatment of any sort was given to cattle in Pakistan and

Debbie Pain said that similarly not much was done to cattle in India either

Judit Smits asked if the vultures ate faeces as these can be a direct route for toxic poisoning.

It was thought that generally the *Gyps* vultures do not consume faeces, although Egyptian Vultures and Hooded vultures do so.

Mark Anderson said that surely if the peak of mortality coincides with the highest levels of spraying, that if toxins are responsible for vulture deaths, the route must be pretty direct.

Lindsay Oaks mentioned that if immune systems were suppressed, more common diseases would be likely to be seen.

Charles Henny pointed out that warble fly controls put on the backs of cattle can be lethal for up to 100 days, so this could be a problem.

Debbie Pain said that it was important to remember that although Pakistan may treat their cattle, India almost certainly does not.

It was asked if anyone knew how often gout is found in vultures and other raptors anyway.

Munir Virani said that he gets e-mails from India to tell him that vultures are making a come back.

Jemima Parry-Jones pointed out that if she believed all the e-mails she got, there were hundreds of eagles with ten-foot wingspans flying around all the *Buteo* areas in the UK.

Mark Anderson suggest that all dead vultures found across the Eurasian and African ranges should be post-mortemed to look for gout as a final cause of death.

Judit Smits suggested that a simple collection kit, to include ethanol for storing samples and a simple instruction manual, with perhaps a photo of what gout looks like would be really useful. Perhaps to collect serum as well.

It was pointed out that formalin although not allowed to be shipped, is usually available in hospitals in most countries. If samples are soaked in formalin for four days and then placed in a saline solution this will keep them useable.

It was suggested that perhaps **Lindsay Oakes** and **Andrew Cunningham** could write out a very simple collecting protocol for samples.

Debbie Pain offered her new member of staff to co-ordinate information and keep in touch with people.

Farah Ishtiaq suggested that we have a standard form for monitoring so that when people offer their services, the information gained is standard and therefore usable.

Debbie Pain said that the Darwin Initiative had run a monitoring workshop in India in January to teach people how to monitor in a useful way.

Todd Katzner supported the idea of minimum requirements for people wanting to help.

Nigel Collar suggestion that the Dept. of Conservation in Iran are very good and they would probably be willing to help if approached. Perhaps he would be willing to take this on.

Campbell Murn said that we needed to talk about a conservation breeding programme.

Originally the Peregrine Fund had intended to set up a breeding programme using eggs in a site probably in Western Pakistan, but at the time the idea was not proceeded upon for a number of reasons.

However over the last two years the populations have declined further and perhaps this should be looked at again.

The questions being

Where would a facility be situated?
Where would eggs that are healthy come from?
Where would the funding come from?

A captive breeding project will take a year to set up and there is a year until the next breeding season.

Jemima Parry-Jones said that National Birds of Prey Centre (NBPC) was sending out two incubators to the Pinjore Vulture Captive Care Centre. NBPC had given a very short training session to a vet being sent out for the Darwin initiative and they were going to consider trying to hatch some eggs to see if a potential disease was being transmitter vertically.

It was decided that a number of Action Points should be decided upon to end a long meeting.

1. Monitoring of *Gyps bengalensis*, *G. indicus*, *G. tenuirostris*, and *G. fulvus* breeding sites should be started as soon as possible.
2. Consider moving 'clean birds,' possibly African *Gyps*, to India or Pakistan to see if they are affected by whatever is killing the Indian birds.
3. The website should be publicized as much as possible and encourage anecdotal information and numbers as well as scientific information
4. A captive breeding programme should be considered as a priority, could people please think of a site and contacts.
5. Susie Kasielske to put a resolution to CITES NOT to list the Indian *Gyps* Vultures on Appendix 1 for the time being as it inhibits research and potential captive breeding programs.
6. The abstracts of this workshop are to be offered for publication in Vulture News.

The workshop ended and everyone was thanked for their participation.