

Prediction and Management of Potential Declines in *Gyps* Species Vultures

Final Report



Submitted by



The Royal Society for the Protection of Birds

in partnership with

The Bombay Natural History Society
Bird Conservation Nepal
Institute of Zoology, Zoological Society of London
Natural Research (UK)



December 2006

ENQUIRIES CONCERNING THIS APPLICATION

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Cover photograph: Dead vultures in Eastern Rajasthan, India (A. Cunningham / IoZ)

Darwin Initiative

Final Report

1. Darwin Project Information

Project Reference No.	162/12/027
Project title	Prediction and management of declines in Gyps species vultures
Country	India, Nepal, Cambodia, Myanmar, South Africa, Namibia, Georgia, Armenia, Azerbaijan
UK Contractor	Royal Society for the Protection of Birds
Partner Organisation(s)	Zoological Society of London (ZSL); University of Aberdeen; Bombay Natural History Society (BNHS); Wildlife Institute of India (WII); Indian Veterinary Research Institute (IVRI); Bird Conservation Nepal (BCN); Natural Research UK (NR); Georgian Centre for Conservation and Wildlife; Azerbaijan Ornithological Society; Armenian Society for the Protection of Birds; BirdLife International in Indochina; Wildlife Conservation Society – Cambodia; Biodiversity and Nature Conservation Association (BANCA), Myanmar; Faculty of Veterinary Science, University of Pretoria, South Africa; De Wildt Cheetah and Wildlife Trust, South Africa; Rare and Endangered Species Trust (REST), Namibia; Veterinary Department, Zoo Botanico Jerez, Spain.
Darwin Grant Value	£231,975
Start/End date	1 October 2003- 31 September 2006
Project website	www.vulturerescue.org
Author(s), date	Dr Richard Cuthbert, Dr Vibhu Prakash and Dr Hem Sagar Baral (28th December 2006)

2. Project Background/Rationale

Three species of Asian vultures, the Oriental white-backed vulture (*Gyps bengalensis*), slender-billed vulture (*Gyps tenuirostris*) and long-billed vulture (*Gyps indicus*), have undergone catastrophic declines over the last decade. These severe declines have taken place in India, Pakistan and Nepal, countries that together previously supported the vast majority of the global population of these three *Gyps* vulture species. The magnitude and speed of the declines (>95% reduction in population over ten years), and the geographic extent of the declines (over most of the species distributional range) has led the IUCN to list all three species as Critically Endangered. For three years, under a previous Darwin Initiative project (ref. 162/10/013) the Bombay Natural History Society (BNHS) together with the Zoological Society of London (ZSL) and the Royal Society for the Protection of Birds (RSPB) investigated the causes of the declines and monitored vulture population changes across India. The focus of the research was identifying the causes of the declines and the possible role of an infectious disease, which was still the main hypothesis for the declines when the current project was approved for funding.

The need for vulture research and monitoring was first identified by the BNHS, who asked for international assistance to address the vulture declines in India. This led to the development and completion of the Darwin Initiative project 162/10/013. The current project was initially designed to lead on from the previous Darwin project to predict the possible spread of the factor(s) causing the declines out of the Indian sub-continent, and to identify ways of managing this problem. A need for such activities was clearly required

However, in May 2003, the Peregrine Fund (a USA based organisation) announced that residues of an anti-inflammatory veterinary drug, diclofenac, were found in a large proportion of vulture carcasses in Pakistan and diclofenac poisoning was the likely cause of the vulture declines. Since this announcement, the focus of research by the RSPB and project partners has shifted to determining the role of diclofenac in the vulture declines over the whole geographic range of the Asian *Gyps* species. We submitted a revised project proposal in September 2003 at the start of the current Darwin project (see Appendix V). The new proposal addressed the change in project focus following the diclofenac discovery and possible future implications on the work schedule. The Darwin Initiative approved the changes to the project. Changes in the focus of the project also meant that the original budget was substantially revised. Further revisions, approved by the Darwin Initiative, were made after the first six-months of the project.

3. Project Summary

The purpose of the project was to determine the relative role of different factors in the vulture population declines, to determine the extent of populations of birds that are affected by the declines, to develop, and to institute a management plan to reverse the declines and mitigate their impacts on human and animal health.

The project's objectives were to:

- a. Current extent of declines established, estimation of current population size of *G. tenuirostris* and potential routes of spread predicted.
- b. Identification of relative contribution of different causal agents in declines across range states.
- c. Plan for the management of declines produced.

- d. Participants from affected countries able to implement and monitor management plan.
- e. *Gyps* population protected from declines.
- f. Knowledge gained from project disseminated to governments, scientists and media.
- g. Funding strategy developed

Other than the changes made at the start of the project following the discovery of the role of diclofenac in the vulture declines, there have been relatively few changes to the project's objectives or operational plan, although the timing and location of some activities had to be altered. Political instability in Nepal forced the project to abandon plans for establishing a vulture conservation breeding centre in the country and we requested approval for the transfer of these funds to a site in West Bengal, India. The Darwin Secretariat approved this request in December 2004.

The articles under the Convention on Biological Diversity which best describe the project are articles 6, 7, 8, 9, 12 and 13 (see Appendix I).

The vulture project has been very successful at meeting its objectives and in achieving additional accomplishments beyond the original aim of the programme. The project has achieved the following with regard to the original seven objectives (a to g listed above):

- a. *Current extent of declines established, estimation of current population size of G. tenuirostris and potential routes of spread predicted.*

Surveys for slender-billed vultures (*G. tenuirostris*) have been undertaken in Assam, West Bengal, Himachal Pradesh and parts of Uttranchal in northern and northeast India, and additionally in lowland areas of Nepal. Establishing the current population size is extremely difficult within these areas, due to the remoteness of much of the country and the solitary nesting habitat of this species. Nonetheless the surveys have been able to uncover small breeding populations in several areas, with over 22 nests located and sightings of >81 individuals. The surveys failed to find any sightings or nests of *G. tenuirostris* within Himachal Pradesh, Uttranchal, West Bengal and in eastern areas of Nepal, and the situation for slender-billed vultures in these areas looks grave. With annual mortality rates from diclofenac poisoning of approximately 50%, and the extreme scarcity of this species, capturing birds for a conservation breeding programme rapidly became a priority. As a result of the surveys catching efforts were focused in Assam State and the project succeeded in capturing 26 *G. tenuirostris* in the 2006 breeding season and aims to capture 30-40 more in 2007. Because of the importance of Assam State for this species, the third vulture breeding centre will be located in this region.

Beyond India and Nepal, the project has also initiated surveys work for *G. tenuirostris* (and *G. bengalensis*) in Southeast Asia, working in partnership with BirdLife International, WWF-Cambodia and the Wildlife Conservation Society Cambodia Programme. A minimum population of 31 *G. tenuirostris* was reported from Cambodia in 2005 along with a minimum of 149 *G. bengalensis*. Conservation efforts around nesting sites and population monitoring are continuing in Cambodia. The location of remaining populations of *G. tenuirostris* in far northeast India and Cambodia suggests that important populations of this species may remain in the region, especially within Myanmar. Consequently we established links with BirdLife International and BANCA (Biodiversity and Nature Conservation Association) in Myanmar. Surveys in Myanmar have recently begun (early December 2006) and two carcass feeding stations have

attracted 27 and 55 vultures, including a minimum of 20 and 8 *G. tenuirostris* respectively. Survey work in Myanmar will continue during 2007.

b. Identification of relative contribution of different causal agents in declines across range states.

Following the discovery of diclofenac toxicity to populations of *Gyps* vultures in Pakistan the project sought to establish whether the use of veterinary diclofenac for treating livestock was also a factor in the vulture declines observed in India and Nepal. Field staff under the direction of BNHS in India and Bird Conservation Nepal (BCN) in Nepal collected vulture carcasses from across the region. These birds, and carcasses previously collected, were analysed for the presence of clinical signs (principally visceral gout) previously recorded in India and Pakistan, and diclofenac residues that appeared to have caused the gout in the Oriental white-backed vultures studied in Pakistan. The same link between diclofenac and visceral gout was found in the birds we collected, with diclofenac linked mortality located in 75% of the carcasses collected. We found similar results for both *G. bengalensis* and *G. indicus*. These results were published in the Proceedings of the Royal Society (B) (Shultz *et al.* 2004, see Appendix III for full citation). Following this discovery, the project estimated the proportion of cattle carcasses that needed to be contaminated with lethal levels of diclofenac to have caused vulture populations to decline at the observed rate. The results indicated that just 0.1 to 0.8% of cattle needed to contain lethal levels of diclofenac to drive the vulture declines (Green *et al.* 2004). Moreover, the proportion of vulture carcasses containing gout or diclofenac was consistent with diclofenac residues being the main, if not the only, factor responsible for the vulture declines. Since these results, the project has undertaken further research to establish the duration of diclofenac within different ungulates tissues following treatment with the drug (Green *et al.* 2006; Taggart *et al.* 2006) and has measured the actual proportion of livestock carcasses containing diclofenac residues through sampling over 1800 carcasses across 12 states in India (Taggart *et al.* in press). The results of this work, combining data on the proportion of diclofenac contaminated carcasses (>10%), diclofenac concentrations within the animals and the killing power of these residues to *Gyps* vultures, are consistent with diclofenac being the principal or only causal agent of the dramatic vulture declines.

c. Plan for the management of declines produced.

One of the first actions of this project was to organise and support an international workshop in Himachal Pradesh, India, to produce a species recovery plan for vultures in South Asia (February 2004). This report was agreed upon by all regional and international delegates present at the meeting and has formed the basis for the plan of action followed over the last three years (the report is available from www.vulturerescue.org/page11.html and has also been published as a document by BNHS; see Appendix III). This is a long-term plan, which is intended to be flexible and used in an adaptive way. Many of the key recommendations of the report have been initiated or implemented, including the three principle recommendations; finding a safe alternative to diclofenac, achieving nationwide bans on the veterinary use of diclofenac in India, Nepal and Pakistan, and establishing vulture conservation breeding centres.

A second workshop and meeting on vulture conservation was organised by the Indian Ministry of Environment and Forests (MoEF), Government of India, in January 2006. This meeting produced an Action Plan for Vulture Conservation in India, and recommended additional priorities and objectives for vulture conservation (such as promoting the use of a drug that we had tested and found to be safe to vultures - meloxicam), as well continuing to support the key objectives of the original plan.

d. Participants from affected countries able to implement and monitor management plan.

We have developed strong ties with governmental and non-governmental conservations organisations working in the region. These organisations (principally the Bombay Natural History Society, Bird Conservation Nepal, Indian Veterinary Research Institute and the Haryana State Forest Department) have taken a leading role in implementing the recommendations of the vulture conservation action plan. Evidence for this comes from the effective working partnership between BNHS and IVRI in testing the alternative drug meloxicam and then presenting these results in a formal report to the Indian Government. BNHS and BCN have also been effective in advocating for a ban on the drug diclofenac in India and Nepal, and along with the development of the safe alternative drug, this has been instrumental in obtaining the bans. BNHS and the Haryana State Forest Department have also implemented the vulture action plan through the establishment of two vulture breeding centres in India.

e. Gyps population protected from declines.

The key recommendations of the vulture conservation action plan were to ban the veterinary use of diclofenac within the Indian sub-continent, find a safe alternative drug to replace diclofenac, and to establish vulture conservation breeding centres within South Asia to secure the survival of the species. All three of these recommendations have been met. Across the region, India, Nepal and Pakistan have all announced government measures to ban the manufacture and importation of diclofenac. This is the key conservation action that will ultimately enable vulture populations to recover in south Asia. Together with actions to promote an alternative vulture safe drug (meloxicam) we are hopeful that levels of diclofenac use will swiftly drop to levels where vultures can forage in a safe environment. Monitoring the use of diclofenac and other anti-inflammatory drugs and the prevalence of these drugs in livestock carcasses are priorities for further research. Prior to the ban being implemented the key obstacle was a lack of any alternative drugs to treat livestock in the region. The project identified potential candidate alternative drugs to diclofenac by sending out questionnaire on NSAID use on birds and its clinical outcomes to veterinarians and bird keepers worldwide (results published in the journal Biology Letters, Cuthbert *et al.* 2006). This identified meloxicam as a potential alternative drug. The project then established links with veterinary researchers and vulture conservationists in South Africa and Namibia in order to test the safety of the alternative drug meloxicam. Safety testing of meloxicam to *Gyps* vultures and other scavenging species was then replicated in India to demonstrate its safety to the critically endangered species. BNHS and BCN were then effective in bringing the results of the safety testing to the attention of government departments, and in Nepal BCN and this project has worked closely with the country's largest pharmaceutical manufacture to develop and launch this drug.

Two vulture conservation breeding centres have now been established in India, located in Haryana State and West Bengal. These two centres currently hold 116 birds of all three species, including the rarest of the three species, the slender-billed vulture (*G. tenuirostris*). Plans for a third centre are now well under way for Assam State in the far northeast of India. While plans for a centre in Nepal have had to be postponed because of political instability, there has recently been firm progress towards establishing additional centres in India. The project is now working in collaboration with the Indian Central Zoo Authority (CZA), which is planning to open four centres in partnership with BNHS. As an example of this new partnership, the project and the RSPB have recently (December 2006) supported a workshop on best practise for vulture conservation

breeding centres, attended by Chief Wildlife Wardens from states across India and international experts. CZA has committed itself to funding the printing costs of the best practise manual. It is very early days for the breeding programme, but in 2005 two pairs of birds attempted to breed at the centres. This is several years ahead of schedule and very encouraging for the future.

f. Knowledge gained from project disseminated to governments, scientists and media.

The real success of the project in disseminating knowledge to governments is borne out by the conservation actions initiated by the governments of India, Nepal and Pakistan. Achieving policy changes at the government level within these three countries was far beyond the original scope of the project and is an outcome beyond our expectations. This has been achieved through a combination of quality scientific publications in collaboration with host-country scientific institutions, international and national scientific acceptance of the research results, concern at the scale of the problem from governmental and non-governmental conservation organisations, and widespread national and international media interest in the vulture declines effectively coordinated through a full time conservation advocacy programme.

The project has been very successful in reporting its results to the scientific and conservation community. To date, 13 papers have been published in international peer-reviewed journals, with a further two papers and one book chapter currently in press, and two papers submitted to journals. A further ten published reports, articles or action plans have been made by the RSPB or partners (BNHS, BCN and MoEF), as well as confidential research reports produced by the project for submission to Indian and Nepali government departments. Published scientific papers have appeared in high profile journals such as Public Library of Science (PLoS) Biology, Biology Letters and the Journal of Applied Ecology, which has helped the project gain important scientific credibility in its progress. The project has also produced considerable numbers of educational posters, leaflets and accessible reports, to enable the research results to be effectively disseminated to a wider group. The project website (www.vulturerescue.org) has also been used to effectively disseminate information about vulture conservation and the project's progress. Information on the website includes updates on recent vulture news stories, the project's scientific publications and background information on the cause of the declines and vulture ecology. The project frequently refers journalists to the website so they can rapidly obtain much of their necessary information.

The catastrophic scale of the vulture declines, discovery and potential impact of pharmaceutical residues in the environment, and the implications for human health of the loss of a key group of scavengers has galvanised extensive media interest in the project, and one of the most difficult aspects of the project has been keeping track of media articles on the vulture project. For example, a recent relatively small workshop in West Bengal (north-east India) in November 2006 attracted at least four newspaper articles on the day before the event, eight newspapers articles in the State's press on the following day, and two television interviews on the regional news. A "Google search" of the phrases "Asian vulture crisis" and "diclofenac ban" reveals 89,000 and 76,700 results respectively. The scale of the press interest within the region and the importance of this for shaping the opinion of decision makers meant that a full time conservation advocacy officer had to be appointed in India to co-ordinate this (funded by the RSPB, with support from the British High Commission Global Opportunities Fund) and within Nepal considerable time and support is given to vulture news including supporting a regular radio-programme. One of the more innovative ways of informing both decision makers and the public was undertaken in Nepal, through using an international paragliding competition as an event to promote information on vulture conservation (see

www.saveoursoarers.com). The event, titled “SOS Vulture – Save Our Soarers” was a great success and news of the vulture’s plight and measures for conservation were spread widely across Nepal through print, radio and television media, as well as internationally through radio-interviews with the BBC World Service and BBC Asia network, as well as promoting vulture conservation to the 80 paraglider pilots attending the competition. Within Nepal, the project has also been effective at disseminating information through the production of vulture education posters (>5000 distributed in areas around vulture colonies) and in printing a full-page colour-spread on vulture conservation in Nepal’s largest daily newspaper. Internationally, the project has attracted media attention with at least ten articles in broad-sheet newspapers in the UK and USA, articles in scientific/natural history magazines such as Science, Science News, BBC Wildlife and Smithsonian Magazine, national radio-interviews including three interviews on BBC Radio 4 Today Programme, and a vulture conservation film produced by the distinguished Indian wildlife film maker Mike Pandey, which was distributed widely across India in eight local languages and has been seen by the Indian Prime Minister. Vulture conservation is now one of the RSPB main areas of publicity and advocacy, which has further promoted the role of vultures and this project. Recently the RSPB has extended the vulture message to the society’s youth branch the “RSPB Wildlife Explorers”, exposing a young new audience to international conservation issues and the vulture crisis in Asia.

g. Funding strategy developed

Obtaining funding to cover the long-term costs for the recovery of vulture populations remains an important priority, particularly given the very high costs of constructing and running vulture conservation breeding centres. The RSPB has committed itself towards supporting up to four centres in South Asia and the vulture programme now forms one of the RSPBs main areas of publicity and fund raising. Further long-term international support towards the centres comes from two of the project’s partners: the Zoological Society of London and the National Bird of Prey Trust. The project’s main partner in India (BNHS) has committed considerable staff time and resources towards the vulture project and at a recent BNHS executive committee meeting has established plans to raise increased support from its members and the Indian public towards the project. Within government institutions in India there is an increasing financial commitment towards vulture conservation. Evidence in support of this comes from the key role taken by the Indian Ministry of Environment and Forests (MoEF) in organising and funding the meeting and reporting on an International Workshop on Vulture Conservation held in January 2006. This meeting was originally planned to be part of this Darwin Project as a follow up to the international meeting that developed the regional action plan, however with MoEF willing to finance the meeting, these funds were directed to other areas (breeding centre costs). Other evidence for increased Indian support towards funding vulture conservation comes from the Central Zoo Authority of India which has committed 1 Crore Rupees (Rs 10,000,000, ca. £110,000) towards establishing four vulture breeding centres within the zoo network, and a recent offer (November 2006) from the Madhya Pradesh State Government to construct a breeding centre as well as provide half the long-term running costs of the centre. Developing reliable and long-term financial support towards the project and breeding centres remains a major challenge, although there is a growing commitment from countries within South Asia to support and fund this.

Two major additional accomplishments that the project has achieved are to raise global awareness of the potential secondary conservation impacts of pharmaceutical products and to illustrate the economic and human health value of species such as vultures. These points have been recognised within the region and the human health issues have certainly helped the project gain government support and action in South Asia.

Internationally the potential impact of pharmaceutical compounds is becoming increasingly recognised. For example, a proposal recently put forward in South Africa to use diclofenac in livestock was shelved because of the potential impact of the drug on Africa's vultures. This was achieved through press publicity of the issue in South Africa.

4. Scientific, Training and Technical Assessment

Research

The project has used and worked collaboratively with a wide range of staff and researchers, with many selected for their particular research expertise and experience. Within India the project's main partner and the director of the vulture programme is Dr Vibhu Prakash. Dr Prakash originally discovered the dramatic declines of *Gyps* vultures in India and was the main partner on a previous Darwin award (Project 162/10/013 "Conservation of Critically Endangered *Gyps* spp. Vultures in India). Dr Prakash is a leading authority on vultures and raptors, and he now manages the vulture conservation breeding centres, but has also coordinated much of the research in India including nationwide multi-species vulture surveys, surveys for the rare *G. tenuirostris*, and has also been involved in the safety testing of meloxicam. BNHS staff employed by the project and under the direction of Dr Prakash includes three research biologists (Mr. S. Saravanan, Mr. Sachin Ranade and Mr R. Venkak) and two veterinarians (Dr Devojet Das and Dr Jehural Islam) and a third veterinarian (Dr Percy Avari) who worked on the project for an 18 month period. These staff were either retained from the previous Darwin vulture project (162/10/103) or were recruited following interviews held by BNHS at their head office in Mumbai. The project has also employed a further research biologist (Dr Kalu Ram Senacha) to undertake the nationwide surveys of carcasses in India. Within Nepal the project has worked closely with Dr Hem Sagar Baral, the Chief Executive Officer of Bird Conservation Nepal (BCN). Dr Baral and his team of permanent staff at BCN and three Nepali researchers employed on short-term contracts have undertaken important research, monitoring and assessing the size of remaining vulture populations. They are now very involved with in-situ conservation efforts, further monitoring and efforts to swap diclofenac for meloxicam in key areas.

Collaborations and partnerships have also been established within South Asia and Southern Africa. One of the key successes of the project has been working with Dr Devendra Swarup, Head of Division of Medicine of the Indian Veterinary Research Institute (IVRI). Dr Swarup and a team of up to five of his staff have been key to undertaking safety testing of the alternative drug meloxicam within India. As IVRI is a government research institute the research results have had a significant impact on decision makers within India. The other main key collaboration has been with Professor Gerry Swan, a world expert on pharmacology and veterinary wildlife research in South Africa. Professor Swan coordinated toxicity testing of diclofenac and meloxicam safety testing on African white-backed vultures (*Gyps africanus*) in South Africa and Namibia. Research carried out here and a visit to South Africa by Dr Swarup, Dr Prakash and Dr Lal Krishna (the Additional Director General, Indian Council for Agriculture Research, Government of India) to collaborate on the project, were key to obtaining permission for similar research to go ahead in India. A partnership was also established with the Veterinary Department, Zoo Botanico Jerez, Cadiz, Spain in order to establish the toxicity of diclofenac to Eurasian griffon vultures (*Gyps fulvus*). Another partnership was with Natural Research UK, to monitor and satellite tag Eurasian griffon vultures in the Caucuses. This partnership was originally established to follow the risk of a potential disease spreading from Asia to European and African vulture populations. While disease

risk has now been ruled out, the partnership has continued to learn more on the foraging ecology and population trends of this species in the Caucuses (see: http://www.natural-research.org/projects/eurasion_vultures.htm). Lastly, we have also continued a long running partnership on the project with the Zoological Society of London (ZSL). The RPSB and ZSL are working very closely on many areas of vulture conservation and some of the specific skills provided by ZSL staff (particularly veterinary staff and staff working in captive breeding programmes) are providing crucial guidance to the vulture breeding centres, as well as providing support to in-situ conservation efforts in Nepal.

The project's main research efforts have focused on: testing whether diclofenac was responsible for the declines of all three species of *Gyps* vulture in India and Nepal following the discovery of diclofenac poisoning of Oriental white-backed vultures in Pakistan; assessing whether this could be the main causal factor behind vulture population declines; determining the toxicity of diclofenac to other *Gyps* vulture species; finding potentially safe alternatives to diclofenac; testing the safety of an alternative drug (meloxicam) to replace diclofenac; determining the residence time of diclofenac in ungulates and the prevalence of diclofenac in cattle carcasses across India; and reviewing the extent to which other NSAIDs are likely to impact *Gyps* vultures and other species of scavenging birds. The project has additionally continued with efforts to monitor the extent of the vulture declines, initiating surveys for *G. tenuirostris* in Nepal, India and Cambodia, undertaking colony monitoring of *G. bengalensis* and *G. indicus* in these countries, assessing population trends of other vulture species within the region including Egyptian vultures (*Neophron percnopterus*) and red-headed vultures (*Sarcogyps calvus*) in India, surveys of Himalayan Griffon vultures (*G. himalayensis*) in Nepal, and surveys of Eurasian Griffon vultures in the Caucuses.

The methods employed have obviously varied greatly between research areas, although survey and analysis methods for monitoring nationwide trends of other vultures in India (Cuthbert *et al.* 2006a) has relied on road transects as carried out previously. After first establishing that diclofenac was present in vulture carcasses in India and Nepal (Shultz *et al.* 2004), we tested the role of diclofenac as the main causal agent of the vulture declines through taking a modelling approach, using available information on vulture demography and testing what levels of contamination are needed to produce declines in the model at the rate observed in the wild (Green *et al.* 2004). Further experimental research was then needed to determine the residence time of diclofenac in cattle and goat tissues, to test how long diclofenac would remain available at toxic levels (Green *et al.* 2006a; Taggart *et al.* 2006). Lastly, carcass sampling of ungulates has taken place across India, to test levels of diclofenac contamination. These results have been combined with information on residue levels and the vulture population model to demonstrate that this drug is the main, and quite possibly only, cause of the declines. For the toxicity trials we used previously published information on the toxicity of diclofenac (the results of diclofenac testing in Pakistan) to ensure that we only used the minimum number of birds to establish toxicity in the two other *Gyps* species tested (Swan *et al.* 2006a). Testing the safety of other drugs to vultures and scavenging birds was initially undertaken through an international survey of zoo veterinarians on the outcome of the clinical treatment of birds with these drugs (Cuthbert *et al.* 2006b). We then developed a phased programme of safety testing of meloxicam to *Gyps* vultures, undertaking this first in Southern Africa (Swan *et al.* 2006b), and then in India (Swarup *et al.* *in press*). We have promoted our approach to safety testing as an appropriate model for assessing the safety of other drugs to vultures and other scavenging birds (Cuthbert *et al.* *in press*).

All of our research findings have been subject to peer review in international

journals, and papers have been published in high profile journals such as Public Library of Science (PLoS) Biology, Biology Letters and the Journal of Applied Ecology. A list of some of the main papers (cited above) is provided below, as well as a complete list in Appendix III.

- Cuthbert, R., Green, R.E., Ranade, S., Saravanan, S.S., Pain, D.J., Cunningham, A.A. & Prakash, V. (2006a). Rapid population declines of Egyptian Vulture *Neophron percnopterus* and Red-headed Vulture *Sarcogyps calvus* in India. *Animal Conservation* **9**, 349-354
- Cuthbert, R., Parry-Jones, J., Green, R.E., Pain, D.J. (2006b). NSAIDs and scavenging birds: potential impacts beyond Asia's critically endangered vultures. *Biology Letters* doi:10.1098/rsbl.2006.0554
- Cuthbert, Pain, D.J., Green, R.E., Swan, G., Swarup, D. (in press). Comparative toxicity studies of NSAIDs in birds: A criticism of Reddy et al. *Environmental Toxicology and Pharmacology*
- Green, R.E., Newton, I., Shultz, S., Cunningham, A.A., Gilbert, M., Pain, D.J., Prakash, V., (2004). Diclofenac poisoning as a cause of vulture population declines across the Indian subcontinent. *Journal of Applied Ecology* **41**, 793-800
- Green, R.E., Taggart, M.A., DAS, D., Pain, D.J., Kumar, S., Cunningham, A.A., Cuthbert, R. (2006). Collapse of Asian vulture populations: risk of mortality from residues of the veterinary drug diclofenac in carcasses of treated cattle. *Journal of Applied Ecology* **43**, 949-956
- 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. *Proc. Roy. Soc. Lond. B (Suppl.)* **271**, S458-S460. DOI 10.1098/rsbl.2004.0223
- Swan, G.E., Cuthbert, R., Quevdeo, M., Green, R.E., Pain, D.J., Bartels, P., Cunningham, A.A., Duncan, N., Meharg, A.A., Oaks, J.L., Parry-Jones, J., Shultz, S., Taggart, M.A., Verdoorn, G., Wolter, K. 2006a. Toxicity of diclofenac to *Gyps* vultures. *Biology Letters* DOI: 0.1098/rsbl.2005.0425
- Swan, G.E., Naidoo, V., Cuthbert, R., Green, R.E., Pain, D.J., Swarup, D., Prakash, V., Taggart, M., Bekker, L., Das, D., Diekmann, J., Diekmann, M., Killian, E., Meharg, A., Patra, R.C., Saini, M. & Wolter, K. 2006b. Removing the Threat of Diclofenac to Critically Endangered Asian Vultures. *PLoS Biology*, 4, 1-8. DOI 10.1371/journal.pbio.0040066.
- Swarup, D., Patra, R. C., Prakash, V., Cuthbert, R., Das, D., Avari, P., Pain, D.J., Green, R.E., Sharma, A.K., Saini, M., Das, D., & Taggart, M. (in press). The safety of meloxicam to critically endangered *Gyps* vultures and scavenging birds in India. *Animal Conservation* in press.
- Taggart, M.A., Cuthbert, R., Das, D., Sashikumar, C., Pain, D., Green, R., Feltner, Y., Shultz, S., Cunningham, A.A., Meharg, A.A., (2006). Disposition of diclofenac in Indian cow and goat with reference to *Gyps* vulture population declines. *Environmental Pollution*, doi:10.1016/j.envpol.2006.08.017.

Training and capacity building activities

Rather than through running formal training courses, the majority of training has involved 1:1 working in India alongside BNHS and other counterparts. Dr Cuthbert has spent over six months in India and Nepal working with staff, and other UK staff (Dr Mark Taggart from Aberdeen University – three months in India, and Dr Debbie Pain and Dr Rhys Green from the RSPB – over five weeks in India) have spent considerable time in India working with partners and attending meetings. Many of the meetings in India and Nepal involved discussions of project design, pros and cons of different research approaches etc, giving project staff in the host countries real experience of the areas needed to successfully design and undertake good quality science. Staff have gained considerable experience and new areas of expertise during the project. This most specifically relates to skills and capacity towards the vulture breeding centres, especially with levels of veterinary skills and experience of captive care and vulture husbandry. Training has

been given to provide project staff with expertise at capturing and satellite tracking vultures. This has been successfully undertaken in India (2 staff trained), Nepal (3 staff) and in Georgia (3 staff). A previous Darwin award (Project 162/10/013) had previously given considerable training to staff, particularly for captive care and husbandry of vultures, training in vulture identification, colony monitoring and population surveys. This project has continued to support staff in these activities and to ensure the accuracy of information and accuracy of analysis of all data the project has been collecting. Knowledge and practical experience of safety testing was provided to Indian scientists with the visit arranged to South Africa to work on safety testing of meloxicam with scientists and veterinarians from Pretoria University. The observation, participation and discussion of safety testing facilitated the safety testing trials undertaken in India, which were crucial for the acceptance of these results within the host countries. Project staff have also been trained by Dr Mark Taggart, an analytical chemist from Aberdeen University, and have gained knowledge on methods of chemical extraction and analysis of diclofenac residues which will allow project staff to quantify this in the future. One staff member (Dr Kalu Ram) has visited the UK to discuss data collection and analysis methods, to gain experience of giving scientific presentations, and to attend the Cambridge Student Conference on Conservation Science.

5. Project Impacts

The real evidence that the project has accomplished its main objectives is the nationwide ban on the production and importation of diclofenac within India, Nepal and Pakistan. This remains the single most important conservation action, which, if effectively implemented, will remove the main threat to vulture populations in South Asia and allow populations to recover. The impact of the project in being able to change government policy in the region was beyond the original expectations of the project, even though this was recognised as key activity under the species action plan. The fact that this has been achieved so rapidly (within three years of the discovery of diclofenac in Pakistan) is testament to the success of the project in raising awareness of the seriousness of the problem and providing conservation solutions through the development of a safe alternative to diclofenac. Other evidence that the project has achieved its main purpose includes the establishment of two vulture conservation breeding centres within India, and the plans of the RSPB, BNHS and Indian Central Zoo Authority to work collaboratively in developing at least three more centres and to share expertise on best-practise.

The main unexpected impact of the project is an increased global awareness of the potential secondary impacts of pharmaceutical compounds within the environment and increased awareness within the Indian sub-continent of the economic and human health values of species like vultures. This has triggered international programmes assessing the impact of pharmaceutical drugs on vultures and scavenging birds in other areas of the world (e.g. research projects in South Africa and North America). The collapse in Asian vulture populations will (unfortunately) become a text-book example in much the same way as the population declines of raptor species following the introduction of DDT served to highlight and illustrate the environmental impacts of pesticides in the 1960s. Similarly the economic and environmental value of vultures will very likely become an example of where an unrecognised ecosystem service (acting as South Asia's free carcass disposal system) has had major economic and human health consequences following the collapse of vulture populations.

The project has helped India, Nepal and other countries in the region to achieve several of their obligations under the Convention on Biological Diversity (CBD). These include:

CBD article 6	National strategies have been developed for vulture conservation as part of international recovery plans at a workshop organised by the project in 2004 and a second workshop organised by the Indian Ministry of Environment of Forests in 2006.
CBD article 7	Through monitoring vultures and identifying the role of diclofenac in the declines, the project has identified and monitored biodiversity that requires urgent conservation action and identified the processes and activities that have adverse effects.
CBD article 8	In-situ conservation efforts in Nepal and Cambodia around vulture colonies is helping to regulate biological resources, promote the protection of habitats, manage areas adjacent to protected areas and protect knowledge of biological resources.
CBD article 9	The project's ex-situ conservation activities in the establishing vulture breeding centres supports the conservation of biological diversity in the country of origin and the recovery of threatened species.
CBD article 10	The project has promoted research towards the conservation of biological diversity through promoting its' findings on the role of diclofenac and safety of meloxicam to the governments of South Asia.
CBD article 13	Public awareness and education activities within India and Nepal and southeast Asia are promoting the importance of measures to conserve biological diversity.

Appendix I lists the project's contribution to measure for biodiversity conservation as defined by the CBD Articles.

The project has developed significant capacity in vulture husbandry and conservation breeding. Within India BNHS is now regarded as the key agency leading on vulture breeding programmes, and the Indian Central Zoo Authority is endorsing a "Vulture Breeding Best Practise Manual" recently compiled at a workshop organised by BNHS and the RSPB, with support from this project. The project has also had a significant impact on the development of scientific skills of a wide range of staff, as illustrated by the project outputs, and numerous scientific publications.

The RSPB has previously worked with the both of the two main partners (BNHS in India and BCN in Nepal), but the scale of the vulture project has taken the partnerships to a new level and the vulture programme forms the largest individual project in both of these NGOs. Because of the long-term commitment required for the breeding centres and the need to monitor and advocate for vulture conservation, BNHS, BCN and the RSPB are aware of the need to work closely in the future and ensure the partnership remains successful. The development of the first vulture breeding centres in South Asia has placed BNHS in a unique position, and they are now recognised as the lead authority on this subject within South Asia. Within Nepal, the scale of the project has enable BCN to significantly increase the number of contract staff they are employing, raising the organisations credibility within the region. Publicity surrounding the vulture situation has also helped raise the profile and membership of BCN. Within Nepal BCN is recognised as the key conservation NGO working towards vulture conservation.

The project has also developed closer links or new links with other conservation

and research organisations in South Asia, as well as with State Governments and National Government ministries. This includes the Indian Veterinary Research Institute (IVRI) and the Wildlife Institute of India (WII). Strong links have been established in India with Forestry Departments in the states of Haryana, West Bengal, Assam, Maharashtra and Madhya Pradesh, as well as at the ministerial level in Haryana. Nationally the project has worked with the Departments of Drug Administration and the Ministry of Environment and Forests in India, and has developed strong links with the Departments of Drug Administration, Department of Livestock Services and Department of National Parks and Forestry in Nepal.

The project has contributed substantially to the local economy in areas around the breeding centres in India. This includes employment opportunities for labourers and contractors involved in the construction of breeding centres at the sites in Haryana and West Bengal, employment of local people as night watchmen and vulture attendants at the centres, and the employment of goat herders and purchase of goats from the surrounding rural community to provide a safe food resource for the vultures. The provision of goats is not a small task and the Pinjore centre in Haryana, which houses over 100 birds, currently has a goat bill of around £2000 per month. Much of this money is going to the villagers around the centre who are rearing the animals. Other benefits to the local communities around the centres include the provision of a reliable electrical supply to the area and also veterinary treatment to livestock in the area from the project veterinarians. In India and Nepal, local villagers have also been employed by the project in the course of capturing vultures and monitoring vulture colonies. This includes casual works as local guides and porters, and earning opportunities through providing local accommodation and transport. Local villagers and guides are now used in Nepal to monitor three areas with vulture colonies and to disseminate vulture conservation materials.

6. Project Outputs

A full list of the project's outputs is provided in Appendix II

Appendix III lists all publications and material produced as part of the vulture project. This material includes 13 scientific publications, 2 action plans, 8 published reports/articles, 2 research reports to Indian and Nepali government departments and more than 5 posters and pamphlets related to the project. The full text of many of these papers and posters is provided in the Appendices.

The project has been very successful in disseminating information. Target audiences reached include national government officials and decision makers, local government officials and departments, the scientific and veterinary communities, national and local veterinary practitioners, and the public in rural and urban areas. Internationally the project has also succeeded in relaying the risk of pharmaceutical compounds to scavenging birds. An example of the success of this comes from South Africa, where recent attempts to introduce diclofenac as a veterinary treatment were exposed in the national newspapers because of the threat to the country's vulture populations. This resulted in the application being withdrawn (G. Swan *pers. com*).

Information on the project and issues of vulture conservation will continue to be disseminated after the project's completion. This will be achieved through the continued employment of a full-time conservation advocacy officer in India (appointed in mid 2005)

working for BNHS. The long-term commitment the RSPB is making towards vulture breeding centres, along with public awareness of vulture conservation means that vultures will remain a high profile issue within the UK.

7. Project Expenditure

8. Project Operation and Partnerships

The main local partners working with the Darwin Vulture project are:

1. Bombay Natural History Society (BNHS)
2. Haryana Government Forest Department (HGFD)
3. West Bengal Government Forest Department (WBGFD)
4. Indian Veterinary Research Institute (IVRI)
5. Wildlife Institute of India (WII)
6. Bird Conservation Nepal (BCN)
7. BirdLife International in Indochina
8. Wildlife Conservation Society – Cambodia
9. Georgian Centre for Conservation and Wildlife (GCCW)
10. Azerbaijan Ornithological Society (AOS)
11. Armenian Society for the Protection of Birds (ASPB)

The two main and most active local partners on the project have been the BNHS and BCN. Both organisations are the local countries official BirdLife partners and are the largest and oldest conservation NGOs within India and Nepal. BNHS and BCN have both been fully involved in the planning and implementation of the project, and they have been fully involved in the development of all plans for breeding centres, research and *in situ* conservation priorities. Within India at a state level, the Haryana Government Forest Department and Chief Wildlife Warden (Dr Jakati) have been a key players in the project, and the advice from Dr Jakati has been crucial, especially in negotiations for permits for capturing and transporting vultures.

A considerable number of new local partnerships have formed during the course of the project. The key new partnership has been with the Indian Veterinary Research Institute (IVRI), the official government veterinary research institute. This partnership has been instrumental in facilitating safety testing of meloxicam in India and, and in advocating the results of this work at a governmental level. This partnership will continue beyond this project. Working with the Wildlife Institute of India (WII) has enabled carcass sampling surveys to be undertaken across the country. New partnerships have also been established in Southeast Asia with the Wildlife Conservation Society – Cambodia and BirdLife International in Indochina. This has enabled surveys and a conservation assessment of *G. tenuirostris* to occur within this region. These partnerships will continue. Additionally a new partnership is being established with the Biodiversity and Nature Conservation Association (BANCA) in Myanmar to survey vultures in this region. Within the Caucuses the three main local partners (GCCW, AOS & ASPB) have worked with Natural Research (UK), one of the project's international partners.

There was close collaboration in the first two years of the work with another Darwin Project (Ref 162/10/013 "Conservation of Critically Endangered Gyps spp. Vultures in India") managed by the Institute of Zoology, Zoological Society of London. This project provided a great deal of input to the breeding programme as well as funding the nationwide surveys for vultures. There has also been collaboration with The Peregrine Fund (USA) working in Pakistan on the vulture crisis. The project has not consulted with the host countries Biodiversity Strategy Office.

The main international partners working with the project are:

1. Faculty of Veterinary Science, University of Pretoria (South Africa)
2. De Wildt Cheetah and Wildlife Trust (South Africa)
3. Rare and Endangered Species Trust (Namibia)
4. Veterinary Department, Zoo Botanico Jerez, Cadiz (Spain)
5. National Birds of Prey Trust (UK)
6. Natural Research (UK)
7. University of Aberdeen (UK)
8. Zoological Society of London (ZSL), Institute of Zoology (IoZ), (UK)

Vulture conservation activities will continue in South Asia through the work of the local partners. Continued funding is being sought by partners and commitments have been obtained for a certain amount of medium-term funding to cover the running of the vulture conservation breeding centres. State governments in India will remain important for breeding centre activities and the forest departments of Haryana, West Bengal and Assam states (where a third centre is planned) are working for vulture conservation as part of Indian biodiversity strategy. Both BNHS and BCN are continuing with colony monitoring and *in situ* conservation efforts. Community participation has been particularly active in Nepal and conservation education efforts are continuing around remaining breeding colonies.

With the exception of one company in Nepal, the private sector has not been heavily involved with the project to date. Within Nepal, "Medivet" Nepal's largest veterinary pharmaceutical company has been instrumental in changing government policy. Medivet was Nepal's largest diclofenac manufacturer (making 80% of Nepalese diclofenac, accounting for 40% of the total diclofenac in the country), but voluntarily ceased production of this drug. Medivet subsequently rapidly produced meloxicam, which helped persuade government authorities to quickly approve the use of this drug in Nepal. After the launch of meloxicam in Nepal, the government State Drug Controller publicly announced a ban on the production and importation of diclofenac in to the country. Within India pharmaceutical companies have been less proactive, but are now responding in a positive manner for vultures through switching their production of diclofenac to meloxicam. Only two Indian companies were manufacturing meloxicam prior to the diclofenac ban: more than 12 companies are now producing meloxicam.

9. Monitoring and Evaluation, Lesson learning

Monitoring and evaluation of the project's progress has occurred through the development, monitoring and revision of annual workplans in collaboration with all main project partners. This has involved regular visits of project staff to India and Nepal, as well as visits to Cambodia, South Africa and Namibia. The project team is also in regular phone and email contact to keep each other up to date with progress and discuss problems and opportunities. Dr Vibhu Prakash, manager of the BNHS breeding centres in India, has recently started a monthly email round up of all news, progress and problems with the centres, enabling increased dissemination of knowledge acquired within the centres, and of the project's progress.

Two main problems have been encountered during the course of the project: 1., political instability in Nepal and 2., bureaucratic difficulties in India.

Political instability in Nepal over the last three years has been a major problem for the project and has caused some of the work objectives within Nepal to be altered. The major change forced upon us was over the security and long-term viability of establishing a vulture conservation breeding centre in Nepal and in December 2004 we requested that Darwin funds allocated for this purpose be transferred to India, as progress was possible here. This centre (in West Bengal) has now been established and holds significant numbers of *G. tenuirostris*, the rarest of the three critically endangered species. The security situation in Nepal also caused a one-year delay in efforts to undertake surveys for *G. tenuirostris* and caused the postponement of plans to capture and satellite tag vultures and work with local communities in areas where vultures still remain in relatively good numbers. Recent political changes in Nepal and improvement in the security situation in 2006 enabled the project to start working more visibly in previously unsafe areas, and to proceed with plans for a vulture breeding centre. Tragically, a helicopter crash in September 2006 killed 12 members of Nepal's small conservation community, including heads of department and key personnel from the Department of National Parks and World Wide Fund for Nature, which the project was in discussion with over the proposed breeding centre and a national action plan for vultures. Plans for a breeding centre and action plan are still being discussed, but these actions have been unavoidably delayed. Despite these difficulties, considerable progress has been made within Nepal, including the introduction of the safe drug meloxicam and subsequent banning of diclofenac, as well as widespread in-situ conservation efforts around remaining vulture colonies.

Within India there is generally good National and State support for the project, and this is essential for progress, especially of the conservation breeding centres. We encountered some major problems in the second year of the project when the previously very supportive Chief Wildlife Warden in Haryana State (Dr Jakati) was replaced in early 2005 by a less supportive bureaucrat. Consequently, no permission was given for the capture and transfer of birds from within and outside Harayana State (where the Pinjore breeding centre is located) for most of 2005. This official has now been replaced by the original Chief Wildlife Warden, who is again continuing his excellent support for the project. The actions of this one official severely hampered catching plans during the 2005 breeding season, and we are still trying to compensate for the delays caused. An additional difficulty the project has encountered in India has, ironically, resulted from 'Schedule 1' listing of the three vulture species under the Indian Wildlife Protection Act (placing *Gyps* vultures on the same conservation status as tigers and rhino in India). This has resulted in significant delays and difficulties in obtaining permits for the capture and transportation of birds. Separate permits to catch, to hold and to transport vultures are required from three levels of government (National, State and local Forestry Departments), and transport permits are required from every State that vultures move through if transported by road. This has slowed the catching operations and continues to present considerable logistical problems for the breeding programme. It also takes a great deal of BNHS staff time that ideally would be used elsewhere on the project. Problems with permits has also hampered plans to satellite track vultures in India. Despite these difficulties, the project has succeeded in capturing and transporting nearly 120 birds to breeding centres. The project also succeeded in catching and satellite tracking *G. bengalensis* through switching this work to Nepal, and managed to catch and track (non-Schedule 1) Eurasian and Himalayan griffon vultures in India.

The project set up a Science Advisory Team, which has met as a group on average twice a year. In addition there are frequent discussions among team members on the progress of work. The Science Advisory Team meets to evaluate project progress, review deadlines, and set activities to be addressed in the next period of work. External reviews of the project's progress have been provided following the submission of

each year's annual report (March 2004, 2005 and 2006). These reviews have provided helpful guidance and have commended the progress of the project. The captive breeding side of the project has now expanded the external review process by establishing an interim (subject to Indian government approval) Technical Advisory Group. External evaluation of the project has occurred through regular visits to the vulture conservation breeding centres in India. This includes visits from State Government Chief Wildlife Wardens and Forestry Department Officials, representatives from research institutions working in India (IVRI and WII) and Nepal (BCN), and visits from British High Commission staff.

The key lesson learnt during the project is the vital need to establish positive collaborative links with those organisations most able to influence implementation of the required conservation actions. For example, in India we established a working relationship with the Indian Veterinary Research Institute and arranged a visit of key researchers and a relevant central government official to the research underway in South Africa. This visit, and the involvement of IVRI and BNHS in running the safety testing programme in India and reporting this to Government Ministries, was crucial for the acceptance of the research findings. As IVRI is a government research institute, the Indian Government subsequently took their recommendations seriously. Had the project simply presented the results of the South African research to the Indian Government, the impact may have been far weaker. Similarly, the project established a close relationship with officials from the Department of Livestock Services in Nepal and the Nepali Veterinary Department, and organised meetings in Nepal and funded their visit to India to the international meeting in Delhi in 2006. These ministries again advised their government in a far more powerful way than the project could have achieved alone.

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

Annual reviews were circulated to the main partners on the project. Reviewers raised questions on the project's first annual report, regarding the project's withdrawal from working in Jordan, contact with veterinarians and budgeting. A response to these queries was accepted by the Darwin Initiative together with changes to the budget. The annual reviews in years two and three were very positive in their praise of the progress the project and no issues were raised that required a response or change of project activities.

11. Darwin Identity

The Darwin Initiative has been acknowledged and promoted wherever possible during the project and is acknowledged and displayed on the project website (www.vulturerescue.org) as well as on the vulture section of the websites of partner organisations (www.bnhs.org and www.natural-research.org). Information with the Darwin logo includes over 5000 vulture conservation posters distributed in rural Nepal and a full page colour-spread on vulture conservation in Nepal's largest daily newspaper, which has a circulation of more than 250,000 copies and is read throughout the country. Support from the Darwin Initiative is always reported in talks and seminars, and in the acknowledgements of all scientific publications. The Darwin Initiative is also acknowledged on the signs outside the two Vulture Conservation Breeding Centre and on the plaque erected to celebrate the opening of the centre. The Darwin logo is painted on one of the main walls visible at the Pinjore Vulture Conservation Breeding Centre, as well as being used in all leaflets, pamphlets and educational posters produced by the project. Darwin initiative funding is mentioned in radio and television interviews, and

interviews with journalists.

The Darwin Initiative is well known by State and Central Government officials in India and Nepal, as well as by our partner conservation organisations working in both these countries as well as Cambodia, South Africa and Namibia. The support of the Darwin Initiative is held in high regard by these groups, especially by officials in the Haryana State Government. Members of BNHS (the largest conservation NGO in India) and Bird Conservation Nepal have also come to know of the Darwin Initiative through this project.

Because of the conservation breeding centres established in India the project has retained a clear identity with this regard and is now recognised as the leading agency in this field. Outside the breeding centres interest and work by other organisations in collaboration or additional to the work of this project has meant that the vulture conservation crisis is recognised as part of a larger biodiversity conservation programme.

12. Leverage

A total of £643,335 of additional funding or funding in kind was raised for vulture conservation in the region. Additional money could be added to this total if funds in kind (staff time, office costs etc) were added for all the project partners working towards vulture conservation. Details of the amounts supported are listed below:

The RSPB has provided support toward salaries and overheads and capital expenditure (£40,000 for satellite tags and data, and £20,000 towards centre construction costs) worth **£190,835** over the three years of the project.

The RSPB has also provided a further **£157,500** towards research costs (carcass sampling in India, safety testing in South Africa and Namibia, and funds for Cambodia) and **£64,000** towards constructing and running captive breeding centres.

The National Bird of Prey Trust has given a grant of **£12,000** towards construction costs at the Pinjore vulture breeding centre and **£6,000** towards construction costs at the Buxa vulture breeding centre.

The British High Commission Global Opportunities Fund (GOF) awarded the project **£55,000** towards vulture advocacy work in India and for an economic analysis of the costs of the vulture declines to Indian society.

North Star award of three satellite transmitters (worth **£5,000**) to use for tracking vultures

The Institute of Zoology/Zoological Society of London has provided **£14,000** towards travel and subsistence costs for research and training activities.

The Oriental Bird Club has provided **£6,000** towards the vulture breeding programme.

The Rufford Foundation has awarded the project **£20,000** towards conservation activities.

The Indian Central Zoo Authority has committed 1 Crore rupees (ca. **£110,000**) towards

funding vulture breeding centre at four sites in India.

The Body Shop Foundation has given the project £3,000

The project has worked with partners to try and secure additional funds. The award from the British High Commission Global Opportunities Fund was a joint application from the RSPB and BNHS. The project has also advised Bird Conservation Nepal on a recent application it has submitted to the UNDP-SGP fund.

13. Sustainability and Legacy

The project will have a long-lasting legacy within the region, through increased capacity to undertake conservation breeding of endangered wildlife species within the Indian sub-continent, regional conservation awareness of the role played by vultures and other wildlife as one of the key scavengers that provided a previously unrecognised ecosystem service, and international awareness of the risks posed by secondary impacts of pharmaceutical drugs and the need for proper environmental testing of the safety of these compounds.

The issues regarding vulture conservation and the role of diclofenac have received considerable media and scientific interest within South Asia and internationally. The announcement of the phase out of diclofenac within the region has resulted in an enormous amount of media interest. There has been national and local broadsheet and online news coverage of this news in India and Nepal, and it has been widely reported on international news websites and in the conservation literature. The implementation of the diclofenac ban in South Asia will have a major impact on the effort to conserve *Gyps* vultures. The role of diclofenac has raised awareness of the whole issues of drug residues in carcasses and the environment, and other countries in Africa and South America are now becoming aware of the potential impact of residues. Captive breeding centres in India are also raising increasing awareness of conservation, and the training of veterinarians and staff at these centres has raised the capacity within India to ensure the long-term viability of these captive centres. These centres are now being run and managed almost exclusively by BNHS staff.

BNHS, BCN and the RSPB are actively seeking further funding to support the project and to provide additional income to the long-term financial commitment made by the RSPB towards the breeding centres.

14. Value for money

We consider that the vulture project has been excellent value of money for the Darwin Initiative programme. It has achieved its key purposes within the duration of the project, has established facilities, capacity and expertise to continue working towards conservation of critically endangered vultures, and has secured considerable financial leverage during the course of the project and beyond the completion of the project. The project has also benefited greatly from the commitment of time and energy from all of the project's staff, as well as the time and commitment from state Government staff and staff from other research institutions.

Final report prepared by:

Dr Richard Cuthbert (RSPB)

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Dr Hem Sagar Baral (BCN)

28th December 2006



Logos of project partners involved in "Vulture Rescue" see www.vulturerescue.org

APPENDICES

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* PDF of document attached as separate email and printed version attached with hard copy of final report

+ JPG image(s) inserted in electronic appendix, full version available with hard copy of final report

Appendix I

Project Contribution to CBD

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

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	20%	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	10%	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	20%	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	15%	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	15%	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 assessment 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

Appendix II

Standard Outputs

16. Appendix II Outputs

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	1 (BNHS vet)
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)	18
6b	Number of training weeks not leading to formal qualification	14
7	Number of types of training materials produced for use by host country(s)	1
Research Outputs		
8	Number of weeks spent by UK project staff on project work in host country(s)	102 weeks
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
10	Number of formal documents produced to assist work related to species identification, classification and recording.	0
11a	Number of papers published or accepted for publication in peer reviewed journals	13 published, 3 in press
11b	Number of papers published or accepted for publication elsewhere	10
12a	Number of computer-based databases established (containing species/generic information) and handed over to host country	2 – database on vulture colony monitoring and haematological and pathological findings
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 vulture serum and tissue samples
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 plan workshop February 2004, second planned workshop organised by Indian Ministry
14b	Number of conferences/seminars/ workshops attended at which findings from Darwin project work	30

Code	Total to date (reduce box)	Detail (←expand box)
	will be presented/ disseminated.	
15a	Number of national press releases or publicity articles in host country(s)	>50
15b	Number of local press releases or publicity articles in host country(s)	>50
15c	Number of national press releases or publicity articles in UK	>30 publicity articles in UK or published internationally
15d	Number of local press releases or publicity articles in UK	0
16a	Number of issues of newsletters produced in the host country(s)	4
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	1 Project webpage
17b	Number of dissemination networks enhanced or extended	0
18a	Number of national TV programmes/features in host country(s)	1 vulture conservation advocacy film produced, >10 interviews/features
18b	Number of national TV programme/features in the UK	0
18c	Number of local TV programme/features in host country	>10 interviews featured
18d	Number of local TV programme features in the UK	0
19a	Number of national radio interviews/features in host country(s)	>20
19b	Number of national radio interviews/features in the UK	13
19c	Number of local radio interviews/features in host country (s)	>30
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)	£135,000 (mainly construction of Breeding Centres and associated vehicles and equipment)
21	Number of permanent educational/training/research facilities or organisation established	2 Vulture Conservation Breeding Centres
22	Number of permanent field plots established	18 vulture colonies monitored in Nepal and India
23	Value of additional resources raised for project	£643,335

Appendix III

List of Project Publications

17. Appendix III: Publications

* Indicates attached to appendices

Type	Detail	Publishers	Available from	Cost
Scientific article	Saving Asia's Gyps vultures: the 'Vulture Rescue' team's conservation programme, Prakash, V., Pain, D.J., Shultz, S., Cunningham, A.A. In Proceedings of the WWGBP (Budapest 2003)	World Working Group for Birds of Prey	www.raptors-international.de	£0
* Published manifesto	DICLOFENAC MANIFESTO (2004)	BCN, BirdLife International, BNHS, Ornithological Society of Pakistan, RSPB, The Peregrine Fund, ZSL	www.vulturerescue.org and the RSPB	£0
* Published article	Vulture death mystery explained? Shultz, S.(2003)	World Birdwatch, September 2003, page 9	RSPB	£0
* Scientific article	Diclofenac poisoning is widespread in declining vulture populations across the Indian subcontinent. Shultz,S. Baral, H, Charman, C., Cunningham, A. Das, D., Ghalsasi, G, Goudar, M, Green, R., Jones, A., Nighot, P., Pain, D. & Prakash, V. (2004)	Proceedings of the Royal Society of London B. (2004), DOI: 0.1098/rspb.2004. 0223	www.vulturerescue.org and from RSPB	£0
* Scientific article	Diclofenac poisoning as a cause of vulture population declines across the Indian subcontinent. Green, R., Newton, I., Shultz, S., Cunningham, A., Gilbert, M., Pain, D.J., & Prakash, V. (2004)	Journal of Applied Ecology (2004), 41, 793–800	www.vulturerescue.org and from RSPB	£0
* Species Recovery Plan	South Asian vulture recovery plan	RSPB	www.vulturerescue.org and from RSPB	£0
* Species Recovery Plan	Report of the International South Asian Vulture Recovery Plan Workshop	BUCEROS (BNHS) (2004), 9, 2-48	BNHS and RSPB	£0

Scientific article	Evidence to support that diclofenac caused catastrophic vulture population decline. V. Prakash, R.E. Green, A.R. Rahmani, D.J. Pain , M.Z. Virani, A. A. Khan , H.S. Baral , Y.V. Jhala, R. Naoroji, N. Shah , C.G.R. Bowden , B.C. Choudhury, G. Narayan, P. Gautam. (2005)	Current Science, vol. 88, no. 10, 25 May 2005.	From BNHS	£0
Scientific article	Phylogenetic analysis of the DNA polymerase gene of a novel alphaherpes virus isolated from an Indian <i>Gyps</i> vulture. Cardoso M, Hyatt A, Selleck P, Lowther S, Prakash V, Pain D, Cunningham AA, Boyle D. (2005)	Virus Genes. 2005 May; 30(3):371-81	From the RSPB	£0
* Scientific article	Toxicity of diclofenac to <i>Gyps</i> vultures. Swan, G., Cuthbert, R., Quevedo, M., Green, R., Pain, D., Bartles, P., Cunningham, A., Duncan, N., Lindsay Oaks, J., Parry-Jones, J., Taggart, M., Verdoorn, G. & Wolter, K. (2006a)	Biology Letters (2006), DOI: 0.1098/rsbl.2005.0425	www.vulturerescue.org and from RSPB	£0
* Scientific article	Removing the Threat of Diclofenac to Critically Endangered Asian Vultures. Swan, G., Naidoo, V., Cuthbert, R., Green, R., Pain, D., Swarup, D., Prakash, V., Taggart, Bekker, L., Das, D., Diekmann, J., Diekmann, M., Killian, E., Meharg, Patel, R., Mohini, S. & Wolter, K. (2006)	PLoS Biology (2006) 4(3) DOI: 10.1371/journal.pbio.0040066	www.vulturerescue.org www.plosbiology.org and from RSPB	£0
* Scientific article	Rapid Population declines of Egyptian Vulture <i>Neophron percnopterus</i> and Red-headed Vulture <i>Sarcogyps calvus</i> in India. Cuthbert, R., Green, R., Ranada, S., Saravanan, S., Pain, D., V. Prakash & Cunningham, A. (2006)	Animal Conservation (2006), 9, 349-354.	www.vulturerescue.org and from RSPB	£0
* Published Proceedings	Proceedings of the International Conference on Vulture Conservation	Ministry of Environment and Forests, Government of India (2006)	Ministry of Environment and Forests, Government of India	£0
* Species Action Plan	Action Plan for Vulture Conservation in India	Ministry of Environment and Forests, Government of India (2006)	Ministry of Environment and Forests, Government of India and the RSPB (electronic copy)	£0

* Scientific article	Collapse of Asian vulture populations: risk of mortality from residues of the veterinary drug diclofenac in carcasses of treated cattle. Green, R.E., Taggart, M.A., DAS, D., Pain, D.J., Kumar, S., Cunningham, A.A., Cuthbert, R. (2006)	Journal of Applied Ecology (2006), 43, 949-956	www.vulturerescue.org and from RSPB	£0
* Scientific article	Disposition of diclofenac in Indian cow and goat with reference to <i>Gyps</i> vulture population declines. Taggart, M.A., Cuthbert, R., Das, D., Sashikumar, C., Pain, D., Green, R., Feltner, Y., Shultz, S., Cunningham, A.A., Meharg, A.A., (2006)	Environmental Pollution (2006) doi:10.1016/j.envpol.2006.08.017.	Aberdeen University and the RSPB	£0
* Scientific article	NSAIDs and scavenging birds: potential impacts beyond Asia's critically endangered vultures. Cuthbert, R., Parry-Jones, J., Green, R.E., Pain, D.J. (2006)	Biology Letters (2006) doi:10.1098/rsbl.2006.0554	www.vulturerescue.org and from Biology Letters and the RSPB	£0
* Scientific article	Comparative toxicity studies of NSAIDs in birds: A criticism of Reddy et al. Cuthbert, Pain, D.J., Green, R.E., Swan, G., Swarup, D. (2006)	Environmental Toxicology and Pharmacology (2006)	www.vulturerescue.org and from RSPB	£0
* Scientific article	Tracking Vultures from the Caucasus into Iran. M.J. McGrady & A. Gavashelishvili (2006).	Podoces (2006) 1 (1/2), 21–26	Natural Research	£0
Research report for Indian Government	The identification and safety testing of meloxicam: a vulture safe alternative to replace diclofenac	RSPB March 2006	RSPB	£0
Research report for Indian Government	The dangers of untested non-steroidal anti-inflammatory drugs for Critically Endangered vultures and scavenging birds in India	RSPB December 2006	RSPB	£0
* Project newsletter	Jatayu 3: A newsletter of the project Conservation of Critically Endangered <i>Gyps</i> Species of Vultures in India	BNHS (2005)	BNHS, Hornbill House, S.B. Singh Road, Mumbai, India	£0
* Project newsletter	Jatayu 4: A newsletter of the project Conservation of Critically Endangered <i>Gyps</i> Species of Vultures in India	BNHS (2006)	BNHS, Hornbill House, S.B. Singh Road, Mumbai, India	£0

* Published report	Conservation of Asia's critically endangered vultures. R.J. Cuthbert 2005	Conservation Science in the RSPB 2005, pp 34-35.	RSPB	£0
* Published report	Finding a cause for and solution to the decline of Asia's endangered vultures. R.J. Cuthbert 2006	Conservation Science in the RSPB 2006, pp 12-13.	RSPB	£0
* Conservation leaflet	Help us stop our vultures vanishing (2005)	BNHS & RSPB (2005)	RSPB	£0
* Published report	Vulture Conservation Programme, Bird Conservation Nepal 24 th Annual Report (2005/06)	BCN (2006)	Bird Conservation Nepal, PO Box 12465, Lazimpat, Kathmandu, Nepal	
* Conservation poster	Conserve Critically Endangered Vultures of Nepal (2006)	BCN (2006)	Bird Conservation Nepal, PO Box 12465, Lazimpat, Kathmandu, Nepal	£0
* Conservation leaflet	Protect Nepal's vultures (leaflets 1 and 2, 2006)	BCN (2006)	Bird Conservation Nepal, PO Box 12465, Lazimpat, Kathmandu, Nepal	£0
* Information leaflets	Vulture Conservation Breeding Centre, Pinjore, Haryana State and Vulture Conservation Breeding Centre, Raja Bhat Khawa, West Bengal (2006)	BNHS (2006)	BNHS, Hornbill House, S.B. Singh Road, Mumbai, India	£0
* Conservation Film	The Vanishing Vultures – A conservation film by Mike Pandey	BNHS & RSPB (2006)	BNHS and RSPB	£0
* Conservation poster	I'm helping vultures (2006)	RSPB Wildlife Explorers (2006)	RSPB	£0
Scientific article	The safety of meloxicam to critically endangered <i>Gyps</i> vultures and other scavenging birds in India. D. Swarup, R. C. Patra, V. Prakash, R. Cuthbert, D. Das, P. Avari, D. J. Pain, R. E. Green, A. K. Sharma, M. Saini, D. Das, M. Taggart (in press)	Animal Conservation (in press, 2007)	Not available until published	
Scientific article	Diclofenac residues in carcasses of domestic ungulates available to vultures in India. M.A. Taggart, K. Senacha, R.E.Green, R. Cuthbert, D.J. Pain, B. Randagan, Y. Jhala, A. Rahmani, A.A. Meharg (in press)	Environment International (in press, 2007)	Not available until published	

Book chapter	Immunological determination of the pharmaceutical Diclofenac in environmental and biological samples. Knopp, D., Deng, A., Letzel, M., Taggart, M.A., Himmelsbach, M., Zhu, Q., Perobner, I., Kudlak, B., Frey, S., Sengl, M., Buchberger, W., Hutchinson, C., Cunningham, A., Pain, D., Cuthbert, R., Raab, A., Meharg, A., Swan, G., Jhala, Y., Prakash, V., Rahmani, A., Quevedo, M., Niessner, R., (in Press).	ACS Symposium Series, Rational Methods for the Selection and Use of Agrochemicals - ACS Symposium Series, Chapter 13 (in press 2007)	Not available until published	
Scientific article	Rate of decline of the oriental white-backed vulture <i>Gyps bengalensis</i> population in India estimated from measurements of diclofenac in carcasses of domesticated ungulates. Green, R.E., Taggart, M.A., Senacha, K.R., Pain, D.J., Jhala, Y., Cuthbert, R.	Submitted to Journal of Applied Ecology	Not available until published	
Scientific article	Long distance migration of Griffon (<i>Gyps fulvus</i>) and Himalayan Griffon (<i>Gyps himalayensis</i>) from Northern India. Cuthbert, R.J. Pain, D.J., Prakash, V., Cunningham, A.A., Shultz, S.	In prep for submission to Journal of Raptor Research	Not available until published	

Appendix IV

Darwin Contacts

18. Appendix IV: Darwin Contacts

Project Title	162/12/027
Ref. No.	Prediction and management of declines in <i>Gyps</i> species vultures
UK Leader Details	
Name	Dr Deborah J. Pain
Role within Darwin Project	Darwin Project Leader
Address	Royal Society for the Protection of Birds, The Lodge, Sandy, Bedfordshire, SG19 2DL, UK
Phone	
Fax	
Email	
Other UK Contact	
Name	Dr Richard Cuthbert
Role within Darwin Project	Darwin Project Manager and RSPB Vulture Programme Research Manager
Address	Royal Society for the Protection of Birds, The Lodge, Sandy, Bedfordshire, SG19 2DL, UK
Phone	
Fax	
Email	
Partner 1	
Name	Dr Vibhu Prakash
Organisation	Bombay Natural History Society, Principal Scientist
Role within Darwin Project	Main partner in India, directs research activities carried out by BNHS and overall person in charge of Vulture Conservation Breeding Centres
Address	BNHS, Hornbill House, S.B. Singh Road, Mumbai, India
Fax	
Email	
Partner 2	
Name	Dr Hem Sagar Baral
Organisation	Bird Conservation Nepal, Executive Director
Role within Darwin Project	Main partner in Nepal, supervises a team of vulture researchers and vulture conservation activities, principal contact for raising awareness of vulture conservation in Nepal with other NGO and with government departments
Address	Bird Conservation Nepal, PO Box 12465, Lazimpat, Kathmandu, Nepal
Fax	
Email	