Darwin Initiative for the Survival of Species

Final Report

1. Darwin Project Information

Project Reference No.	162/10/013
Project title	Conservation of Critically Endangered *Gyps* spp. Vultures in India
Country	India
UK Contractor	Institute of Zoology, Zoological Society of London
Partner Organisation (s)	Bombay Natural History Society
Darwin Grant Value	£148,411
Start/End date	01-Apr-01 to 31-Mar-04
Project website	vulturerescue.org
Author(s), date	Andrew A. Cunningham & Vibhu Prakash. Received 15 Aug 2005

2. Project Background/Rationale

In the mid-1990s, Dr Vibhu Prakash, Principle Scientist, Bombay Natural History Society (BNHS) discovered a dramatic decline of *Gyps* spp. vultures in and around Keoladeo National Park (KNP), Rajasthan, India. Follow-up nation-wide surveys in 2000 (funded by the Royal Society for the Protection of Birds (RSPB) and the Ministry of Environment and Forests, Government of India) showed that these declines were not limited to KNP, but that, over the previous 10 years, three species of Gyps vulture had declined by > 90% throughout their ranges in India. Once regarded as abundant, all three species are now classified as critically endangered by the IUCN. Working with the RSPB and the Institute of Zoology, Zoological Society of London (ZSL), the BNHS showed that the declines are due to abnormally high mortality rates of all age classes and abnormally low reproductive success rates. Birds were noticed to exhibit evidence of disease prior to death; namely progressively increasing lethargy with periods of abnormal neck-drooping behaviour. Vultures with similar illness were seen throughout India and, subsequently, in Nepal and Pakistan – with concomitant abnormally high mortality rates.

The project aimed to address the problem of the *Gyps* spp. vulture declines; its cause(s), its effect on *Gyps* spp. vulture populations and the measures needed to halt and to reverse the declines.

The need for this project was initially identified by the BNHS, who called for international assistance in addressing the problem of vulture declines. This led to the situation being reviewed by Indian and international experts at an 'International Meeting on the Vulture Situation in India' held in Delhi, 18-20 September 2000, organised by the BNHS and supported financially by the RSPB and the Ministry of Environment and Forests, Government of India. At this meeting there was a consensus that there was a catastrophic and unknown problem affecting *Gyps* spp. vultures in India and that urgent measures needed to be taken. The participants produced a statement expressing concern about the problem and calling for support to establish the cause of the declines and to develop a vulture recovery plan. Determining the cause of the vulture declines and producing a recovery plan were major aims of this project. Since its inception, the local partner has shown great commitment to the project. The BNHS has provided staff, facilities, logistical support and pressed for political support during the course of the project.

3. Project Summary

The purpose of this project was the conservation of *Gyps* spp. vultures in India. The project objectives were: 1) the identification of the cause(s) of *Gyps* spp. vulture declines in India, 2) the establishment of a vulture captive care facility for disease (infectious and non-infectious) investigation and research into possible treatments, 3) determination of the extent of the progression of the declines in India through annual nationwide surveys, and 4) the development of a recovery plan for *Gyps* species in India.

Through repeated nation-wide surveys and the establishment of a nationwide monitoring network for vulture colonies, the extent and rate of declines of the three affected species of Gyps vulture have been determined. We have determined that all three resident *Gyps* spp. (*G. bengalensis*, *G. indicus* and *G. tenuirostris*) have declined by > 97% (by > 99.5% for the Indian white-backed vulture, *G. bengalensis*) throughout their ranges in India, with many areas of the country now devoid of *Gyps* spp. vultures.

The cause of these vulture declines has been found to be secondary poisoning with the veterinary drug, diclofenac, via the consumption of dead cattle and buffalo that were treated with this drug prior to death. Although the finding of diclofenac toxicity was not discovered by the Darwin Initiative-funded team, but by another research group working in Pakistan, the DI-funded project alerted other organisations to the plight of vultures in South Asia and may have been indirectly responsible for this breakthrough. [N.B. It would have been impossible for the DI-funded team to make such a finding due to a lack of suitable analytical facilities in India and the failure of the Indian Government to issue permits to export samples for analysis outside of India (other than a small number of very small tissue samples to Australia – see below).] We confirmed diclofenac toxicity as a cause of vulture mortality in India through the analysis of our archived vulture tissue bank (although tissues cannot be exported, tissue extracts containing no DNA can be exported for analysis and, knowing which chemical to analyse samples for, specific diclofenac extractions were conducted within the Vulture Care Centre laboratory). In addition to diclofenac toxicity, we have discovered a novel herpes virus associated with inflammatory lesions in the nervous system of vultures found dead. Also, lesions which appear to be caused by this virus have been found in the bursa of Fabricius of juvenile birds found dead with no evidence of diclofenac toxicity. Whether this virus is an important cause of death of vultures is currently unknown. Work is now continuing to further investigate both the diclofenac and the herpes virus findings.

A Vulture Care Centre (VCC) was established in Pinjore, Haryana with the original objective of holding sick vultures for veterinary investigation. The VCC was officially opened by Mr Elliot Morley, then Parliamentary Under Secretary of State, DEFRA, on 7th February 2003, since when it has continued to expand. The VCC has proved to be highly successful, both as the scientific base for the project in India and as an important political landmark. Amongst other outputs, research at this centre has shown that symptomatic treatment of sick birds with supportive therapy, such as parenteral fluids, can bring about an apparent full recovery within a week or so. It is unclear, however, if the recovered birds were suffering from diclofenac toxicity, herpes virus infection or an unknown ailment (see below) and further research into this is underway.

A range of options for remedial measures have been evaluated by project staff and by an international gathering of vulture experts, who were brought together in India during a Recovery Plan workshop as the culmination of this Darwin Initiative-funded project. Measures necessary for halting the vulture declines (primarily, the initiation of a major, international, captive breeding programme for all three affected species and the banning of diclofenac use in livestock) were identified at this workshop and these have been presented to the Indian and other South Asian governments as part of an internationally-endorsed Recovery Plan. We are now acting on these measures as rapidly as possible with funding from a variety of sources, including post-project funding from the Darwin Initiative.

During the course of the project, much of the capacity required to implement and monitor the vulture recovery plan has been developed. As the conservation situation for vultures continues to be parlous, with three vulture species likely to go extinct throughout South Asia, further development of the necessary capacity is required and this has been addressed by the granting of post-project funding from the Darwin Initiative along with funding from other organisations (e.g. ZSL, RSPB & the National Birds of Prey Trust (NBPT)).

At the beginning of the project, support for halting the vulture declines and implementing a recovery plan was largely restricted to the BNHS and rural communities (which are adversely affected by the vulture

declines, but who have little or no political or economic influence in India). At the end of the project, there is now widespread concern about the vulture situation, both nationally and internationally, and there is a strong political will at the levels of both State and Central Government to address this problem. Additionally, the Indian Government, along with many national and international conservation NGOs, has endorsed the recovery measures identified in the Recovery Plan and there is now a long-term commitment to carry out these measures from the partner organisations (ZSL, BNHS & RSPB), individual State Governments in India and the Central Government of India.

Although the original objectives were not changed during the course of the project, the operational plan was modified, with the approval of the Darwin Secretariat, as follows:

1. Year 1 - At the beginning of the project, difficulties in transferring monies to the BNHS resulted in a delay to the arrival of initial funds to the BNHS. This money was required for the payment of staff to conduct vulture surveys. As these surveys had to be carried out at the same time of year to be comparable with previous work, we had to cancel this aspect of the first year's work. However, the money saved was transferred to the second year of the project and this enabled vulture surveys and population monitoring to be carried out in a more in-depth and detailed way than would otherwise have been possible.

2. Year 1 - Changes of personnel in the positions of Chief Wildlife Warden and Deputy Wildlife Warden of Rajasthan meant that the permission to build vulture aviaries in Rajasthan, which was obtained at the time of submission of the original grant proposal, was no longer automatic and required re-negotiation. This can be a lengthy process, but fortunately the Chief Wildlife Warden (Mr Jakati) of the neighbouring State of Haryana, intervened and offered the required permission. This allowed vulture aviary construction to proceed almost without delay and the personal interest of Mr Jakati in the project has proved to be very beneficial for the project in a variety of ways, such as the provision of office facilities and expediting the granting of certain permissions (e.g. to catch sick vultures).

3. Year 2 - A planned training visit by Andrew Cunningham in the second year of the project had to be cancelled due to ill health, but his place was taken by Dr. Romain Pizzi (an MSc veterinary graduate in Wild Animal Health) from the Institute of Zoology. Training focussed on the collection and examination of sick and dead vultures, interpretation of histological sections and the interpretation of the results from diagnostic tests, such as histopathology, bacteriology, virology and toxicology. Dr. Pizzi spent three months (Nov 2002-Feb 2003) at the Vulture Care Centre and this visit included the additional training of four BNHS staff (for at least 5 weeks over the three-month period) in setting up a diagnostic laboratory, diagnostic laboratory techniques and in the care of sick vultures. Originally, it had been anticipated that ten Indian nationals would be given this training, but no further individuals other than those working on the project for the BNHS & PDRC could be identified for this training. We were able to provide more-advanced and detailed training than anticipated, however, to the BNHS staff through the prolonged visit by Dr. Pizzi.

The Articles under the Convention on Biological Diversity which best describe the project are: 6, 7, 8, 9, 12 & 13.

During the course of the project all of the objectives have been met: the cause of the declines has been identified, a vulture captive care facility has been established, the extent and progression of the vulture declines in India have been determined, and a Recovery Plan for Gyps species in India has been developed and internationally ratified. Perhaps most importantly, there is now a strong national (in India) and international constituency in support of vulture conservation. India is not the easiest of countries to carry out conservation projects in, but despite this, and largely through the extremely hard work of the project staff, this project has proved to be highly successful in achieving its original aims and objectives.

4. Scientific, Training, and Technical Assessment

The research work of this project can be separated into two main areas: (1) determining the extent and rate of vulture declines through population surveys and monitoring of vulture colonies, and (2) determining the cause of vulture declines through clinical and post mortem, including follow-up, investigations of sick and dead vultures.

Surveys and Monitoring

The nationwide surveys were carried out by Dr. Vibhu Prakash, Principal Scientist, BNHS along with three biologists, Mr. Sachin Renade, Mr. S. Saravanan and Ms. N. Gomarthi, employed specifically for this project. Dr. Prakash is one of the world's leading authorities on raptor biology and he had originally discovered the problem of vulture mortality and declines in India. His staff were selected for working on this project following selection interviews held by the BNHS at their Head Office in Mumbai. Training in survey techniques and vulture species identification was given to these project staff by Dr. P. Donald and Dr. R. Gregory (RSPB) and by Dr. Prakash (BNHS).

Raptor surveys conducted between 1991 & 1993 by the BNHS were repeated for *Gyps* spp. vultures in 2000 (funded by the RSPB and the Ministry of Environment and Forests, Government of India). In the 2000 survey, 6355 km of road transect surveys (65 transects ranging from 8 to397 km in length) were carried out between April and June, repeating transects surveyed by the BNHS for raptors between 1991 & 1993, to assess the populations of Gyps vulture species in the north, west and east of India. In 2000 a further 5041 km of transects were added to the survey to provide vulture population data in regions for which there were no previous data. The 11,396 km of transects were surveyed between April and June 2002 and again between April and June 2003 as part of the Darwin Initiative project. Road transects are a common method for counting conspicuous raptors and we followed the methods of Fuller & Mosher (1981) Studies in Avian Biology, **6:** 235-248. Transect were driven at 10-20 km/h in protected and surrounding areas, and 50 km/h on highways. Birds sitting or soaring within 500 m of the road were recorded. For this study, the North region comprised the States of Haryana, Punjab, Himachal Pradesh, Jammu and Kashmir, Uttar Pradesh and parts of eastern Rajasthan. The West region comprised the States of Gujarat, most of Rajasthan and west Maharashtra. The East region comprised the States of West Bengal, and Orissa. The Central region comprised the States of Madhya Pradesh and Maharashtra.

Our 2000 surveys, which were undertaken prior to the start of this project, showed that *G. bengalensis* and *G. indicus* had declined by 95.7% and by 92.2% respectively when compared to the results of surveys conducted in the early 1990s. The surveys conducted in 2002 and 2003 showed a continuation of marked declines for these species. The numbers of G. bengalensis counted per km of transect declined from 0.098 in 2000, through 0.060 in 2002, to 0.012 in 2003. The rate of population change (λ) averaged over this period by Poisson regression, was 0.520 (48% decline per year). For G. indicus, the encounter rates in the three years were 0.066, 0.051 and 0.022 birds per km of transect and λ was 0.775 (22% decline per year). The rate of decline was significantly slower for G. indicus than G. bengalensis ($\chi^2 = 22.44$, 1 degree of freedom, $P < 0.001$). The slender-billed vulture (G. tenuirostris), a recently-recognised species which had previously been lumped with G. indicus, was counted as a separate species during transects only in 2002 and 2003, but its rate of decline appears to be similar to that for G. bengalensis. The methods and results of our surveys have been subjected to peer-review with papers published in respected international journals, as follows:

1. Prakash, V., Pain, D. J., Cunningham, A. A., Donald, P. F., Prakash, N., Verma, A., Gargi, R., Sivakumar, S. and Rahmani, A. R. (2003) Catastrophic collapse of Indian white-backed *Gyps bengalensis* and long-billed *Gyps indicus* vulture populations. *Biological Conservation* **109,** 381-390.

2. Pain, D. J., Cunningham, A. A., Donald, P. F., Duckworth, J. W., Houston, D. C., Katzner, T., Parry Jones, J., Poole, C., Prakash, V., Round, P. and Timmins, R. (2003) Causes and effects of temporospatial declines of Gyps vulture in Asia. *Conservation Biology* **17,** 661-671.

Also, our findings have been presented at numerous national (Indian & British) and international conferences. Additional papers are planned or are in preparation.

While nation-wide population surveys are essential for determining the overall effects of the declines on vulture populations, colony monitoring is required in order to gain more-detailed information on the dynamics of the declines within and between vulture populations. In January 2002 a workshop was held in India to train 38 biologists and ornithologists in colony monitoring techniques and to set up a network of volunteers to monitor colonies across the country. Workshop attendees were recruited primarily from the Indian Bird Conservation Network (IBCN) and State Governments and selection was based on their proximity to vulture colonies and their known abilities through previous professional collaborations with the BNHS.

Colony monitoring was conducted by the above three BNHS biologists along with a network of volunteers (see below). Dr. Vibhu Prakash and Mr. Sachin Renade coordinated the volunteer network, periodically visiting volunteers to ensure that standard methods were being employed and that correct vulture identifications were being made. In February 2004, a further workshop on colony monitoring was held to provide refresher training and to bring together the volunteers to compare notes and experiences.

In addition to the monitoring conducted by the volunteer network, project staff carried out monitoring of 16 vulture colonies in North, West and Central India and one colony in South India (Kerala) during the course of the project, including intensive (daily or weekly) monitoring of one of the few remaining large *G. indicus* colonies (in Bayana, Rajasthan). The results of these monitoring activities have shown some geographic and temporal variation in rates of decline and breeding success, although in all places the overall demographic trends follow those of the nation-wide surveys. In addition to providing demographic data at a finer scale than nation-wide surveys, colony monitoring has been useful for obtaining vulture carcases for pathological investigations and for raising the profile of vulture conservation at the local level. The methods and results of the colony monitoring have been presented at national (Indian) and international conferences and publication of a peer-reviewed paper in an international journal is planned.

Vulture Captive Care and Husbandry

Training workshops in captive care and husbandry were held at the Vulture Care Centre in June 2002 and in February 2004 by Jemima Parry-Jones, Director of the National Birds of Prey Centre, U.K. BNHS project staff and Haryana forestry and wildlife officials (appointed by the Forest and Wildlife Department, Govt. of Haryana) attended these courses, which included training in vulture handling and nutrition, aviary design and cleaning protocols. International standards of health and welfare aspects of keeping vultures in captivity were emphasised and disease prevention measures were discussed and demonstrated in detail. These workshops included slide presentations and theory, but primarily involved practical interactive demonstrations and on-the-job training.

In addition to training on-site at the Vulture Centre in India, two project staff, Dr. Vibhu Prakash and Dr. Devojit Das, visited the U.K. for training. Dr. Das was appointed as project veterinarian following a national advertisement of the position and both oral and practical interviews (the interview panel included Dr. Prakash, Dr. Rahmani (the Director of BNHS) and Dr. Cunningham). Dr. Vibhu Prakash visted the U.K. from September to December in 2001, during which time he was trained to international standards in the husbandry, management and handling of captive vultures and other birds of prey at the National Birds of Prey Centre, Gloucestershire. In addition, he visited other institutions holding birds of prey in order to experience alternative husbandry methods. Dr. Prakash re-visited the U.K. in February 2003. It had originally been planned that this visit would also be for three months, but work demands of the project in India and the ability to provide much of the necessary training in India (through Dr. Pizzi's three-month visit – see below) curtailed the period of this visit to three weeks. During this period, Dr. Prakash spent most of his time working on the collaborative analysis of data collected from the first half of the project. These analyses were conducted at the Institute of Zoology (ZSL) and at the RSPB. At the RSPB, this work included training in statistical analyses and data management. While in the UK, Dr. Prakash was presented with an international award (the Marsh Award) for bird conservation, primarily for his work on vulture declines in India.

Dr. Devojit Das visited the U.K. for three months veterinary training in 2004 (see below), during which time he also experienced two weeks of training in captive husbandry and handling of vultures and other birds of prey at the National Birds of Prey Centre, Gloucestershire.

Clinical and Post Mortem Investigations

Training in carcase collection and submission was given by Dr. Andrew Cunningham to the participants of the Monitoring Workshop held in January 2002. Training in post mortem sample collection, pathological investigation methodologies and the interpretation of results was given by Dr. Cunningham to three staff at the Poultry Diagnostic Research Centre, Pune (PDRC) (Dr. Prashant Nighot, Dr. Malikarjun Goudar & Dr. Supriya Kshirsagar). The PDRC was selected as a project partner after visits by Dr. Prakash and Dr. Cunningham to several veterinary diagnostic institutions throughout India showed the PDRC to be the most competent and reliable of these. The staff trained were chosen by the General Manager of the PDRC on the criteria that they were his most capable staff members for conducting vulture diagnostic work in his laboratory. Each of Dr. Cunningham's frequent training visits was of 7-10 days duration. Training focussed on the collection and examination of sick and dead vultures, interpretation of histological sections and the

interpretation of the results from diagnostic tests, such as histopathology, bacteriology, virology and toxicology. A planned visit by Dr Cunningham in 2002 had to be cancelled due to ill health, but his place was taken by Dr. Romain Pizzi (an MSc veterinary graduate in Wild Animal Health) from the Institute of Zoology. Dr. Pizzi spent three months (Nov 2002-Feb 2003) at the Vulture Care Centre and this visit included the additional training of four BNHS staff (for at least 5 weeks over the three-month period) in setting up a diagnostic laboratory, diagnostic laboratory techniques and in the care of sick vultures.

During 2002, advances were made in the diagnostic capabilities of the project. Firstly, a Research Agreement was signed by the BNHS, PDRC and the Australian Government's CSIRO Australian Animal Health Laboratory (AAHL) and was approved by the Indian Central Government, allowing a limited number of diagnostic samples to be exported to AAHL, one of the top veterinary diagnostic laboratories in the world. Secondly, the establishment of a diagnostic and research laboratory at the Vulture Care Centre enabled the collection of sequential clinical samples from sick birds and the ability to conduct detailed post-mortem examinations. The requirement for regular veterinary observation, treatment and sampling of captive vultures and the continued ability to conduct detailed post mortem examinations of vultures led to the appointment of a dedicated veterinarian (Dr. Devojit Das) to the vulture project.

In March 2003 Dr. Das was recruited to the project (employed by BNHS) following the completion of the Vulture Care Centre aviaries and laboratory (VCC). Dr. Cunningham and a veterinary colleague (Dr. Yedra Feltrer, an MSc veterinary graduate in Wild Animal Health at the Institute of Zoology) provided on-the-job training in clinical and pathological vulture disease investigations to Dr. Das over the course of several visits to the VCC. Dr. Feltrer spent a three month period in India (from March – June 2003) training Dr. Das in wildlife veterinary techniques. In addition, Dr. Das visited the UK for three months veterinary training in 2004. During this period, Dr. Das worked at the Zoological Society of London's Veterinary Department, was trained in avian haematology by Mike Hart (one of the world's leading wildlife haematologists) at Greendale Laboratories in Surrey and spent some time working at the National Bird of Prey Centre (NBPC), Gloucestershire and with the NBPC's veterinary surgeon (Mr. Neil Forbes, a recognised specialist in raptor medicine and surgery).

Obtaining freshly-dead vultures for post-mortem examination proved to be very difficult. This was because (i) the high temperatures and presence of mammalian scavengers meant that vultures needed to be found very quickly after death (or as sick birds close to death), (ii) by the time the project started, vultures already were very rare, and (iii) obtaining permits from State authorities was problematic, often preventing the collection and/or examination of dead birds. Also, the euthanasia of wild birds (no matter how sick) is not permitted in India. During the course of the project, 49 freshly-dead vultures were examined post mortem. Fifteen of these birds died with visceral gout (the accumulation of uric acid in their tissues). No gross abnormalities were found in the remaining birds. On histological examination, however, a significant proportion of the birds had mild inflammatory lesions within some of the tissue, usually including the brain. A novel herpes virus was isolated from one of these birds, and the subsequent development of a specific PCR test has led to this virus being found within a high proportion of the dead birds examined. While the inflammatory lesions (particularly those in the brain) are consistent with herpes virus infection, we have not yet been able to demonstrate a causative relationship and it is possible that the herpes virus is benign to *Gyps* spp. vultures. It is also possible that the inflammatory lesions are caused by diclofenac toxicity, although this has not been demonstrated by experimental diclofenac exposure in vultures conducted by other groups.

As had been noticed previously by Dr. Prakash, we found that vultures would show signs of progressive illness (primarily characterised by increasing lethargy, drooping of the neck, fluffing of feathers and closing of the eyes) for variable amounts of time, but often lasting several days or weeks, prior to death. Of 11 birds caught which displayed this range of clinical signs and which were transferred to the VCC, only one died. This bird died on the same day of capture with extensive visceral gout. The other sick vultures had clinical evidence of dehydration and all recovered over a period of several days following symptomatic treatment with parenteral fluids. A range of haematological and plasma biochemistry examinations was conducted on blood samples taken from sick, recovered and healthy vultures. No significant differences were found between affected and unaffected birds other than that birds with neck drooping syndrome had a monocytosis relative to healthy or recovered vultures. Monocytosis in birds is usually due to infection with *Aspergillus* spp. fungus, *Mycobacterium* spp. bacteria or herpes virus. It is not known if diclofenac toxicity causes monocytosis in birds.

Following the discovery of acute diclofenac toxicity as a cause of vulture declines in Pakistan (via death due to renal failure and visceral gout), we tested our archived vulture tissues for the presence of this drug (although tissues cannot be exported, tissue extracts containing no DNA can be exported for analysis and, knowing which chemical to analyse samples for, specific diclofenac extractions were conducted within the Vulture Care Centre laboratory by the project staff). Ten of the 15 vultures that died with gout were tested for diclofenac. Three of these birds had levels of diclofenac in their tissues (liver and/or kidney) in the range of those reported previously from vultures that died with acute toxicity and the remaining birds had lower levels of diclofenac in their tissues. There was a significant association between the presence of diclofenac and death with visceral gout. Interestingly, however, we found that none of the sick birds which had been brought to the VCC and recovered had raised plasma uric acid levels (diclofenac toxicity invariably causes a marked increase in plasma uric acid levels) or any other sign of impaired renal function when showing clinical illness.

Many of the pathological findings from the project have been subjected to peer-review with papers published in respected international journals, as follows:

1. Cunningham, A. A., Prakash, V., Pain, D., Ghalsasi, G. R., Wells, G. A. H., Kolte, G. N., Nighot, P., Goudar, M. S., Kshirsagar, S. and Rahmani, A. (2003) Indian vultures: victims of an infectious disease epidemic? *Animal Conservation* **6,** 189-197.

2. Shultz, S., Baral, H. S., Charman, S., Cunningham, A. A., Das, D., Ghalsasi, G. R., Goudar, M. S., Green, R. E., Jones, A., Nighot, P., Pain, D. J. & Prakash, V. (2004) Diclofenac poisoning is widespread in declining vulture populations across the Indian subcontinent. *Proceedings of the Royal Society of London, Series B: Biological Sciences* **271,** S458-S460.

3. Green, R. E., Newton, I., Shultz, S., Cunningham, A. A., Gilbert, M., Pain, D. J. & Prakash, D. J. (2004) Diclofenac poisoning as a cause of vulture population declines across the Indian subcontinent. *Journal of Applied Ecology* **41,** 793-800.

4. Cardoso, M., Hyatt, A., Selleck, P., Lowther, S., Prakash, V., Pain, D., Cunningham, A. A. and Boyle, D. (2005) Phylogenetic analysis of the DNA polymerase gene of a novel alphaherpesvirus isolated from an Indian *Gyps* vulture. *Virus Genes* in press.

Also, our findings have been presented at numerous national (Indian & British) and international conferences. Additional papers are planned or are in preparation.

5. Project Impacts

Evidence that the project achievements have led to the accomplishment of the project includes a series of peer-reviewed publications in international scientific journals, which demonstrates the extent and rate of vultures declines in India (3rd project purpose) and the cause of the declines (1st project purpose). Additionally, the construction of a Vulture Centre has allowed the pathological examination of dead vultures and the clinical examination of sick vultures, enabling the latter to be treated and to recover (2nd project purpose). This Centre has since formed the basis of an international conservation breeding programme, recommended in the Recovery Plan developed by the Darwin Initiative-funded international recovery plan workshop (4th project purpose).

An unexpected impact has been a heightened interest in India, by both conservation biologists and politicians, in wildlife disease issues in general. This has led to the increased capacity developed within the BNHS during this project, to be sought for investigating other wildlife disease and conservation issues, such as sarus crane mortality (which resulted in a scientific publication) and annually recurring outbreaks of mortality in peafowl.

The project has helped India to meet several of its obligations under the Biodiversity Convention (CBD), as follows:

A national strategy has been developed for vulture conservation as part of an international recovery plan for *Gyps* spp. vultures (CBD article 6 a).

The project identified *Gyps* spp. vultures as components of India's biological diversity important for conservation (CBD article 7 a) and developed monitoring of vulture populations nation-wide (CBD article 7 b). (It was the results of this project that led to the listing by the IUCN of *G. bengalensis*, *G. indicus* and *G. tenuirostris* as critically endangered.) Electronic databases of these monitoring and survey activities have been developed and maintained (CBD article 7 d).

Through the work of this project, activities (i.e. use of veterinary diclofenac) were identified as having significant adverse impacts on biodiversity conservation in India (CBD article 7 c) and recommendations have been made (and acted upon by the Indian Government) to protect vulture populations in the face of this threat (CBD article 8 d, f, i, k & l).

Measures for the *ex-situ* conservation of *Gyps* spp. vultures, through the development and implementation of a national (in India) and international captive breeding programme, have resulted from this project (CBD article 9 a, b, c).

The training programmes conducted as part of this project helped to meet obligations under CBD article 12 a, b & c.

Several scientific articles and a large number of media outputs were generated by this project, promoting and encouraging understanding of the importance of, and the measures required for, the conservation of *Gyps* spp. vultures in India (article 13 a).

The final workshop of this project resulted in the development and publication of a vulture Recovery Plan which has been ratified by the Indian Government and several national and international conservation NGOs. This Plan includes the implementation of internationally cooperative captive breeding programmes for each of the three affected *Gyps* spp. and educational public awareness programmes about the threats to these species (CBD article 13 b)

The major policy decision resulting from the project has been the announcement by the Prime Minister of India to phase out the manufacture and sale of veterinary products containing the non-steriodal anti-inflammatory drug, diclofenac, over a six-month period. Some States (i.e. Gujurat, Tamil Nadu, Himachal Pradesh, Uttaranchal, Punjab) had already announced their own bans on the sale of veterinary diclofenac.

Vulture conservation has been catapulted to a priority position by many State governments, with several States (e.g. Haryana, Gujurat, Rajasthan and West Bengal) developing specific conservation policies, including seeking collaboration with BNHS to develop conservation breeding programmes.

The research findings, and the new skills and capacity acquired by the BNHS during this project, has led this organisation to develop a nation-wide conservation breeding and veterinary strategy for vultures. This is the first time this organisation has been involved in either of these fields. Furthermore, the breeding strategy includes international collaboration with other NGOs, such as Bird Conservation Nepal and the Ornithological Society of Pakistan, and training will be provided by BNHS to these collaborating organisations.

The Ministry of Environment and Forests, Government of India, the Bombay Natural History Society, BirdLife International, the Royal Society for the Protection of Birds and the Zoological Society of London moved a joint resolution at the World Conservation Congress at its 3rd Session in Bangkok, Thailand, 17-25 November 2004, urging the IUCN Director General and the Species Survival Commission to make strategic and long-term commitments to vulture conservation.

Capacity for biodiversity work has been improved through (i) the training of veterinarians and biologists in disease (infectious and non-infectious) threats to biodiversity conservation and in international standards for the investigation of these threats, and (ii) the development of infrastructure (including laboratory equipment) for wildlife disease investigations within the country's largest national biodiversity conservation NGO. The publication of results from the current project and of results from other investigations (e.g. Pain et al. Mortality of globally threatened Sarus cranes Grus antigon from monocrotophos poisoning in India. (2004) *Sci. Total Env.* **326,** 55-61) in peer-reviewed journals and at international conferences is evidence for this.

Many personnel were trained during the course of this project to varying degrees. The required information about the personnel receiving training during specific training workshops, training visits to the U.K. and/or on-the-job- training by experts visiting from the U.K. is as follows:

1. Dr. Vibhu Prakash – trained in wildlife disease issues; interpretation of the results from diagnostic tests, such as histopathology, bacteriology, virology and toxicology; statistical analyses and data management; advanced captive care and husbandry of vultures; project management and budgeting. Continues to be employed as Principal Scientist, BNHS and Project Manager for the BNHS' vulture conservation project in India.

2. Mr. S. Saravanan – trained in vulture species identification; vulture trapping; vulture handling; captive care and husbandry of vultures; colony monitoring and population survey techniques; carcase collection and submission techniques; oral and written questionnaire survey methods; driving (licence obtained during project). Continues to be employed by BNHS on the vulture project, where he is now in charge of nation-wide colony monitoring and data collection, supervises vulture trapping and submission of carcases to the Vulture Centre laboratory. It is expected that he will continue these duties on the project, although he has also conducted preliminary investigations into the socio-economic effects of the vulture declines and this aspect of his work might increase in due course.

3. Mr. Sachin Ranade - trained in vulture species identification; vulture trapping; vulture handling; captive care and husbandry of vultures; colony monitoring and population survey techniques; carcase collection and submission techniques; oral and written questionnaire survey methods; driving (licence obtained during project). Continues to be employed by BNHS on the vulture project, where he is now project manager for the construction of a new Vulture Conservation Breeding Centre in West Bengal. It is expected that he will continue to work on the project, primarily conducting population surveys and managing vulture captive care and husbandry.

4. Ms. N. Gomarthi - trained in vulture species identification; captive care and husbandry of vultures; colony monitoring and population survey techniques; carcase collection and submission techniques; oral and written questionnaire survey methods. She is currently employed by the Salim Ali Centre for Natural History and Ornithology, Tamil Nadu on a vulture conservation project.

5. Dr. Devojit Das - trained in wildlife disease issues; vulture species identification; clinical and pathological examinations of sick and dead wildlife, specifically vultures; interpretation of histological sections and interpretation of the results from diagnostic tests, such as histopathology, bacteriology, virology and toxicology; solvent extraction of tissues; venepuncture techniques for blood-sampling vultures; treatment of avian diseases; avian haematology and biochemistry; vulture handling, advanced captive care and husbandry; carcase collection and submission techniques; driving (licence obtained during project). Continues to be employed by BNHS as vulture project veterinarian and will be expected to train additional veterinary staff in wildlife (vulture) captive care, management and diagnostics.

6. Mr. Udayan Borthakur - captive care and husbandry of vultures; colony monitoring and population survey techniques; carcase collection and submission techniques; solvent extraction of tissues. Mr. Borthakur was also sent on a training workshop in Centre for Cellular and Molecular Biology, Hyderabad, India on molecular biology, but unfortunately he left the project shortly afterwards and his current employment situation unknown.

7. Dr. Malikarjun Goudar - trained in wildlife disease issues; pathological examinations of wildlife, specifically vultures; interpretation of the results from diagnostic tests, such as histopathology, bacteriology, virology and toxicology; venepuncture techniques for blood-sampling vultures. Continues to be employed by the Poultry Diagnostic Research Centre, Pune as a senior diagnostic veterinarian.

8. Dr. Supriya Kshirsagar - trained in wildlife disease issues; pathological examinations of wildlife, specifically vultures; interpretation of the results from diagnostic tests, such as histopathology, bacteriology, virology and toxicology; venepuncture techniques for blood-sampling vultures. Continues to be employed by the Poultry Diagnostic Research Centre, Pune as a diagnostic

veterinarian.

9. Dr. Prashant Nighot - trained in wildlife disease issues; pathological examinations of wildlife, specifically vultures; venepuncture techniques for blood-sampling vultures; interpretation of histological sections and the interpretation of the results from diagnostic tests, such as histopathology, bacteriology, virology and toxicology. Left employment at the Poultry Diagnostic Research Centre, Pune to take up a scholarship to study for a PhD at the North Carolina State University under their Comparative Biomedical Sciences Programme.

10. Mr. C. Sashikumar - vulture species identification; colony monitoring and population survey techniques; carcase collection and submission techniques. Now part of a volunteer network of vulture colony monitors.

11. Mr. Kartik Shastri - vulture species identification; colony monitoring and population survey techniques; carcase collection and submission techniques. Now part of a volunteer network of vulture colony monitors.

12. Mr. Bishwa Swarup Raha - vulture species identification; colony monitoring and population survey techniques; carcase collection and submission techniques. Now part of a volunteer network of vulture colony monitors.

13. Dr. Satish Kumar - vulture species identification; colony monitoring and population survey techniques; carcase collection and submission techniques. Now part of a volunteer network of vulture colony monitors.

14. Mr. Vishwas Dattatray Katdare - vulture species identification; colony monitoring and population survey techniques; carcase collection and submission techniques. Now part of a volunteer network of vulture colony monitors.

15. Mr. Jaikisha Sharma - trained in vulture trapping, vulture handling, advanced captive care and husbandry. Employed as a vulture care attendant at the Vulture Care Centre, Haryana.

16. Mr. Sagun Chand - trained in vulture trapping, vulture handling, captive care and husbandry. Employed as a vulture care attendant at the Vulture Care Centre, Haryana.

17. Mr. Rajendra Singh Negi – trained in book-keeping, driving (licence obtained during course of the project), vulture handling. Employed by BNHS as administrator, book-keeper and veterinary assistant.

18. Mr. Sadaran – trained in vulture species identification; vulture handling; captive care and husbandry of vultures; colony monitoring and population survey techniques; carcase collection and submission techniques. Continues to be a Wildlife Inspector for the Government of Haryana and is extremely keen to be more involved with vulture conservation work.

19. Mr. Rakesh Sharma – trained in vulture species identification; vulture handling; captive care and husbandry of vultures; colony monitoring and population survey techniques; carcase collection and submission techniques. Continues to be a Forestry Officer for the Government of Haryana and is extremely keen to be more involved with vulture conservation work.

This project has been the first collaboration between the ZSL and the BNHS. During the course of the project, additional areas of collaboration between the two organisations have been identified and these are now being worked up. In addition to areas of conservation research related to vulture declines (e.g. threats to public health and wildlife conservation from dog diseases) and research into other wildlife diseases of conservation importance (e.g. apparent lead poisoning of endangered waterfowl, apparent widespread pesticide toxicoses of wildlife, recurring annual outbreaks of mortality in peafowl), other areas of potential collaboration, such as wildlife-human conflict (e.g. elephants) and the ecology of endangered species (e.g. tigers), are being developed. Some of these collaborations will be directly dependent on the capacity built up within BNHS during the course of the current project.

The project has developed closer links between the BNHS and Forest and Wildlife departments of several State Governments, including Haryana, Rajasthan, Maharashtra, Madhya Pradesh, Assam and West Bengal. In addition, the links that already existed between BNHS and the Ministry of Environment and Forests, Government of India, have been strengthened, with Government officials visiting the Vulture Centre on several occasions. Also, Indian Government officials attended the final (Vulture Recovery Plan) workshop of the Darwin Initiative-funded project.

The rural community local to the Vulture Centre has benefited greatly from the project in the following ways: (i) local villagers have been employed on the project as vulture attendants and night watchmen, (ii) local firms have been contracted to carry out aviary and laboratory construction, (iii) all construction materials were sourced locally, and (iii) the installation of three-phase electricity to the Vulture Centre has resulted in the village of Jodhpur, Haryana (which is near-by to the Vulture Centre) being connected to a reliable electricity supply. This connection has brought many benefits to the village, such as enabling domestic electrical appliances to be used for the first time. Food for the vultures is sourced locally and the local butcher now earns as much in one month as he used to earn in one year. With this increased employment, the local economy has noticeably improved, as has the standard of living for villagers in the region surrounding the Vulture Centre. Also, the project veterinarian, Dr. Das, has provided free treatment for livestock and companion animals local to the Vulture Centre. In addition, medical advice for villagers has been provided by the project veterinarian and visiting veterinarians from the U.K., further improving their standard of living. Therefore, village communities local to the project are extremely supportive of the vulture conservation project.

In addition, villagers have been employed as assistants and to provide accommodation and transport at two long-term monitoring sites in Rajasthan and at one site in Kerala. Also, several villagers from Bihar have been employed for their expertise in trapping vultures.

6. Project Outputs

Information relating to project outputs and outcomes has been disseminated via project workshop proceedings; conference presentations, abstracts and proceedings; articles in peer-reviewed journals; articles in the popular and scientific press; radio and television interviews and documentaries; project newsletters; partner organisation's web sites and a dedicated "Vulture Rescue" website. It is planned that dissemination via websites, journals and media will continue, with the costs continued to be borne by the partner organisations.

7. Project Expenditure

CATEGORY	BUDGETED EXPENDITURE (in original proposal)	ACTUAL EXPENDITURE	COMMENTS
YEAR 1			
SALARIES			
OVERHEADS			
OFFICE COSTS			
TRAVEL & SUSBSISTENCE			
PRINTING			
CONFERENCES & WORKSHOPS			
CAPITAL			
OTHER			
TOTAL			
YEAR 2			

SALARIES			
OVERHEADS			
OFFICE COSTS			
TRAVEL & SUSBSISTENCE			
PRINTING			
CONFERENCES & WORKSHOPS			
CAPITAL			
OTHER			
TOTAL			
YEAR 3			
SALARIES			
OVERHEADS			
OFFICE COSTS			
TRAVEL & SUSBSISTENCE			
PRINTING			
CONFERENCES & WORKSHOPS			
CAPITAL			
OTHER			
TOTAL			

8. Project Operation and Partnerships

Four local partners worked on project activities:

1. Bombay Natural History Society (BNHS)
2. Haryana Government Forest Department (HGFD)
3. Indian Bird Conservation Network (IBCN)
4. Poultry Diagnostic Research Centre of Venkateshwara Hatcheries Ltd. (PDRC).

Initially, we had anticipated that the vulture project would be based in Bharatpur, Rajasthan with support from the Government of Rajasthan's Forest Department for the siting and construction of the Vulture centre. However, changes of personnel in the positions of Chief Wildlife Warden and Deputy Wildlife Warden of Rajasthan meant that the permission to build vulture aviaries in Rajasthan was no longer automatic and required re-negotiation. This can be a lengthy process, but fortunately Mr Jakati, the Chief Wildlife Warden of the neighbouring State of Haryana, intervened and offered the required permission. This allowed vulture aviary construction to proceed almost without delay and no problems arose from this change of location. Indeed, the personal interest of Mr Jakati in the project has proved to be extremely beneficial – for example, in expediting the granting of other permissions required and in the provision of wildlife warden services that would otherwise not have been available to the project.

The BNHS was the main local partner on the project and was involved with project planning and implementation from the very beginning (proposal application stage) and throughout the course of the project.

The HGFD was involved in the implementation of the captive aspects of the project: siting and construction of the VCC, granting permits for the capture of vultures and for keeping them in captivity,

granting permits for the collection of dead vultures in Haryana and for the transport of vulture carcases to the VCC for pathological investigation, lobbying Central Government and State Governments on vulture conservation issues, primarily for their support of, and cooperation with, the Darwin Initiative-funded project.

Members of the IBCN attended training workshops and participated in the nation-wide monitoring of vulture colonies.

The PDRC was our main local partner for the implementation of veterinary aspects of the study. From the outset, PDRC staff assisted with pathological examinations and with obtaining permits to conduct various pathological studies at their, and other, institutions and the involvement of the PDRC was instrumental in obtaining permits to submit samples to the CSIRO Australian Animal Health Laboratory. The main PDRC laboratory in Pune was used as the project base for veterinary work until the construction of a laboratory at the VCC and the employment and training of a full-time project veterinarian.

There were no similar projects in the host country, but there was collaboration with similar projects in Pakistan and Nepal – the former run by the Ornithological Society of Pakistan (OSP) in collaboration with the Peregrine Fund (USA), the latter run by Bird Conservation Nepal in collaboration with the RSPB and ZSL.

In India each State has a biodiversity officer as part of the country's Biodiversity Strategy. As in Haryana, this is usually the same person as the Chief Wildlife Warden. These officers have been integral to the project in many States, including Haryana, Rajasthan, Madhya Pradesh, Himachal Pradesh, Maharashtra, Gujurat, West Bengal, Assam, Uttaranchal, Uttar Pradesh, Arunachal Pradesh and Orissa. Additionally, the Secretary, Ministry of Environment and Forests, Government of India (the most senior bureaucrat in charge of wildlife in India) has been consulted, and apprised of progress and results, throughout the project.

There have been four international partners participating in project activities:

1. Institute of Zoology, Zoological Society of London (UK).
2. The Royal Society for the Protection of Birds (UK).
3. The National Birds of Prey Trust (UK).
4. The CSIRO Australian Animal Health Laboratory (Australia).

There has been a great deal of vulture conservation activity, both practical and political, since the end of the Darwin Project. This has been picked up and enhanced with the implementation of a post-project extension grant and additional Darwin Initiative-funded vulture conservation work through a separate grant to the RSPB. The BNHS continue to lead vulture conservation activities in India, both through field activities and the development of a captive breeding programme. The Haryana Government Forest Department has continued to be very active in working with other State Governments and with the Central Government on vulture conservation as part of the Indian biodiversity strategy process. The Government of West Bengal has provided land, buildings and logistical support for the construction of a second Vulture Conservation Breeding Centre. The private sector has been involved throughout the project through the activities of the PDRC in providing facilities, staff time and political support. The PDRC is a division of Venkateshwara Hatcheries Ltd., a private company which owns over 80% of poultry production in India and it has continued to provide technical and logistical support since the end of the Darwin Initiative-funded project. More recently, with the demonstration that diclofenac residues in livestock carcases are the major cause of vulture mortality and declines, participation in vulture conservation efforts (primarily ceasing the sale of diclofenac as a veterinary product) has been actively sought from the pharmaceutical industry in India and the Indian Veterinary Research Institute (to conduct research on safe alternative veterinary drugs). Where required (e.g. colony monitoring, support for the VCC), IBCN and community support and participation in this project has been readily forthcoming. Vulture conservation is now regarded as an essential activity by a large section of the Indian population.

9. Monitoring and Evaluation, Lesson learning

Monitoring and evaluation (M&E) of the project work was carried out on a regular basis during visits to India by UK staff. Day-to-day M&E was conducted by named Indian project staff who were responsible for selected aspects of the project. For example, Mr. Sachin Ranade was responsible for ensuring colony monitoring was conducted correctly by the volunteer network. To do this, he would make regular contact with volunteers by telephone and visit the volunteers twice per year. Mr. Ranade was supervised by Dr. Vibhu Prakash and the outputs were discussed and analysed regularly during visits by UK staff throughout the duration of the project and at a follow-up colony monitoring workshop (along with colony monitoring volunteers) in February 2004. M&E of project staff trained in techniques new to them was conducted on a frequent basis initially, and then less frequently as they became more competent at the task. For example, when Dr. Das was initially employed as the project veterinarian, he was evaluated on a daily and then a weekly basis by Dr. Feltrer on his ability to conduct clinical and laboratory work. As his abilities improved and as it became obvious that he was competent in the required techniques, M&E was decreased to less-frequent intervals.

During the course of this project, baseline information was collected on the following:

1. Population sizes and structures of three species of *Gyps* spp. vulture in India.
2. Sizes of vulture populations at 17 colonies and 2 carcase dumps.
3. Haematological and blood biochemical parameters of *G. indicus* and *G. bengalensis* (these were previously unknown).
4. Body weights for adult, subadult and juvenile *G. indicus* and *G. bengalensis* (these were previously unknown).

The main problem encountered during the course of the project was obtaining permits to conduct the work. Almost every aspect of the project, from picking up a dead vulture to constructing aviaries or catching sick or healthy birds, required permits; with a permit needing to be issued for each occasion something had to be done (e.g. a permit was required every time a dead vulture was to be collected). Also, moving vultures, or their tissues, across State borders required additional permits from both States concerned. Permits are issued by State Government Forestry and Wildlife Departments (usually through or by the Chief Wildlife Warden of each State), but often not without first obtaining permission in writing from the Central Government. Applying for permits is one thing, obtaining them in a timely fashion (or at all) is quite another. In all cases, permits were applied for by the BNHS as they would not be issued to foreigners. The Haryana State Government were very supportive in helping us to obtain permits, and they almost always issued their own permits very rapidly, mainly thanks to the efforts of Dr. Jakati, Chief Wildlife Warden of Haryana. It is likely that this project would not have been such a success without the personal interest and strong support of Dr. Jakati. Personal contacts were cultured between Dr. Vibhu Prakash (BNHS project leader) and Chief Wildlife Wardens in other States, and also with Wildlife Staff in Central Government. Visits to the Project by UK officials, such as the Deputy High Commissioner (in January 2002) and by Elliot Morley MP (in February 2003) also helped a great deal in facilitating the issuing of permits, although care had to be taken for these visits not to be seen as lobbying for Indian Government support.

External evaluations have been conducted by several visits from British High Commission staff (in 2002, 2003 & 2004) and during a visit by Simon Lister (Darwin Initiative) in November 2003. In addition, the project was visited by Mr Elliot Morley MP in February 2003.

Internal evaluations of the project were carried out annually by the BNHS Research Advisory Committee, and annual appraisals were made by Georgina Mace, Director, Institute of Zoology, ZSL.

The key lesson from this project is that personal contacts and the commitment of project staff and supporters is crucial if the work plan is to be achieved in countries with a bureaucracy such as India's. It would be very helpful to such projects if, once an award has been approved, the Darwin Initiative Secretariat officially informed the relevant government department (in this case, the Ministry of Environment and Forests, Government of India) in the host country at the highest level. This contact should be to inform the government about the project outline and goals. It should be emphasised that funding has been given because the U.K. government is convinced that the project is important under the criteria of the CBD and to request that the project be supported by the government of the host country. Finally, in our project, we found contacts within the British High Commission to be very helpful and supportive with certain logistical and political (to a certain degree) aspects and in providing small amounts of key additional funding at short notice. I would recommend that other DI project leaders also make personal contact with

BHC, or British Embassy, staff in their host country.

10. Actions taken in response to annual report reviews (if applicable)

Annual report reviews were disseminated amongst all project partners for discussion. The reviews were positive in nature and no issues were raised that required a response or a modification to the project activities.

11. Darwin Identity

The Darwin Initiative logo has been used on official project paperwork and documents, including workshop outputs and the Vulture Recovery Plan, and it is used on the project website. It has been prominently displayed in all talks given about the work and results of the project given at conferences and seminars around the world. A large image of the Darwin Initiative logo was painted on one of the walls of the Vulture Care Centre, and on all signage associated with the Centre, and the logo has been prominent in published photographs of the Centre. The Darwin Initiative has been mentioned in all media interviews given by project staff and has often been mentioned in the resulting articles. Funding from the Darwin Initiative has been acknowledged wherever possible in scientific articles and other publications arising from the project.

The Darwin Initiative is now recognised by the State and Central Government officials we have interacted with during the course of the project. In particular, it is held in high regard by officials of the Haryana State Government. Indian science journalists and the membership of the BNHS (the largest conservation NGO in India) have also become familiar with the Darwin Initiative through this project.

The project was primarily seen as a distinct project with the clear identity of vulture conservation. However, at the State and Central Government levels, there was general recognition that the project fell into the larger context of biodiversity conservation.

12. Leverage

A total of £ of additional funding was raised for the vulture conservation work during the course of the project. This is detailed below. In addition, a Darwin Initiative grant (ref. 12027) was won by the RSPB, in collaboration with the other project partners (the ZSL and the BNHS) and other conservation NGOs within *Gyps* spp. vulture range states to build capacity within these states to conserve vultures and to better manage the ecological effects of vulture declines.

1st Year: No additional funding was secured.

2nd Year:
£ was raised jointly from the ZSL & the RSPB to pay for diagnostic work at AAHL. Also, the ZSL provided staff time (approximate value **£**) and the RSPB provided expenses (**£**) for Dr. Cunningham to visit AAHL in July 2002 in order to guide diagnostic work on vulture samples. During this visit, support in-kind to a value of approximately **£** was obtained from AAHL for diagnostic work on vulture samples.

Synermed Europe Ltd., a medical and veterinary diagnostic equipment manufacturer, donated a **£** automated biochemistry analyser plus technical support to the project.

An award of **£** was made by the British High Commission, New Delhi to the BNHS to pay for a transformer to enable a reliable electricity supply to be connected to the Vulture Centre.

The National Birds of Prey Trust provided **£** of additional funding to pay for the construction of a block of eight quarantine/hospital aviaries and an additional **£**for the purchase of laboratory equipment for the Vulture Centre.

The Forest and Wildlife Department, Government of Haryana provided **£** for fencing the perimeter of the

Vulture Centre compound and making this secure.

3rd Year:
An award of **£** was made by the British High Commission, New Delhi to the Darwin project partners (ZSL, RSPB & BNHS) to set up a pilot project to monitor the migration routes of migratory Gyps vultures (*G. fulvus* and *G. himalayensis*) using satellite telemetry. The RSPB provided an additional **£** funding for this project and the services of a volunteer raptor biologist were obtained for a period of one month to assist with the satellite tagging.

The National Birds of Prey Trust provided **£** of additional funding to pay for the construction of a large flight (colony) aviary for the housing of vultures that had recovered from disease or that had been caught healthy.

From April 2003 to March 2004, the ZSL and RSPB jointly funded a post-doctoral biologist (total cost **£**) to manage, and participate in, vulture conservation programmes within India and other *Gyps* spp. range states.

Additional funding **(£**) was obtained from the Institute of Zoology to extend and equip the laboratory at the Project's Vulture Care Centre, Pinjore to allow chemical extractions of diclofenac (if present) from vulture and livestock tissues. Additional funding for tissue chemical analysis was obtained from the RSPB (**£**) and ZSL (**£**).

The ZSL, the RSPB & the BNHS signed a collaborative agreement to formalise their vulture conservation partnership. This formal collaboration goes under the name of "Vulture Rescue" and enables the participatory organisations to directly fundraise for vulture conservation activities. As part of this commitment, the ZSL and the RSPB jointly funded a post-doctoral biologist to manage, and participate in, vulture conservation programmes within India and other *Gyps* spp. range states. Fund-raising initiatives are being developed and executed by the ZSL's and the RSPB's fundraising departments to obtain funds from international donors in addition to grant applications to donor organisations by all three partners (either jointly or individually) to obtain funds for this project.

13. Sustainability and Legacy

Enduring project achievements will include the finding of diclofenac as a cause of vulture mortality in India, the establishment of 19 vulture monitoring sites and the development of a Vulture Centre for conservation breeding and research. The latter is to form the basis of an international captive breeding programme, in which it will be used as an international training centre for vulture captive care, breeding and conservation research. It is planned (by the BNHS and ZSL) also to further develop the laboratory for additional wildlife conservation research projects. As such, the project partners are highly likely to keep in touch.

The project's conclusions, as detailed in the Vulture Recovery Plan, have been ratified by several international NGOs, the BNHS and the Indian Government. These conclusions are now being applied throughout South Asia and have been picked up by conservation organisations in Africa and South America, where diclofenac is also used as a veterinary drug. In addition, the legacy of the project should result in an increase in international partnerships for conservation activities with Indian organisations and in an increase in wildlife disease research activities in India. It is doubtful that the project's legacy could have been improved.

In addition to a successful post-project grant application by the ZSL and BNHS, a Darwin Initiative grant was won by the RSPB in 2003, in collaboration with the other project partners (the ZSL and the BNHS) and other conservation NGOs within *Gyps* spp. vulture range states, to build capacity within these states to conserve vultures and to better manage the ecological effects of vulture declines.

The BNHS is actively fundraising within India and expects to achieve both corporate and additional government sponsorship for the project. Additionally, grant applications have been, and will continue to be, made to donor organisations by all three partners (either jointly or individually) to obtain funds for this project.

14. Post-Project Follow up Activities *(max. 300 words)*

A post-project application has been successful.

15. Value for money

I consider the project to be tremendous value for money for the U.K. Government. A huge amount of time, effort and goodwill has been put into this project by committed staff in both the U.K. and India, giving a great deal more than would have been possible if all this had to be paid for at normal rates. This was possible partly because of staff working large amounts of unpaid overtime, but also because the main partner organisations (ZSL, BNHS & RSPB) put in more financially and logistically than had originally been agreed or funded. In addition to project staff, a great deal of support and commitment was given to the project by others, including Haryana Government staff and volunteers from both India and the U.K. Although vultures in India continue to decline towards extinction, the project outcomes in the short space of three years are more than could be expected given the notorious difficulties of working in a developing country with such a lethargic and complex bureaucracy as India.

16. Appendix I: Project Contribution to Articles under the Convention on Biological Diversity (CBD)

Please complete the table below to show the extent of project contribution to the different measures for biodiversity conservation defined in the CBD Articles. This will enable us to tie Darwin projects more directly into CBD areas and to see if the underlying objective of the Darwin Initiative has been met. We have focused on CBD Articles that are most relevant to biodiversity conservation initiatives by small projects in developing countries. However, certain Articles have been omitted where they apply across the board. Where there is overlap between measures described by two different Articles, allocate the % to the most appropriate one.

Project Contribution to Articles under the Convention on Biological Diversity		
Article No./Title	**Project %**	**Article Description**
6. General Measures for Conservation & Sustainable Use	20	Develop national strategies that integrate conservation and sustainable use.
7. Identification and Monitoring	30	Identify and monitor components of biological diversity, particularly those requiring urgent conservation; identify processes and activities that have adverse effects; maintain and organise relevant data.
8. In-situ Conservation	5	Establish systems of protected areas with guidelines for selection and management; regulate biological resources, promote protection of habitats; manage areas adjacent to protected areas; restore degraded ecosystems and recovery of threatened species; control risks associated with organisms modified by biotechnology; control spread of alien species; ensure compatibility between sustainable use of resources and their conservation; protect traditional lifestyles and knowledge on biological resources.
9. Ex-situ Conservation	10	Adopt ex-situ measures to conserve and research components of biological diversity, preferably in country of origin; facilitate recovery of threatened species; regulate and manage collection of biological resources.
10. Sustainable Use of Components of Biological Diversity		Integrate conservation and sustainable use in national decisions; protect sustainable customary uses; support local populations to implement remedial actions; encourage co-operation between governments and the private sector.
11. Incentive Measures		Establish economically and socially sound incentives to conserve and promote sustainable use of biological diversity.
12. Research and Training	30	Establish programmes for scientific and technical education in identification, conservation and sustainable use of biodiversity components; promote research contributing to the conservation and sustainable use of biological diversity, particularly in developing countries (in accordance with SBSTTA recommendations).

13. Public Education and Awareness	5	Promote understanding of the importance of measures to conserve biological diversity and propagate these measures through the media; cooperate with other states and organisations in developing awareness programmes.
14. Impact Assessment and Minimizing Adverse Impacts		Introduce EIAs of appropriate projects and allow public participation; take into account environmental consequences of policies; exchange information on impacts beyond State boundaries and work to reduce hazards; promote emergency responses to hazards; examine mechanisms for re-dress of international damage.
15. Access to Genetic Resources		Whilst governments control access to their genetic resources they should also facilitate access of environmentally sound uses on mutually agreed terms; scientific research based on a country's genetic resources should ensure sharing in a fair and equitable way of results and benefits.
16. Access to and Transfer of Technology		Countries shall ensure access to technologies relevant to conservation and sustainable use of biodiversity under fair and most favourable terms to the source countries (subject to patents and intellectual property rights) and ensure the private sector facilitates such assess and joint development of technologies.
17. Exchange of Information		Countries shall facilitate information exchange and repatriation including technical scientific and socio-economic research, information on training and surveying programmes and local knowledge
19. Bio-safety Protocol		Countries shall take legislative, administrative or policy measures to provide for the effective participation in biotechnological research activities and to ensure all practicable measures to promote and advance priority access on a fair and equitable basis, especially where they provide the genetic resources for such research.
Total %	**100%**	**Check % = total 100**

17. Appendix II Outputs

Please quantify and briefly describe all project outputs using the coding and format of the Darwin Initiative Standard Output Measures.

Code	Total to date (reduce box)	Detail (←expand box)
Training Outputs		
1a	Number of people to submit PhD thesis	0
1b	Number of PhD qualifications obtained	0
2	Number of Masters qualifications obtained	0
3	Number of other qualifications obtained	0
4a	Number of undergraduate students receiving training	0
4b	Number of training weeks provided to undergraduate students	0
4c	Number of postgraduate students receiving training (not 1-3 above)	0
4d	Number of training weeks for postgraduate students	0
5	Number of people receiving other forms of **long-term** (>1yr) training not leading to formal qualification(i.e. not categories 1-4 above)	0
6a	Number of people receiving other forms of short-term education/training (i.e. not categories 1-5 above)	88
6b	Number of training weeks not leading to formal qualification	77
7	Number of types of training materials produced for use by host country(s)	3
Research Outputs		
8	Number of weeks spent by UK project staff on project work in host country(s)	54
9	Number of species/habitat management plans (or action plans) produced for Governments, public authorities or other implementing agencies in the host country (s)	1 – Vulture Recovery Plan, Report of the International South Asian Vulture Recovery Plan Workshop, 12-14 February 2004
10	Number of formal documents produced to assist work related to species identification, classification and recording.	1
11a	Number of papers published or accepted for publication in peer reviewed journals	6
11b	Number of papers published or accepted for publication elsewhere	5
12a	Number of computer-based databases established (containing species/generic information) and handed over to host country	3 – vulture pathology database; vulture clinical (including haematology and serum biochemistry) database; survey and monitoring database
12b	Number of computer-based databases enhanced (containing species/genetic information) and handed over to host country	0
13a	Number of species reference collections established and handed over to host country(s)	1 – reference collection of formalin-fixed and frozen tissues from, and frozen carcases of, *Gyps* spp. vultures.
13b	Number of species reference collections enhanced and handed over to host country(s)	0

Dissemination Outputs		
14a	Number of conferences/seminars/workshops organised to present/disseminate findings from Darwin project work	1 – Vulture Recovery workshop, Parwanoo, 12-14 February 2004
14b	Number of conferences/seminars/ workshops **attended** at which findings from Darwin project work will be presented/ disseminated.	22
15a	Number of national press releases or publicity articles in host country(s)	95
15b	Number of local press releases or publicity articles in host country(s)	0
15c	Number of national press releases or publicity articles in UK	47
15d	Number of local press releases or publicity articles in UK	0
16a	Number of issues of newsletters produced in the host country(s)	3
16b	Estimated circulation of each newsletter in the host country(s)	200
16c	Estimated circulation of each newsletter in the UK	0
17a	Number of dissemination networks established	0
17b	Number of dissemination networks enhanced or extended	1
18a	Number of national TV programmes/features in host country(s)	3
18b	Number of national TV programme/features in the UK	2 international documentaries made (by National Geographic and by Discovery)
18c	Number of local TV programme/features in host country	0
18d	Number of local TV programme features in the UK	0
19a	Number of national radio interviews/features in host country(s)	6
19b	Number of national radio interviews/features in the UK	3, plus 1 feature on Canadian National radio
19c	Number of local radio interviews/features in host country (s)	0
19d	Number of local radio interviews/features in the UK	0
Physical Outputs		
20	Estimated value (£s) of physical assets handed over to host country(s)	
21	Number of permanent educational/training/research facilities or organisation established	1
22	Number of permanent field plots established	19 – (17 colonies, 2 carcase dumps)
23	Value of additional resources raised for project	£

18. Appendix III: Publications

Provide full details of all publications and material that can be publicly accessed, e.g. title, name of publisher, contact details, cost. Details will be recorded on the Darwin Monitoring Website Publications Database that is currently being compiled.

Mark (*) all publications and other material that you have included with this report

Type * (e.g. journals, manual, CDs)	**Detail** (title, author, year)	**Publishers** (name, city)	**Available from** (e.g. contact address, website)	**Cost £**
Journal article	Catastrophic collapse of Indian white-backed *Gyps bengalensis* and long-billed *Gyps indicus* vulture populations. Prakash, V., Pain, D. J., Cunningham, A. A., Donald, P. F., Prakash, N., Verma, A., Gargi, R., Sivakumar, S. and Rahmani, A. R. 2003	*Biological Conservation* **109,** 381-390. Elsevier		
Journal article	Causes and effects of temporospatial declines of Gyps vulture in Asia. Pain, D. J., Cunningham, A. A., Donald, P. F., Duckworth, J. W., Houston, D. C., Katzner, T., Parry Jones, J., Poole, C., Prakash, V., Round, P. and Timmins, R. 2003	*Conservation Biology* **17,** 661-671. Blackwell Publishing Inc.		

Journal article	Indian vultures: victims of an infectious disease epidemic? Cunningham, A. A., Prakash, V., Pain, D., Ghalsasi, G. R., Wells, G. A. H., Kolte, G. N., Nighot, P., Goudar, M. S., Kshirsagar, S. and Rahmani, A. 2003	*Animal Conservation* **6,** 189-197. Cambridge University Press		
Journal article	Diclofenac poisoning is widespread in declining vulture populations across the Indian subcontinent. Shultz, S., Baral, H. S., Charman, S., Cunningham, A. A., Das, D., Ghalsasi, G. R., Goudar, M. S., Green, R. E., Jones, A., Nighot, P., Pain, D. J. & Prakash, V. 2004	*Proceedings of the Royal Society of London, Series B: Biological Sciences* **271,** S458-S460.		
Journal article	Diclofenac poisoning as a cause of vulture population declines across the Indian subcontinent. Green, R. E., Newton, I., Shultz, S., Cunningham, A. A., Gilbert, M., Pain, D. J. & Prakash, V. 2004	*Journal of Applied Ecology* **41,** 793-800.		

Journal article	Phylogenetic analysis of the DNA polymerase gene of a novel alphaherpesvirus isolated from an Indian *Gyps* vulture. Cardoso, M., Hyatt, A., Selleck, P., Lowther, S., Prakash, V., Pain, D., Cunningham, A. A. and Boyle, D. 2005	*Virus Genes* in press.		
Book chapter and conference proceedings	Saving Asia's *Gyps* vultures: the "Vulture Rescue" team's conservation programme. Prakash, V., Pain, D. J., Shultz, S. & Cunningham, A. A. 2004	Pp. 245-255 *In:* Raptors Worldwide. Proceedings of the VI World Conference on Birds of Prey and Owls, Budapest, Hungary. 18-23 May 2003. (R. D. Chancellor and B. –U. Meyburg, eds.). World Working Group on Birds of Prey and Owls, Berlin, Germany. 867 pp.		
Conference abstract	Investigating the cause of catastrophic declines in Asian griffon vultures, *Gyps indicus* and *G. bengalensis*. Cunningham, A. A., Prakash, V., Ghalsasi, G. R. and Pain, D. 2001	Proceedings of the 4th Eurasian Conference on Raptors, Seville, Spain, 25-29 September 2001. Raptor Research Foundation. P. 49.		

Conference proceedings	Investigating the Cause of Catastrophic Declines in Asian Griffon Vultures (*Gyps indicus* and *G. bengalensis*). Cunningham, A. A., Prakash, V., Ghalsasi, G. R., Pain, D. 2001	*In*: Katzner, T., Parry-Jones, J. (Eds.), Reports from the workshop on Indian *Gyps* vultures, 4th Eurasian Congress on Raptors. Seville, Spain. Estación Biológica Donaña, Raptor Research Foundation, p. 10-11.		
Newsletter article	No respite for India's vultures. Prakash, V., Pain, D. J., Cunningham, A. A. 2002	*World Birdwatch* **24(1),** 14-15. BirdLife International		
Newsletter article	Catastrophic declines of griffon vultures in India. Cunningham, A. A., Pain, D., and Prakash, V. 2002	*Falco* **20,**10-11. Middle East Falcon Research Group		
Conference proceedings	Vulture declines in India: patterns, causes and spread. Pain, D. J., Cunningham, A. A., Prakash, V. and Ghalsasi, G. R. 2002	*In:* Reports from the workshop: Conservation of *Gyps* Vultures in Asia, 3rd North American Ornithological Conference, 24-28 September 2002, New Orleans, USA. pp. 4-7.		

Workshop Report	Report of the International South Asian Vulture recovery Plan Workshop. 12-14 February 2004. 2004	Zoological Society of London, Royal Society for the Protection of Birds, Bombay Natural History Society		Free of charge
Newsletter	Report of the International South Asian Vulture recovery Plan Workshop. 2004	BUCEROS, ENVIS Newsletter: Avian Ecology & Inland Wetlands Vol. 9, No. 1, 2004. Bombay Natural History Society		Free of charge
Workshop proceedings	Proceedings of a Gyps spp. vulture monitoring workshop, 21-25 January 2002	Bombay Natural History Society		
Project Newsletter	Jatayu, the newsletter of the project: Conservation of Critically Endangered Gyps species vultures in India 2002	Bombay Natural History Society		
Pamphlet	Conservation of critically endangered Gyps Vultures in India 2002	Bombay Natural History Society		
Project Newsletter	Jatayu, the newsletter of the project: Conservation of Critically Endangered Gyps species vultures in India 2003	Bombay Natural History Society		

Project Newsletter	Jatayu, the newsletter of the project: Conservation of Critically Endangered Gyps species vultures in India 2004	Bombay Natural History Society		

Appendix IV: Darwin Contacts

To assist us with future evaluation work and feedback on your report, please provide contact details below.

Project Title	Conservation of Critically Endangered *Gyps* spp. Vultures in India
Ref. No.	162/10/013
UK Leader Details	
Name	Dr. Andrew A. Cunningham
Role within Darwin Project	Principal Investigator
Address	
Phone	
Fax	
Email	
Other UK Contact (if relevant)	
Name	Dr. Debbie Pain
Role within Darwin Project	Co-investigator
Address	
Phone	
Fax	
Email	
Partner 1	
Name	Dr. Vibhu Prakash
Organisation	Bombay Natural History Society
Role within Darwin Project	Co-investigator
Address	
Fax	
Email	
Partner 2 (if relevant)	
Name	Dr. R. D. Jakati
Organisation	Department of Forestry and Wildlife, Haryana State Government
Role within Darwin Project	Collaborator
Address	
Fax	
Email	