VCBC

WORKING MANUAL

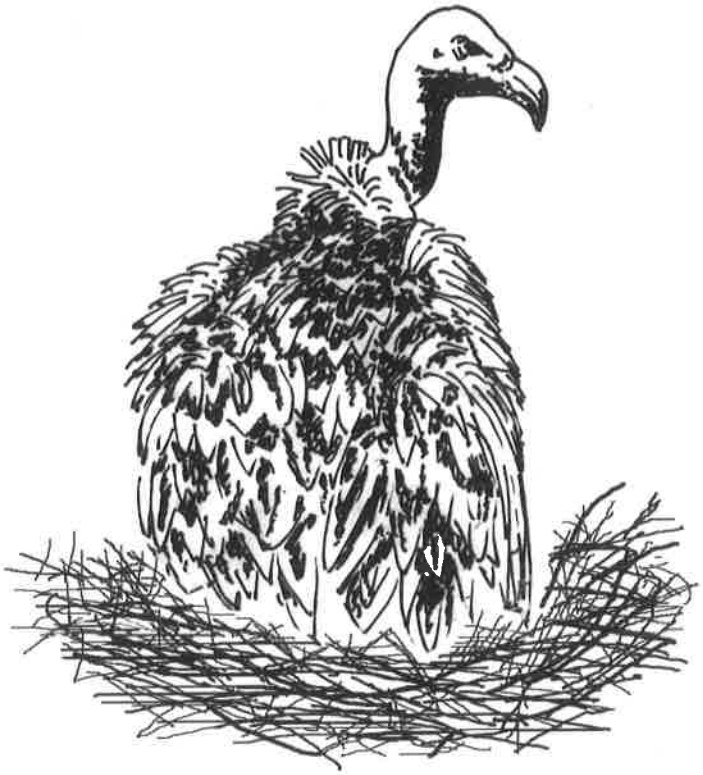
VULTURE CONSERVATION BREEDING PROGRAMME

Ministry of Environment & Forests
Government of India

केन्द्रीय चिड़ियाघर प्राधिकरण
Central Zoo Authority

Haryana Forest Department

BNHS india



The population of the White-backed, Long-billed and Slender-billed vulture has declined by more than 99% over a decade. This is an extremely urgent conservation problem as, in addition to the declines continuing at a very rapid rate, only a handful of the three resident *Gyps* vultures are currently in captivity, most of them in the conservation breeding centres. Without an aggressive captive-breeding programme, it is highly probable that the affected *Gyps* species will become extinct, with the Slender-billed vulture projected to disappear within 10 years.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WORKING MANUAL OF
Vulture Conservation Breeding Programme

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Ministry of Environment & Forests
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B. S. Bonal, IFS
Member Secretary
Central Zoo Authority

The Government of India established the Central Zoo Authority in the year 1992 to oversee the functioning of the zoos in the country and to enforce the minimum standards of upkeep and care of animals.

Based on the National Zoo Policy adopted in 1998, the main objective of the Zoos was to complement and strengthen the national efforts in conservation of rich biodiversity of the country particularly wild fauna. This objective could be achieved by supporting the Conservation Breeding Programme of endangered species to raise their stocks and rehabilitating them in wild. Conservation education and research for conservation of wildlife were the other objectives of zoos as defined by the National Zoo Policy.

The National Wildlife Action Plan (2002-2016) also laid emphasis on the role of zoos for ex-situ breeding of endangered species of wild fauna and their rehabilitation in the wild as per the IUCN guidelines for reintroduction.

The planned Conservation Breeding Programme of critically endangered species is the flagship programme of the Authority. The Authority has tried to help various zoos to take up the Conservation Breeding Programmes by organizing workshops for the zoo personnel in various aspects of establishing such programmes including appropriate housing, and husbandry and care of captive animals and birds.

Ex-situ wildlife conservation is not the best of conservation strategies but certainly serves as a "Life Boat" for the species which are critically endangered due to various biotic and other pressures. With the continuing degradation of wildlife habitats, more and more species might require Conservation Breeding Programme for their survival and zoos with their expertise in housing captive animals will have an important role to play.

A concept paper was prepared by the

Central Zoo Authority in July 2007 detailing the Authority's initiative on Conservation Breeding Programme. An expert group on Conservation Breeding constituted by the Central Zoo Authority, in consultation with the Chief Wildlife Wardens, in-situ conservation

Managers and Zoo Directors had identified 73 endangered species for the Conservation Breeding Programme. A further prioritized list of 26 species was prepared from the existing list by the expert group for the Conservation Breeding Programme in 2012. Accordingly, one zoo in the natural distribution of the animal or bird which was listed for Conservation Breeding Programme was identified as the Coordinating Zoo for the species. The zoos were asked and were funded for creating off-display area in the zoos for setting up Conservation Breeding Programme. Participating zoos were also identified for the Conservation Breeding Programme of the species if they had the animals in their stock.

The three species of once abundant *Gyps* vultures, White-backed vulture, Long-billed vulture and Slender-billed vulture are now on the verge of extinction. They are now critically endangered and on the priority list of Conservation Breeding Programme of the Central Zoo Authority. The Central Zoo Authority supported the

establishment of five Vulture Conservation Breeding Centres in different zoos namely Van Vihar Zoo, Bhopal, Madhya Pradesh, Nandankanan Zoological Park, Bhubaneshwar, Orissa, Sakkarbaug Zoo, Junagadh, Gujarat, Nehru Zoological Park, Hyderabad, Andhra Pradesh and Muta, Ranchi, Jharkhand. Sakkarbaug Zoo, Junagadh, Gujarat, has 47 White-backed vultures and 6 Long-billed vultures while Nehru Zoological Park, Hyderabad, Andhra Pradesh has 5 White-backed vultures. The rest of the zoos are in the process of acquiring the founder stock.

The Bombay Natural History Society and Haryana Forest Department took the lead and established the first scientifically managed Vulture Conservation Breeding Programme at Pinjore in 2004. The centre has now over ten years of experience in captive management and care of vultures and has successfully bred all the three species, the White-backed vulture, the Long-billed vulture and the Slender-billed vulture in captivity. The Vulture Conservation Breeding Centre, Pinjore has been identified as the Coordinating Zoo for the Vulture Conservation Breeding Programme of Central Zoo Authority. As most of the vulture centres are in the process of establishment, the Central Zoo Authority organized 'workshop on Conservation Breeding of the Vultures' at Pinjore from 20 to 22 April 2011 in collaboration with the Haryana Forest Department and Bombay Natural History Society.

The Chief Wildlife Wardens, Directors and Biologists of the zoos where the vulture centres have been established were invited to the workshop. The participants were explained the process of setting up and managing the centre. This working manual is largely based on the proceedings of this workshop. I congratulate the team of the Vulture Conservation Breeding Centres for producing this easy to use manual and I am sure that the centres which have been recently set up in the zoos will find it useful in running the centre.

PREFACE

The Bombay Natural History Society and the Haryana Forest Department have experience in holding and managing captive vulture populations for over ten years. The first Conservation Breeding Programme for the three species of vultures was set up in 2004 at Pinjore. The Centre has been successful in breeding all the three critically endangered *Gyps* species of vultures, White-backed vulture, Long-billed vulture and Slender-billed vulture.

This working manual has been written based on our experience for over a decade in running the Centre. The Centre is fortunate in getting expert advice and help from many national and international collaborators. The Royal Society for the Protection of Birds, our U.K. BirdLife International Partner, has managed to get technical help from various organizations when required. We have received major inputs in design of the aviaries and husbandry and care protocols from Ms. Jemima Parry-Jones, Director of International Centre for Birds of Prey, Gloucestershire, U.K. and an authority on the breeding of raptors. Our staff has received advanced training in captive management from her Centre in U. K. Experts from her Centre have advised and helped in setting up the incubation facility. The Zoological Society of London has provided help in veterinary care of vultures and has helped to develop the protocols for veterinary care. Dr. Andrew Routh, the Chief Veterinarian, London Zoo, is the main advisor and regularly advises on the veterinary care of vultures.

The *Gyps* vultures are slow breeding and long living species. They breed only when they are 5-6 years old and lay only one egg per year. Hence the conservation breeding of the species will be a long term programme, at least for 15 years. It should have long term commitment of funding and support. It is also important that the people who are managing the Centre do not change very often. It takes time to understand the running of the Centre and frequent shifting of staff will greatly undermine the functioning of the Centre. Based on a mathematical model, 600 pairs need to be released in the wild of each of all the three species to form a self sustaining genetically viable population. It will require six Centres to hold 25 breeding pairs and release 100 pairs from each of the Centre within fifteen years from the beginning of release programme. It is important that this many numbers are bred and released in the wild. Merely breeding a few birds and releasing them in wild will not serve any purpose.

Vultures were once very common in the country but their population crashed within a decade and now they are critically endangered. This happened because of the use of the drug diclofenac. The drug is given to cattle in inflammation and pain but if the cattle dies within 72 hours of administration of this drug and vultures feed on it, then the vultures die of visceral gout. The drug is extremely toxic to vultures and in very low concentration (0.4mg/kg of body weight) could cause mortality. The veterinary use of this drug is banned by Government of India. The human formulations of this drug are still used in veterinary purposes and the problem continues. So the release programme will depend a lot on removal of the drug from the system. Efforts will have to be made regularly to remove the drug from the system.

The Conservation Breeding Programme will play a very important role in saving the three vulture species from extinction. I am confident that this manual will go a long way in helping zoos in establishing and running the Centre. This is a working manual and will be continually updated with experience gained in various Centres which are established and also which are in the process of establishment.

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ACKNOWLEDGEMENTS

We are grateful to the Central Zoo Authority for funding and sponsoring this workshop which resulted in publication of this manual. We would specially like to thank Mr. B. S. Bonal, IFS, Member Secretary for taking keen interest in organizing the workshop as well as in preparation of this working manual.

We are highly obliged to Mr. Prahlad C. Gillakheda, Chief Parliamentary Secretary, Government of Haryana, for inaugurating the workshop. His gracious presence enthused the participants and the organizers to work harder for Vulture Conservation.

We are thankful to the Haryana Forest Department, especially Dr. Parvez Ahmed, IFS, Principal Chief Conservator of Forests, Haryana, Mr. C. R. Jotriwal, IFS, Additional Principal Chief Conservator of Forests, Haryana, Mr. R. K. Sapra, IFS, Chief Wildlife Warden, Haryana, and Forest Officials of Haryana Forest Department for hosting the workshop in Haryana State.

We are grateful to Dr. R. D. Jakati, IFS, Director, Indira Gandhi National Forest Academy, Dehradun, Mr. P. N. Pardhi, IFS, Principal Chief Conservator of Forests (Wildlife), Odisha, Mr. J. B. Jauher, IFS, Principal Chief Conservator of Forests (Wildlife), Jharkhand, for finding time to attend the workshop and their invaluable inputs helped in developing the manual.

We are thankful to the Directors of the five state zoos, Mr. J. S. Chauhan, IFS, Director, Van Vihar National Park, Bhopal, M.P., Mr. S. Panda, IFS, Director, Nandankanan Zoological Park, Bhubaneshwar, Odisha, Mr. Malikarjuna Rao, IFS, Director, Nehru Zoological Park, Hyderabad, Andhra Pradesh, Mr. V. J. Rana, Director, Sakkarbaug Zoo, Junagadh, Gujarat, and Mr. A. T. Mishra, IFS, DFO, Ranchi Division, Jharkhand, being funded by the Central Zoo Authority to run the Vulture Conservation Breeding Centres, for making it convenient to attend the workshop and share their experiences on establishing and running the Vulture Centres. Mr. Naim Akhtar, Scientific Officer, Central Zoo Authority, was a great help and support during the workshop and developing the manual.

The manual has drawn a lot from the experience gained from the Vulture Conservation Breeding Centre, Pinjore. We are obliged to the Royal Society for the Protection of Birds (RSPB) and the Darwin Initiative for the Survival of Species, U.K., for providing funding support to the Vulture Conservation Breeding Centre, Pinjore. The RSPB has been a pillar of support both technically and financially for the Centre. The technical expertise provided by Ms. Jemima Parry-Jones of the International Centre for Birds of Prey, U.K., is gratefully acknowledged. She has provided vital technical inputs in the aviary design, husbandry and care, and artificial incubation of vulture eggs. The technical support for veterinary care provided by the Zoological Society of London, U.K., has been very helpful in running the programme. Dr. Andrew Routh, Chief Veterinarian of London Zoo is the veterinary advisor to the Centre and his inputs have been invaluable. We are grateful to the Indian Veterinary Research Institute (National Refferal Centre) for providing veterinary support and also for carrying out the safety testing of meloxicam on the vultures. We are especially grateful to Dr. M. C. Sharma, Director and Dr. A. K. Sharma, In-charge of the Wildlife Centre at IVRI for their support.

Last but not the least, we are grateful to our parent organization the Bombay Natural History Society (BNHS) for providing all the help in successful running of the project especially Dr. A. R. Rahmani, Director, BNHS, for his prompt technical, financial and administrative support.

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INTRODUCTION

This working manual has been developed based on the proceedings of the Workshop on the Vulture Conservation Breeding Programme which was held at Pinjore from April 22 to 24, 2011, and was sponsored by the Central Zoo Authority, New Delhi. This manual contains information and instructions on developing and maintaining a Conservation Breeding Centre for three critically endangered resident *Gyps* species of vultures and is largely based on the experience gained from the breeding programmes of White-backed vulture *Gyps bengalensis*, Long-billed vulture *Gyps indicus* and Slender-billed vulture *Gyps tenuirostris*, established by the BNHS in collaboration with Central Zoo Authority and various State Governments.

Background

Nine species of vultures are recorded from India of which five belong to the genus *Gyps* (Prakash 1999). Three *Gyps* vultures, namely the White-backed, Long-billed and Slender-billed vultures are resident, and the remaining two, the Eurasian Griffon *Gyps fulvus* and Himalayan Griffon *Gyps himalayensis* are largely wintering species (Prakash *et al.* 2003). The White-backed vulture and Long-billed vulture were abundant across large parts of India until the 1990s. The Slender-billed vulture, which was not distinguished as a separate species from Long-billed vulture until recently (Rasmussen and Parry 2001), was also locally common in north and northeastern parts of the Indian subcontinent (Ali and Ripley 1987).

During the 1980s, the White-backed vulture was thought to be the commonest large bird of prey in the world (Houston 1985). The population of resident *Gyps* vultures in the Indian subcontinent crashed during the 1990s. This was first reported in 1996–97 and later documented by the BNHS, while monitoring raptor numbers in Keoladeo National Park, at Bharatpur in Rajasthan (Prakash 1999).

The BNHS conducted nationwide raptor surveys in many parts of India between 1991 and 1993, using a road transect method (Samant *et al.* 1995). The survey was repeated in 2000 and the results were dramatic. Both White-backed and Long-billed vultures had almost disappeared from the areas surveyed. The populations of White-backed and Long-billed vulture had declined by more than 92% between 1991–93 and 2000 (Prakash *et al.* 2003, 2005).

The latest repeat surveys were carried out from March to June 2007 by driving in a motor vehicle and recording vultures within 500 m on either side of each transect. The results indicated that the population of the three species of vultures continues to decline at an alarming rate. Numbers of White-backed vulture declined by 99.9% between 1992 and 2007 on the transects surveyed each year during that period. The equivalent decline in the combined total of Long-billed and Slender-billed vulture was 96.8%. The population of White-backed vulture had an average annual rate of decline of 43.9% between 2000 and 2007, whereas the combined average annual rate of decline of Long-billed and Slender-billed vulture was over 16%. Because of the evidence of widespread and rapid population decline, all three vulture species were listed by IUCN, The World Conservation Union, in 2000 as Critically Endangered, which is the highest category of endangerment. This assessment indicates a high risk of global extinction in the wild in the near future. Current captive populations need to be viable for all three species, as complete extinction is likely to occur if no action is taken.

World population size is not known for any of these species, although a recent paper (Prakash *et al.* 2007) gives estimates for India of 11,000 White-backed vulture, 45,000 Long-billed vulture and 1,000 Slender-billed vultures. Populations outside India are unlikely to add significantly to these figures.

Role of vultures in the ecosystem

Vultures are nature's most efficient scavengers and can finish off the carcass of an adult cattle in a matter of minutes (Ali and Ripley 1987). Vultures kept the environment clean in India in the absence of any effective carcass and slaughter house waste disposal system, and thereby prevented the outbreak of epidemics, cleaning the carcasses before they could rot and putrefy. Vultures are known to feed on rotting and putrefied flesh without any adverse effect on themselves. Now, with the absence of vultures, the accumulation of livestock carcasses may

have implications for groundwater safety and for livestock-borne disease such as tuberculosis and anthrax. With the decline in numbers of resident vulture species, there is now a superabundance of carrion food (Prakash *et al.* 2003). Concurrently, and probably in response to the increased food availability, there appears to be an increase in resident feral dog populations and in wintering scavenging birds such as Steppe Eagle *Aquila nipalensis* and Eurasian Griffon wintering in India. The increase in feral dog populations could have serious consequences for human and wildlife health, as dogs are carriers of several diseases that affect human beings, wildlife and livestock, including rabies, distemper, and canine parvovirus (Pain *et al.* 2003). India has the highest incidence of rabies in humans in the world, with the majority of these from dog bites (Prakash *et al.* 2003).

Vultures are not only important for environmental health, but also have considerable cultural and religious significance in India and elsewhere. For thousands of years, in different parts of the world, humans have laid out their dead for consumption by scavengers. Of these, the best known and documented are the Parsis, 70% of whom live in Mumbai. The Parsis believe that fire, earth and water are sacred and, as such, must not be contaminated with human corpses, e.g., by burial, cremation or disposal in water. The Parsis, therefore, ritualized the practice of putting out their dead for scavengers by building 'Towers of Silence' to limit access to corpses exclusively to airborne scavengers. Collecting cattle bones for the fertilizer industry is an old trade and vultures effectively and rapidly cleaned skeletons of all soft tissue and facilitated the bone collectors' job. Today, carcasses are rotting in areas with few scavengers, and even where feral dog populations have increased massively, carcasses are not 'cleaned' thoroughly, as dogs only scavenge choice tissues and cannot consume as much as a flock of vultures do. This, and the attempted burning and burial of carcasses in some localities, remove a source of income for bone collectors.

Diclofenac implicated as the main cause of vulture decline

The veterinary use of the non-steroidal anti inflammatory drug (NSAID) – diclofenac – in livestock is the main, and

Dead animals rotting in the absence of vultures

perhaps the only cause of the population declines (Green *et al.* 2004; Oaks *et al.* 2004; Shultz *et al.* 2004). Vultures are exposed to toxic levels of diclofenac when they feed on carcasses of livestock which have died within a few days of treatment, and which contain residues of the drug (Oaks *et al.* 2004). Vultures that consume sufficient tissue from such carcasses die from the effects of diclofenac-induced kidney failure. Green *et al.* (2004) estimated that no more than 0.8% of ungulate carcasses available to foraging vultures would need to contain a lethal dose of diclofenac to have caused the observed population declines. Shultz *et al.* (2004) found that a high proportion of White-backed and Long-billed vultures found dead in the wild had visceral gout, consistent with diclofenac poisoning being the main or sole cause of the population declines.

Vulture Recovery Plan

The first South Asia Vulture Recovery Plan Workshop was held in February 2004, and a Vulture Recovery Plan was formulated. The major recommendations of the plan were to ban the use of diclofenac as a veterinary drug and initiate captive breeding programmes at atleast 6 locations in South Asia to save vultures from imminent extinction. The plan was prepared based on the information available on causes of vulture mortality and declines, and was released by Mr. S. C. Dhesi, IAS, Principal Secretary and Finance Commissioner, Forests, Government of Haryana, in the presence of Mr. S. S. Bist, IFS, I.G., Forests, Ministry of Environment and Forests, Government of India on

February 16, 2004. The recovery plan discussed various aspects of crash in vulture populations in South Asia and suggested measures for the recovery of the vulture populations. The major recommendations of the plan were prepared and approved by senior Forest Officers of the Ministry of Environment and Forests, Government of India and various states, Scientists of the IUCN Species Specialist Group, Royal Society for the Protection of Birds, UK, Zoological Society of London, UK, The Peregrine Fund, USA, Wildlife Conservation Society, USA, Bombay Natural History Society, Zoological Survey of India, Wildlife Institute of India, Dehradun, and Central Zoo Authority during the workshop.

Release of Vulture Recovery Plan

Ban on the veterinary use of diclofenac in India

The Drug Controller General of India, vide letter dated May 11, 2006, instructed all the state drug controllers to withdraw the licenses granted to manufacture diclofenac formulations for veterinary use. The toxicity of diclofenac to vultures and the strong evidence of its effect on their populations were the reasons for withdrawal. The final gazette notification was issued in August 2008.

Various formulations of diclofenac

The need for conservation breeding of vultures

The population of the White-backed, Long-billed and Slender-billed vulture has declined by more than 97% and it continues to decline at the rate of over 50% annually. This is an extremely urgent conservation problem as, in addition to the declines continuing at a very rapid rate, only a handful of the three resident *Gyps* vultures are currently in captivity, most of them in the Conservation Breeding Centres at Pinjore, Haryana, Raja Bhat Khawa, West Bengal, Rani, Assam and Sakkarbaug Zoo, Junagadh. The situation is particularly urgent for the Slender-billed vulture, which is now believed to number less than 200 pairs in the whole world. The Slender-billed vulture is one of the most threatened large bird of prey in the world, being more likely to go extinct even earlier than the Californian Condor.

Californian Condor
Photo credit: Dr. Chris Parish, The Peregrine fund, USA

As has been the case for the Californian Condor *Gymnogyps californianus* (Snyder 1986; Wilbur 1978) in the USA, which owes its continuing existence to captive breeding, such a programme is an urgent and necessary tool for the conservation of *Gyps* vultures in India and the rest of Asia. Without an aggressive captive breeding programme, it is highly probable that the affected *Gyps* species will become extinct, with the Slender-billed vulture projected to disappear within 10 years. In a similar fashion, other wild populations of old world vultures, such as the Eurasian Griffon vulture (Sarrazin 1994), the Cinereous vulture *Aegypius monachus* and the Bearded vulture *Gypaetus barbatus*, have all been either restored or augmented by captive breeding and release programmes, although none of these have had the conservation importance or urgency as the *Gyps* vultures in South Asia.

With so much available knowledge from successful Vulture Conservation Breeding Programmes, the chances of success for a similar programme for South Asian *Gyps* vultures are good. In general, *Gyps* vultures are relatively easy to house, keep and maintain in captivity, provided adequate facilities and management techniques are employed. All species of *Gyps* vultures have been successfully bred in captivity previously.

Conservation Breeding Programmes should not be treated as a last ditch option, but should be used as a conservation tool incorporated within a larger programme of conservation management. BNHS with the State Forest Departments runs such a conservation programme, including monitoring and surveillance of *Gyps* vultures in different range states. Without a captive-breeding component to this programme, however, the extinction of at least three species of resident *Gyps* vultures in India as well as South Asia seems probable.

Diclofenac is definitely found to be responsible for the mortality of vultures (Oaks *et al.* 2004; Shultz *et al.* 2004). Diclofenac is very widely used as a veterinary drug in the country and is also very effective and inexpensive. The drug meloxicam, which is also a non-steroidal anti-inflammatory drug like diclofenac, is the only known safe drug for vultures and appears to be the only alternative to diclofenac at the moment. Though the government has imposed a ban on the manufacturing of diclofenac in 2006, it will be at least 10 to 15 years before it is completely removed from the system, because it will take that much time to exhaust all the stock that is widely distributed across the country, and also for the fact that

White-backed vulture nestling hatched and reared in captivity at VCBC, Pinjore, Haryana

VCBC, Pinjore, Haryana

this drug being used in humans, gets filtered into veterinary use. Due to the fact that only a very small number of carcasses need to contain a lethal dose of diclofenac to cause decline at a very high rate, all the vultures left in the wild are in danger. The only remaining option to save them is to bring as many vultures into the safety of captivity as soon as possible, and to initiate captive breeding programmes. At the same time, efforts should be made to phase out diclofenac from the market. The experience of BNHS at the Vulture Conservation Breeding Centre at Pinjore, Haryana has been most encouraging.

A Captive Breeding Programme is a lengthy commitment. Facilities have to be designed and built, breeding stock has to be obtained and placed in the facility and staff needs to be trained to a high standard. It may take some time from set-up to first breeding, but once the birds start to breed, there are certain management techniques that can be used to artificially increase productivity over and above that found in nature. Such techniques as double clutching, artificial incubation, hand rearing and fostering young are well established, and can greatly increase the success of captive breeding and release programmes. They are now well established for all the three species of resident *Gyps* vultures.

Satellite image of VCBC, Pinjore, Haryana

General Ecology and Biology of Gyps species of Vultures

Classification : *Gyps* vultures

Taxonomically the birds of prey or raptors fall in the Order Falconiformes. Vultures are also birds of prey as evident from highly specialized musculature in their feet, though it has now degenerated because they have taken to an entirely scavenging way of life.

Classification

Phylum : Chordata

Class : Aves

Order : Falconiformes

Suborder : Accipitres

Family : Accipitridae (hawks, Old World vultures and eagles)

Genus : *Gyps*

Twenty-three species of vultures are reported across the world. They are found in all continents except Australia. Sixteen species are reported from the Old World (Asia, Europe, Africa) and seven from the New World (North and South America). Of the sixteen species of vultures of nine genera recorded from the Old World, eight species belong to the genus *Gyps.*

Morphology of *Gyps* vultures

The *Gyps* or Griffon vultures are heavy-bodied birds (weighing 4–12 kg) with a high wing loading (weight per sq. cm of wing area). Their large broad wings are good for soaring on thermals. They have a long naked neck and bald head, mostly covered with fine hair-like feathers. There is a ruff of feathers at the base of the neck. In adult Griffons, the ruff is small and composed of degenerated feathers in a compact-puff, except for the Himalayan Griffon. A striking characteristic of Griffons is the two bare patches of skin just below the collar bone on either side of the crop. These are round areas of naked skin up to 8 cm in diameter and fringed with white down feathers. These are often referred to as 'eye patches' and can become quite prominent during behavioural display. They are evident even in a few days old nestling.

A conspicuous feature of vultures is the presence of a crop, situated at the base of the neck and supported by the collar bone. The crop is mainly used to store food, and no digestion takes place here. It is like a distensible bag at the front end of the oesophagus and gets filled up when the vulture feeds, and protrudes like a bag of skin. All vultures have large powerful beaks and strong legs. Their toes are almost flat, as they spend lot of time on ground. The legs are unfeathered and are strong enough to hold the meat down for tearing, but are not good for grasping. All these species tend to be pale to fairly dark brown. Juveniles tend to be darker than the adults, except in the White-backed vulture, where the adults have darker body feathers.

Long, bare neck and head

Sharp eyes and strong beak

Powerful feet with slightly curved claws

Distribution of *Gyps* species of vultures

World wide distribution

Gyps vultures are distributed throughout Africa, Europe and Asia, rarely above latitude 50° N. Of the eight species of *Gyps* vultures worldwide, four are found only in Asia (White-backed vulture, Long-billed vulture, Slender-billed vulture and Himalayan Griffon vulture), three are found exclusively in Africa (African White-backed vulture *G. africanus*, Cape Griffon *G. coprotheres,* Rüppell's Griffon *G. rueppellii*) and one breeds in Eurasia but migrates into Africa and South Asia (Eurasian Griffon). Geographical ranges of several *Gyps* species overlap to some extent with those of others in the same genus (Pain *et al.* 2003). *Gyps* vultures were typically widespread and abundant, accounting for the majority of individual vulture sightings in both Africa (c. 90%) and Asia (c. 99%) (Houston 1983). Wherever *Gyps* species were monitored, they were sometimes seen to range widely during foraging (Houston 1974, 1983), and immatures could disperse even more widely after fledging, often being more nomadic than adults. The establishment of 'nursery' areas, where juveniles congregate prior to the onset of the breeding season is a common feature (Mundy *et al.* 1992).

Distribution in India

Five *Gyps* species of vultures are recorded from India. Three species, namely White-backed, Long-billed and Slender-billed vultures are resident and breed in the country. The Himalayan Griffon has two populations, a resident and a migratory. The migratory population appears during the winter.

Distribution of White-backed vulture : Found more or less throughout the Subcontinent from West Pakistan (Baluchistan) east through Assam and Manipur; south from Kashmir and along the Himalaya between c. 1500 and 2500 msl (including Nepal), through the Peninsula to Kanyakumari. Not found in Sri Lanka. Were absent or rare in pure desert facies a few years ago, e.g., Sind, Punjab, and Rajasthan, now well established and expanding with advent of river barrages, canal cultivation, populous villages with livestock, and trees for nesting (Ali and Ripley 1987)

Distribution of Long-billed vulture : It is more or less endemic to India. It is found from Southeast Pakistan (Sind) to Rajasthan, Gujarat and peninsular India south of the Gangetic plains. Not found in southwest India or Sri Lanka.

Distribution of Slender billed vulture : This species is distributed north of the Gangetic plains along the foothills of Himalaya from Kashmir through Nepal, Bengal and Assam. Was common in Assam and Bangladesh. Also seen in Malay Peninsula and Indochina.

Social behaviour

Vultures are social birds and are found in flocks. All the major activities of the flock are synchronized, such as feeding, sunning, bathing and even egg-laying. Most species of *Gyps* vultures nest in colonies. They do not defend territories during breeding, as is observed in other raptors. Conspecifics are tolerated on the same tree and close to the nest. The vultures, while flying and food searching observe other vultures, and if some vultures start circling and going down, the others follow and gather in large numbers at a carcass. This can often happen in a surprisingly short period of time.

Gyps vultures are not sexually dimorphic. They form monogamous pairs in which both sexes share all the duties equally including incubation and care of the young. The dead partner is however, immediately replaced within days or sometimes hours. Two of the resident species, White-backed and Slender-billed vultures, nest on trees, while the Long-billed vulture nests on cliffs and caves on the hills. Sometimes they also nest on trees in the absence of cliffs in the area. White-backed vulture nest on house tops if there are not enough trees. Long-billed vulture nest in big colonies, but the White-backed and Slender-billed vultures nest singly or in loose colonies. Both these species also nest together on the same tree.

Social behavior : A flock of vultures sunning together in an aviary

Flying and soaring

Vultures are generally late risers and do not attempt to fly till the day warms up. They would, however, fly even before daybreak if a carcass was located the previous evening to feed. Once soaring they can stay airborne for hours given the right weather conditions. The White-backed vulture also could fly up to 100 km every day while soaring. Radio telemetry studies on vultures at Keoladeo National Park, Bharatpur have revealed that the birds would go up to 35-40 km while soaring but come back to the same foraging area and roost in the evening. Once they have fed, *Gyps* vultures, like most large carnivores, are content to sit still and digest their meal thus saving energy or soar in thermals.

Vocalisation

Most *Gyps* vultures are generally silent but are very vocal as nestlings. When excited (such as at a carcass) they will emit a series of cackles, hisses and croaks. During mating, a pronounced 'wheezing' or dry 'rasping' noise is made by the female.

Food and feeding behaviour

The *Gyps* vultures are obligate scavengers and they never ever kill. They usually feed on the carcasses of mammals, mainly ungulates both domestic and wild, which are located from the air. Foraging vultures either find the carcass themselves, or respond to the feeding activity of other scavengers. Vultures do not get their food by stealing it from predators. They are highly mobile and can travel long distances to forage in a day. If there is sudden mortality of large number of animals, vultures from long distances can reach the place and go back after finishing off the meat, unlike mammalian predators which can only move short distances in a day and feed on a limited quantity of meat. Vultures are known to eat as much as their body weight or more, if food is available. They can, however, go hungry for a couple of weeks without any problem, even in captivity. They are known to finish the skinned carcass of a full grown cow in a matter of minutes.

Vultures feed on the soft tissue and visceral organs including intestines of animals. They usually gorge themselves when food is available in plenty, storing food in the crop which gets empty within 24-48 hours. *Gyps* vultures are social birds, so they feed in flocks, arriving in ones and twos at a food source and very quickly forming

An adult White-backed vulture feeding

large groups. They tear at the softer parts of the carcass to gain entrance and feed deep into larger carcasses. If the carcass is not skinned or opened up by other scavengers, the vultures start feeding from the natural orifices. There is much posturing, squabbling and chasing one another over carcasses. However, despite this, injuries are generally rare during such activity. Usually, the hungry bird dominates and the bird which has fed easily gives way.

Breeding biology

The age of sexual maturity varies; however most *Gyps* vultures start to breed at five to seven years of age, although they have been known to breed earlier. This is the age of breeding in the wild. Breeding in captivity, as for other species, can be influenced by a number of factors, some of which can encourage slightly earlier breeding. The White-backed vultures start breeding when they are 3 years and six months old, whereas the Long-billed vultures start breeding when they are four years old in captivity (VCBC annual report 2010-2011).

Gyps vultures nest either in colonies or 'loose' colonies. Large colonies can be found on suitable cliffs, whilst those species that breed on trees tend to form loose colonies. The Long-billed vulture nests on cliffs but the White-backed and Slender-billed vulture nest on trees. There could be five to six nests on a large tree but usually it is one or two nests on a tree. The Slender-billed vulture sometimes nests beside White-backed vulture on the same tree. As mentioned earlier, this vulture has only recently been given species status, rather than being a sub-species of the Long-billed vulture.

Courtship display and nest building : There is no sexual dimorphism in vultures. Both sexes look alike. They pair for life and occupy the same nest site year after year unless disturbed. The vultures start defending their nest site from September onwards and the pair is always seen together on the nest or a nearby perch. The breeding displays of the *Gyps* vultures are not adequately described, but it appears that 'tandem flying' (where the birds fly together in 'stacks', mirroring each other's flight path), and 'jetting in' (which is fast and close to simultaneous arrival at the nest) are commonly recorded courtship displays. Sitting and roosting together, and some mutual preening, is also recorded by a number of researchers. The established pairs start copulation at the onset of the breeding season in the wild. In captivity, however, the pairs copulate throughout the year and usually on the nest. In captivity, no elaborate courtship display is noticed. The pairs occupy and start defending their nest ledge from other vultures at the onset of breeding season, usually from September. They are often seen together on the nest ledge. The female usually lowers her head before copulation.

Nests : These can be used year after year and building takes place with both birds, often one bringing sticks and the other doing the building (Mundy *et al.* 1992). Both tree and cliff nesters build stick nests.

Usually one egg is laid, and in most *Gyps* vultures the incubation period is between 50–60 days. Average incubation period recorded for the 3 *Gyps* vultures is 55 days. Both birds in the pair assist in incubation and rearing of the nestling, which is fed with regurgitated food.

Fledging takes place in about 100-110 days in the White-backed, 120 days in the Long-billed, and 150 days in the Slender-billed vulture, after hatching in captivity.

Survival

Adequate data does not exist on the longevity of *Gyps* vultures, but birds of similar ecology are usually long

An adult White-backed vulture building nest

lived. A Eurasian Griffon lived for over 37 years in captivity in Europe and an Andean Condor lived for 52 years in captivity in North America (Newton 1979). It is possible that the resident *Gyps* vultures will live upwards of 40 years in captivity. Mortality is higher in juvenile birds and reduces with sub-adults. Adult birds in the wild are thought to have an average attrition rate of 5% per year.

Factors of mortality

The major mortality factor across India and South Asia over recent years has been clearly demonstrated to be diclofenac – a non-steroidal anti-inflammatory drug - poisoning of domestic livestock carcasses, their principal food, which has caused population crashes of three resident *Gyps* species of vultures (Shultz *et al.* 2004, Prakash *et al.* 2008). Vultures suffer from a number of other mortality factors, most of which are indirect such as secondary and direct poisoning, electrocution by power lines, habitat loss, variable food supply, deliberate persecution (e.g., shooting) and injuries due to kite string. Probably the highest cause of mortality in first year birds is starvation due to lack of experience in searching food. Older birds can suffer the same fate if they experience a sub-lethal injury that impairs their foraging ability. All of these are usually site-specific mortality factors, and do not affect the population as a whole. A good number of vultures (20–30) are injured and killed during the festivals like "Uttraan" in Gujarat and Rajasthan, when people fly kites as part of the celebrations, and the powdered glass coated kite strings, designed to cut the string of an opponent's kite, severely damages or cuts the wings of soaring birds which get entangled in them. Again, this is not normally expected to be a cause of population decline. However, when a species becomes critically endangered in the wild, lesser factors of mortality become much more significant.

Dead Long-billed vulture in Bayana, Rajasthan

The resident *Gyps* species of vultures

White-backed vulture

General ecology : It is usually seen in small groups, commonly in association with the Long-billed and other vultures, on the outskirts of villages and habitations. Unless busy feeding, or fully gorged and grounded, they spend most of the day scouting the countryside for food, covering immense distances in the quest. Or they soar for hours on end and circle aloft in the sky with no other apparent motive than fun (Ali and Ripley 1987).

The breeding season is between September and April and varies locally. It extends till June in the foothills of Himalaya. The nest is usually a large untidy platform of sticks and twigs and has a shallow central depression lined with green leaves. It is built at or near the top of various locally available trees. Normally only one egg is laid, rarely two. The egg is thick-shelled, matt white and is unmarked. Incubation period of c. 55 days is recorded in captivity. Nestling is blackish brown, covered in down also on neck and crown. Nestling period recorded in captivity is over 100-110 days.

Status : Globally critically endangered. It is placed in Schedule I of the Wildlife (Protection) Act, 1972 since September 2002.

Long-billed vulture

General ecology : Seen in small flocks near animal carcasses in the countryside or on outskirts of towns and cities along with other vultures, especially White-backed vulture.

The breeding season extends from November to May. It nests on cliffs and makes its nest with sticks. There are very few records of its nesting on trees in Rajasthan. It usually lays one egg which is mostly pure white, sometimes blotched with reddish brown. An average incubation period of 55 days has been recorded in captivity. Nestling period recorded in captivity is 120 days.

Status : Globally critically endangered. It is also placed in Schedule I of the Wildlife (Protection) Act, 1972 since September 2002.

Slender-billed vulture

General ecology : These are social birds and live in flocks. All the activities like feeding, nesting and roosting are carried out in flocks. The fights at the feeding sites are never serious and they do not injure each other. Usually the hungry displace birds which have fed very easily. Gatherings of sometimes 20–30 birds or more are commonly seen at animal carcasses in the countryside or on the outskirts of towns and cities.

The breeding season extends from November to June. The nest is placed on huge trees. The female lays one egg which is usually white. Both parents share duties in raising the nestlings. Incubation period is 55 days in captivity. The nestling has a very black neck and crown with scattered white down. Nestling period recorded in captivity is 150 days.

Status : Globally critically endangered. The species is placed in Schedule I of the Wildlife (Protection) Act, 1972 since September 2002.

White-backed vulture

Long-billed vulture

Slender-billed vulture

Field Identification of Resident *Gyps* Vultures

Peculiar features of *Gyps* vultures/identification aids

Size : huge, majestic and eagle-like bearing

Crown and Neck : bald with hair-like feathers

Neck : long and robust

Bill : strong, hooked

Crown : rounded

Body : broad (long lower body and undertail coverts)

Feathering pattern : outer thighs or tibia heavily covered by large buffy contour feathers. Fine hair-like feathers give the crown a pale cast

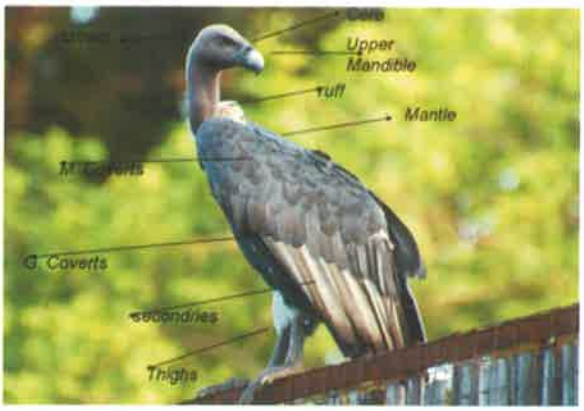
Tongue : strongly grooved, edges serrated with backwardly pointing serrations

Feet : flat and less curved claws, as they spend considerable time on the ground

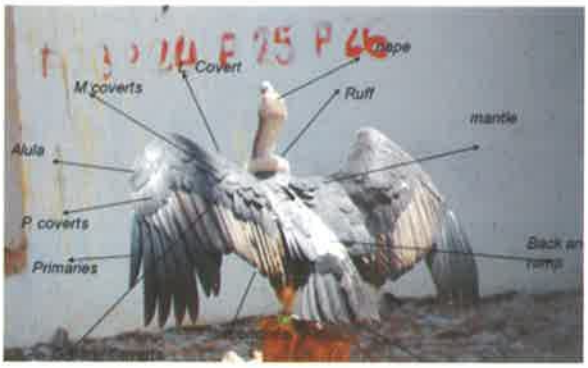
Crop : Bare patches of skin on the upper breast on either side of the crop

Obligate scavengers : feed only on dead animals. Can tolerate extreme periods of starvation

Behaviour : Spend most of their time during the day soaring in the sky



An adult White-backed vulture



The white back is visible only when the wings are spread

Identification of resident *Gyps* vultures

White-backed vulture

Smallest *Gyps* vulture in the country with a body length of 90 cm. It weighs approximately 3.5–5 kg. It has a wingspan of 207.8 cm.

Field characters : The adult has mostly blackish plumage with silvery grey secondaries. At close range, thin whitish streaks can be seen on the underside. Bare skin with small hair-like feathers on the head and neck rather dark brown grey, usually with a pink or maroon tinge to neck, hind neck has very sparse whitish down. The upper mandible is pale bluish grey. Lower mandible and cere blackish. It has a white back and rump which is visible only when it drops its wings or while flying.

The juveniles are overall very dark brown and never show white rump or back. Black beak contrasts with dirty white or brown down on the crown and neck. There is very little contrast between the dark flight feathers and tail, and rest of the body and coverts. There are faint streaks on the lesser and median coverts, scapulars and mantle.

A juvenile White-backed vulture

White-backed vulture : Adult, Juvenile and Sub-adult in flight

Long-billed vulture

A medium sized vulture, with a paler tawny colour (very light brown), bigger and stronger than the White-backed vulture, with a body length of 92 cm. It weighs approximately 5.5–6 kg. It has a wingspan of 205–229 cm. It nests on cliffs.

Field characters : The adults have dark black head and neck, with sparse whitish feathers mainly on the nape. Feathers on the lateral side of tibia are relatively longer and firmer. Feathers on the lower body are also long. The bill is entirely pinkish or yellowish, also the cere. A distinct ruff of soft white feathers at base of neck contrasts with dark neck. There is a strong contrast between dark flight feathers and tail, and the rest of the light underparts. The under-tail coverts are very pale.

The juveniles have head and neck dull black, largely covered with white down feathers; black face and bill with pale tip. It is heavily streaked on the dorsal side and has light brown rump and back, unlike the young of White-backed vulture.

Long-billed vultures : (L-R : Juvenile, Adult and Sub-adult)

Slender-billed vulture

Medium sized, darker than Long-billed vulture, with a body length of 92 cm. It weighs approximately 5.5–7 kg. It has a wingspan of 205–229 cm.

Field characters : The adults have a very long slender head and beak, almost of the same thickness as the neck. Beak, cere, head and neck are jet black. The bill has a pale yellow ridge. The bill of the Slender-billed is much longer and narrower than that of the Long-billed. The ear hole is big and prominent. Feathers on the lateral side of tibia are relatively white and down. The plumage, mantle, scapulars and lesser median coverts are generally darker than in Long-billed, with whitish ruff not very conspicuous.

The juveniles have jet black head and neck, with sparse snow white down. The skin on head and neck have a burnt look. The bill and ceres are entirely blackish.

An adult Slender-billed vulture

A juvenile Slender-billed vulture

Closely related wintering *Gyps* vultures

Juvenile Eurasian Griffons

Picture downloaded from Internet

A juvenile Himalayan Griffon

Mission, Vision and Objectives of a Vulture Conservation Breeding Centre

Vision

To become a living example of saving critically endangered bird species from extinction with an ex-situ conservation programme.

Conservation Message of Breeding Centre

The wildlife species are better conserved in nature but could certainly be saved from extinction by ex-situ efforts if there is a problem and rehabilitated in the wild once the cause of mortality is removed.

Objectives

To establish a founder population of 25 pairs each of 3 species of vultures.

To produce a population of at least 200 birds of each species in 15 years to be reintroduced to the wild.

To rescue injured wild resident *Gyps* vultures and include them in the ongoing Conservation Breeding Programme after recovery.

Minimum number of pairs required for Conservation Breeding Programme

Deterministic model of a captive vulture population and the wild population eventually derived showed that 600 pairs of each of the three species will form a genetically viable population. Hence 150 captive pairs of each of the three species will be required to produce 600 pairs, which will be released in the wild within 10 years of the beginning of the release programme.

Targets for Captive Breeding Programme

- A Breeding Centre with 25 pairs would be capable of producing a derived wild population of 100 pairs about 10 years after the beginning of releases.
- Releases would begin 8 years after the capture of founding stocks.
- To allow for mortality in captivity and unequal numbers of the sexes, it would be necessary to take about 60 birds of each species.

Adult Long-billed vultures in an aviary

- At least six populations in different parts of the country should be established.

Age composition of vultures for captive breeding

Sixty birds of each of the three species, White-backed, Long-billed and Slender-billed vulture consisting of a total of 180 birds will be housed in one Centre. The total birds will be grouped into the following age groups :

- Seventy percent nestlings/juveniles.
- Fifteen percent sub-adults.
- Fifteen percent adults.

Majority of the birds to be collected are nestlings or juveniles because nestlings take to captivity easily, and it also becomes possible to keep a record of their age, as ageing of adult birds is impossible. The sub-adult and adult birds act as guide birds to the younger ones for activities like feeding, nesting, breeding, etc.

Number of birds for Conservation Breeding

- Vultures start breeding when 5-6 years old.
- The first release will take place 8-9 years after the collection of founder stock.
- Birds will be released in flocks of not less than 15, including atleast a few adults and sub-adults after making sure that the cause of mortality has been removed from the system.

Proposed time-table for Conservation Breeding

- Capture of birds including nestlings during the first year of establishment of the Centre. They will form the founder population. Sixty birds of each species.
- First breeding in captivity is expected only after 5 years.
- First release is expected only 10 years after the collection of founder stock.
- 100 pairs would be released within 10 years since the beginning of the release programme
- Thus it is a minimum 20-year programme.

mission

To release 100 pairs each, of the three species of critically endangered resident *Gyps* species of vultures, in the next 15 years to establish at least one viable population of resident *Gyps*, in an environment free of diclofenac and other poisons, from each of the Centres.

ESTABLISHING VULTURE CONSERVATION BREEDING CENTRE

Site selection of Conservation Breeding Centre

Prerequisites for the selection of site for setting up a Conservation Breeding Centre for vultures :

- Should be within the normal distribution range of the species.
- Should be relatively free of natural vulture populations.
- Should be close to a big city where specialized veterinary facilities are available.
- Should be well connected by rail, road and air.
- Should have water, telephone and electricity connection at the site.
- Should be away from human habitation.
- Should be at least 5 km away from wild birds or animals kept in captivity, as the birds are to be released in the wild and should not get exposed to pathogens.
- There should be no poultry farms in a radius of at least 25 km.
- Minimum five acres of land is required for housing and breeding 25 pairs of each of the three species.
- Ideally it should be a degraded patch of forest land with very few trees.
- The site should be at a place where natural calamities like floods, earthquakes and forest fire do not occur frequently.

Considerations for aviary design

Birds will be in captivity and hence will be totally dependent on us for all the facilities for survival, so it is important that the aviaries should be comfortable for the birds as well as safe from danger.

Vultures are large, heavy and strong birds. They need space to fly from one place to another in captivity, but would be required to be captured atleast once in a year. Therefore, the size of the aviary should be such that the birds should have space to do their routine chores, but could be caught easily if required. If the size is too big, it will become difficult to catch them if they are injured or sick and require treatment. The size of the aviary will also depend on the function of the aviaries. Some aviaries will be required for keeping sick birds and will be small, to restrict the movement of vultures. Small size will help the veterinarian to catch the bird easily without putting it under stress. Similarly the size of quarantine, nursery, breeding and display aviaries should be decided. The colony aviaries, where birds will be kept in flocks, will have to be larger. There should be a clear span in the aviary, as this will provide space for vultures to flap fly within the aviary and keep their wings in shape.

Vultures are strong birds and could dash against the netting covering the aviary and also the walls. So the netting should be strong but it should not hurt the vulture when they dash against it. The material should also withstand the elements like the sun, wind and rain. It is recommended that soft but durable material like netlon be used to line all metal constructions from the inside of the aviary.

Vultures are social birds, so they have to be kept in a flock. They perch on the highest available perch, but they also spend a lot of time on the ground. So the aviary should have adequate perches, which are strong enough to bear the weight of a number of vultures sitting together on one perch. The floor of the aviary should not be made of concrete but of soft sand or mud.

Vultures need a lot of water as they usually drink after foraging and also because they like to bathe. So water troughs will have to be provided which are big and deep enough for the vultures to drink and bathe. They should not be very deep, to prevent the birds from drowning.

Established pairs of vultures like to be near the nest throughout the year. So nesting platforms should be provided for established as well as for new pairs. As the vultures build stick nests, nesting material will have to be provided during the breeding season.

As the vultures in the Conservation Breeding Centre have to be kept in such a way that there is minimum human contact with the birds, a window of adequate size should be provided through which the food, consisting of carcasses of goat or buffalo, could be given from outside without going into the aviary.

As vultures are very smart and agile birds, they could escape if the door is left open even for a few minutes. So there should be provision for double door protection in all the aviaries to prevent accidental escapes.

Shaded areas should be provided in the aviaries for the vultures to take shelter from rain and extreme temperature. Non-conducting material should be utilized for providing shade.

Structure of aviaries

The basic structure of all the aviaries should be similar but the sizes could vary depending on the purpose of each aviary.

The flooring of all the aviaries should be of mud, topped with a six-inch thick layer of sand which improves drainage of water and is easy to clean.

All the aviaries should have atleast one solid wall which would have the entrance door. The birds feel secure sitting close to a solid wall.

All the aviaries should open into a gallery which provides double door protection and prevents the birds from accidental escape.

Perches should be placed jutting out horizontally from the wall, as a stump on the ground, or between two walls. The perches kept horizontally should be wound with coconut rope to provide a rough surface which helps to prevent bumble foot, a bacterial disease occurring in the feet of large birds. Perches above human height are the most utilized. Rounded perches of 10–30 cm diameter are ideal for vultures.

Nest ledges measuring 5 x 2.5', either of concrete, wood or jute, should be placed at different locations throughout the aviary. These will be used for nesting and perching. The nesting ledges should have atleast 10" lip to prevent the eggs from rolling down.

The roof should have an inner layer of netlon, a tough plastic, and an outer layer of welded wire mesh. There should be atleast a one-foot gap between the metal and plastic netting.

The aviaries should have at least one solid wall made of brick and cement. The rest of the sides should have brick wall upto 2–3' and then a netting of welded wire mesh. The welded mesh should be lined from the inside by bamboos upto the top.

The aviaries should be provided with water facility, in the form of rounded water troughs of c. 2.5' diameter and a foot deep. The troughs should be made of concrete. There must be a system by which the water could be filled in and emptied from outside.

The troughs should usually be made near the wall and a hatch which opens towards the inside should be made on the wall through which the water troughs could be cleaned. A hatch 2.5' wide and 1.5' high is adequate.

A food hatch 3 x 2' should be made about four feet above the ground on the 100' wall to pass the food inside. Thus human contact with the vultures while feeding could be minimized.

One hatch should be made on both the 100' walls in one of the 20' bamboo window for providing nesting material.

Closed-circuit television cameras should be put in all the aviaries to observe the birds without disturbing them.

Types of aviaries required at a Centre

The following aviaries will be required for various purposes

Quarantine aviaries (20 x 20 x 16')

Nursery aviaries (12 x 10 x 8')

Holding aviaries (20 x 20 x 16')

Colony aviaries (100 x 40 x 20')

Breeding aviaries (20 x 20 x 16')

Hospital aviaries (12 x 10 x 8')

Display aviaries (20 x 20 x 16')

Quarantine aviaries : Birds brought to the Centre will first be kept in these aviaries. The quarantine aviaries should ideally be located atleast 5 km from the Centre. It could be close if there is a geographic barrier like a hill. The aviary should be in a cool, calm place and away from human habitation.

Considerations while deciding the size of the quarantine aviary are :

Birds will be kept for temporary duration (maximum 45 days). Birds will be caught often for health check-up. Birds should be close enough for visual observations. Birds in a large aviary are difficult to catch and are likely to injure themselves.

Based on experience, a 20 x 20 x 16' aviary is good for keeping atleast 10 and not more than 15 birds in quarantine at a single time. The aviary should have perches at different heights. The aviary should be a temporary structure made of netlon and pipes. It should open in a passage made of netlon. Adequate provision for water should be made.

Nursery aviaries : This aviary is for housing nestlings brought from the wild and those which are hatched artificially at the Centre. A Centre should have at least 8 nursery aviaries. A 12 x 10 x 8' aviary is good as a nursery aviary and could house at least two and maximum four nestlings. The main feature of this aviary is a nest ledge of 10 x 2.5' placed 4' above the ground. The nest ledge should be divided into two sections of 5' each. It should be a cot made up of jute netting on a wooden structure. This is good for giving a wind updraft which encourages nestlings to perform wing exercises. It is advisable to group the nestlings into twos in one section of the ledge.

A flock of White-backed vulture nestlings in nursery aviary

Quarantine aviary - Front view

Holding aviaries : The Centre should have four holding aviaries of dimensions 20 x 20 x 16' with capacity to hold 2 pairs of vultures in each aviary. These aviaries should be open to the sky and should have a welded wire mesh on the top. There should be high and low perches wound with coconut rope to provide a rough surface for birds to perch on. This will prevent bumble foot. There should be perches at 5', 10' and 15' height. Some should be in shade but none of them should be above the water troughs. Food hatches should be strategically located in the walls, from where food should be offered to vultures. There should be two water troughs of 2.5' diameter for vultures to drink and bathe in. One trough should alternately be kept dry every week.

The flooring should only be of sand and mud, in no case of concrete. The birds should be kept in these aviaries after they fledge in nursery aviaries. These aviaries will be large enough for the birds to do wing exercises and flap fly from one end to another. They should be provided with bamboo lining to the wire mesh on all three sides, to prevent injury to birds. A lining of thin jute cloth could cover the sides of the aviaries in winter to prevent attack from rock bees. The birds will be kept in this aviary till they are two years old and will also be provided with nest ledges and nesting material to encourage them to breed.

Colony aviaries : These aviaries will house sub-adults and adults of a single species after they have spent about two years in holding aviaries. These aviaries will be large enough for the birds to perform wing exercises by flying from one end to another and to feed communally on carcasses, exactly as they do in the wild.

Adult Long-billed vultures in holding aviary

Colony aviary - inside view

Ideally there should be four such aviaries, with the capacity to hold 40 birds each. These aviaries should be of dimensions 100 x 40 x 20' and should be open to the sky, except for a welded iron mesh to prevent monkeys from getting in. An additional netlon netting, which is soft but strong, should be provided one foot below the iron mesh to prevent the birds from getting injured if they dash against the welded iron mesh. There could be about 25 high and low 3–5' long perches wound with coconut rope. Nest ledges should be provided along the 40' wall. There should be nine rectangular nest ledges made up of wooden frame with jute netting, measuring 5 x 4', on each of the 40' walls. Each nest ledge should have a window 1.5 x 1.5', a couple of feet above it. There should be twelve more similar ledges distributed all over the aviary including the 100' walls. They could ideally be placed one each on the pillars at 15' height.

There should be two strategically placed windows, one on each 100' wall, from where food can be passed inside. Four concrete water troughs of 2.5' diameter are required for vultures to drink and bathe in, about 2–3' from the wall to make it easy to clean from outside. The floor of the aviary should be soft, made of mud and sand. The colony aviaries should be equipped with a CCTV camera which could rotate almost 360° and pan vertically almost 180°. It is useful if the camera also has a zoom function, as it would help in monitoring individual birds/nests more closely.

An adult White-backed vulture on perch

There should be two doors on each of the 40' long wall which open into a 6' wide covered gallery which opens outside. This will provide double door protection to prevent the birds from escaping whenever the door is opened. There should also be a door in the middle of one of the 100' walls which should open into a 6 x 6' room gallery which opens outside. The staff should use the gallery at the middle of the 100' wall to enter for cleaning the aviaries, while for catching birds for examination, the side galleries should be utilized.

There should be three big windows on each of the 100' walls, measuring 20 x 20 x16' separated from one another by a 10' solid concrete pillar. The windows should have 2 x 2" welded iron mesh lined with a layer of bamboo. The bamboo layer would protect the birds if they try to dash against the welded iron mesh.

There should be a 6' wide shaded area over both the 40' walls. This area should be covered by asbestos sheets.

Breeding aviaries : There should be eight breeding aviaries at the Centre to house one or two pairs each. It has been observed that some pairs are not comfortable nesting in a colony aviary. These pairs could be of younger birds which would be breeding for the first time or are sub-dominant pairs for some reason. Such pairs get disturbed by other birds while nesting. Moreover, in a colony aviary where many pairs nest together, it is more difficult to carry out any intervention if there is a problem with the egg or the nestlings, as it disturbs the other breeding pairs. It will be much easier to intervene if only one or a small number of pairs are in an aviary. Hence, eight breeding aviaries

Breeding aviary

should be constructed to keep one or two pairs in one aviary. The aviaries should be of dimensions 20 x 20 x 16'. Two of the walls should be solid till the top. Nest ledges could be put on these walls. A shaded area of about 6' should be provided, using asbestos sheets. The basic design will be that of a holding aviary.

Hospital aviaries : These aviaries are meant to house sick and injured birds. A Centre should have at least 4 hospital aviaries. The size of the aviary must be small enough to facilitate frequent capturing which might be required for veterinary reasons. The aviary should be located close to the lab/hospital and should have adequate electricity and water supply. An aviary of 12 x 10 x 8' is a good size for a hospital aviary. The aviaries should be equipped with perches at various heights. However, for nervous birds which tend to jump off perches and injure themselves on approach of humans, it would be wise to just place a perch on the ground. It would also be good to put a 5 x 2.5' ledge for ease of perching at a convenient height if the vulture is likely to remain in the aviary for long. There should not be any projection which could hurt the bird. There should be atleast two solid side walls and the other sides should have wire mesh with good screening. The aviary should be covered from the top.

Display aviaries : These aviaries should be located away from the other aviaries, preferably at the entrance of the Centre. They should measure 20 x 20 x 16'. They could be used as holding aviaries also. These aviaries should be used as display aviaries for visitors. Vultures which are not fit for the breeding programme can be kept in these aviaries. The basic design of the aviary will be the same as for the holding aviaries, except for the bamboos which will be spaced apart for visibility from outside. There will be two water troughs of 1.5' diameter and about a foot deep. One trough will be kept dry every alternate week. There will be a square ledge of 4 x 4' dimensions and made up of wooden frame with jute netting for the birds to rest and roost.

Other Important Structures Required at the Centre

Veterinary section

The Centre should have a well-equipped laboratory with the following facilities:

Hematology room : The hematology room should be of dimensions 12 x 12 x 10'. It should have all facilities for carrying out routine hematology. The laboratory should have a powerful compound microscope, such as a Leica®, centrifuge machine, a HemoCue® (automated hemoglobin measurement device) and a blood mixer.

Examining vulture blood under microscope

Clinical room : There should be a clinical room of dimensions 12 x 10 x 10' at the Centre. The room should be equipped with gas anesthesia machine, water bath and other equipment required for basic surgery and disease diagnostics. A strong surgical table should be put in the middle of the room. There should be conveniently placed cupboards in the walls for storing medicine and glassware, instrument and surgical supplies like cotton, needles, etc.

Critical care room : The critical care room of dimensions 12 x 10 x 10' should be next to the clinical room. It should be thermo-controlled and should have critical care boxes for keeping birds after surgery, or when they are recovering from serious illness. The wooden

A critical care box

boxes should be of dimensions 3 x 3'. Three sides of the box should be made of wood, whereas the front should have netlon mesh to allow better visibility. Such boxes prevent the bird from moving around or flapping wings and help in faster recovery. The bird should be monitored from the clinical room through a one-way glass observation window on the wall between these two rooms.

Recovery aviary : The recovery aviary should be of dimensions 12 x 10 x 8'. After recovery in the critical care room, the birds should be shifted to this aviary. The aviary should be open to the sky and have a layer of netlon on the top. The aviary could have a similar shape and construction as the hospital aviary. Perches in this aviary should be made in accordance with the requirement of the bird.

Closed-Circuit Television Camera (CCTV) monitor room : Birds should be observed on the CCTV monitors that would be placed in a room of dimensions 10 x 10 x 10'. Most of the observations on the birds should be carried out through camera monitors. Signs of the onset of breeding season, i.e. pair formation, birds sitting close to each other, preening each other and making attempts to build a nest should be looked for carefully. Neck drooping symptom should also be closely monitored. All birds should also be visually examined by the veterinarian every day.

Observing vultures through CCTV camera

Freezer room : The Centre should have two -20 ºC freezers for storing important tissue samples of vultures in a room of dimensions 12 x 10 x 10'.

Food section

The vultures should be fed on the freshly slaughtered goat meat. The goats should be kept at least 10 km from the Centre. They should be quarantined for 10 days before they are slaughtered to make sure there is no diclofenac in their system. The freshly slaughtered skinned goat carcass should be brought to the food processing room of the Centre after removing the gut contents. One vulture should be fed 4 kg of meat/week. They should ideally be fed twice a week, so on one feeding day they could be given 2 kg meat/vulture.

The meat for the nestlings should be kept in the refrigerator placed in the food processing room.

Meat for sick vultures should also be kept in the refrigerator in the veterinary section.

Food processing room

There should be a food processing room of 20 x 12 x 10' at the Centre. Entire goat carcasses should be brought to this

room where they would be processed for providing food to different aviaries. It should have a central platform which should slope down towards one end. There should be a drain in the middle which takes all the waste into the main drain. The drain should empty into a septic tank. Cabinets should be provided for storage, to keep the mixer-grinder and other essential equipment. The room should also have a refrigerator to store food for the nestlings. The room should ideally be air conditioned.

Interpretation room

The Interpretation room should be of dimensions 25 x 30' and should be located at the entrance of the Centre. It should be utilized for imparting information to visitors by displaying material on the Vulture Conservation Breeding Programme. CCTV monitors could also be kept here.

The Centre should mainly be an off display facility but due to the growing interest in vulture conservation, important visitors including government officials, media persons, students and teachers could be showed birds on CCTV monitors and live birds in the display aviary. Thus the main Conservation Breeding Centre will remain undisturbed.

Solid and liquid waste sewerage

Solid waste : The major solid waste would be the left over bones of the goat carcasses provided to the vultures. The bones could be collected and put in a 10x10x10' deep pit outside the boundary of the Centre. The local bone collector contractor should be given the contract of collecting it every week. The other way to do is by incinerating them which will be expensive and polluting.

Liquid waste : The water from the aviaries, laboratory and veterinary section should go into soak away pits located just outside the aviaries. The water from the laboratory and the toilets should go in the septic tank.

Water supply

Ground water tank : A lot of water will be required at the Centre. There should be enough water in all the aviaries for vultures to drink and bathe. Constant supply of good water will be needed at the Centre. It would be good to construct storage tanks to store the water. The tanks should be big enough to hold the requisite amount of water. The tanks could be of 10 x 10 x 12'. The water could

Water Supply

be filled by municipal supply or by water tankers. The tank should be cleaned and painted with lime every month. It will be good to have a bore well if it is not possible to get the municipal supply.

Electrical room

The Centre should have a dedicated electrical room of dimensions 8 x 8 x 8' a little away from the laboratory building. The Centre should have a three phase power connection. There will be need for an 8 KV generator (silent) and two invertors for back-up power. The power break downs are usually frequent but the back- up support should be enough to tide over the situation. All aviaries need to have electrical connections. There should be bulbs inside the aviary as well as in the passage. This is also a requirement according to Central Zoo Authority guidelines.

Perimeter fence

The entire 5 acres of land should be surrounded by 8' high chain link fence to keep trespassers, domestic animals and stray dogs away. Ideally an electric fence should be erected.

Electrical room

VULTURE TRAPPING AND TRANSPORTING TECHNIQUES

Importance of vulture capture

Vultures need to be captured for induction in Captive Breeding Programme to obtain a founder stock for Captive Breeding Programme as well as for disease investigation, treatment, application of marking devices etc.

Legal considerations and requirements for vulture capture

Resident *Gyps* vultures have been listed under the Schedule I of Wildlife (Protection) Act, 1972. Under the rules of this Act, nobody can touch, catch, keep or transport the species without permission from the competent authority, Chief Wildlife Warden of the State. The Chief Wildlife Warden in turn seeks clearance from the Central Government. It is a non-bailable offence under the Wildlife (Protection) Act, 1972, 11(B) to catch, keep or kill an animal listed in this Schedule. Animals listed under this Act remain the property of the State Government and nobody can own them.

The following documents of approval will be required from competent authorities prior to capturing a vulture

Permission from Chief Wildlife Warden for capturing the vulture.

Intimation and involvement of the local forest officers during the capture of the vulture.

Intimation to and approval from Central Zoo Authority for keeping birds in captivity.

Capture of vultures

Important pre-requisites for vulture capture

High degree of expertise and experience of the staff involved.

Knowledge of physiology, anatomy and habits of restrained bird.

Clear understanding of the purpose of capture.

Right equipment and facility.

Humane and effective manner.

Response of vultures while restrained

Vultures being nervous birds, attempt to attack and escape during capture. Due to the stress, there could be a sudden rise in body temperature by 5°C, which may give rise to the possibility of heart failure due to increased blood circulation. Vultures have powerful musculature but delicate bones, and hence are susceptible to injury. They also have a serrated tongue for gorging on meat. During the use of a net for capture, the tongue may get entangled in the net and get injured. They are equipped with powerful legs and talons, with which they try to kick the handler, and in the process injure themselves or the handler. As a mechanism to drive away predators, vultures tend to regurgitate meat from their crop.
The regurgitated fluid is extremely foul smelling, and may cause loss of concentration of the handler leading to loosening of the grip on the bird.

Personnel requirements during vulture capture

A team consisting of two trappers and atleast four assistants are required for trapping birds. The personnel involved must be strong and fit, as the process involves a lot of running around with a net, and then restraining a bird weighing atleast 4 kg. It becomes even more difficult

to handle the bird when it flaps its wings. The trapping team is also required to sit in a hide for long hours, waiting for the vulture to come down on the bait carcass. Hence infirm persons should be excluded from the exercise.

Methods of vulture capture

The methods adopted for the capture of vultures depend on the age group to be trapped. For trapping a nestling, the trapper must climb upto the nest to pick up the nestling. For capturing foraging vultures the snake-trap and the clap-trap methods are commonly used.

Nestling collection

In the setting up of a captive breeding programme, most of the founding stock of vultures should be obtained as nestlings or known-age juveniles. The advantages of taking nestlings in a captive breeding programme are that the nestlings take to captivity easily, and it is also possible to have known-age birds, which is important for the breeding programme. It is possible to age vultures only till they are five years old.

The following equipment is required during nestling collection :

a. Duffle bag about 3' long with string.

b. 200' long strong nylon rope.

c. Vulture box with anti-slip mat at the base.

Method of nestling collection

Nestling collection should be attempted only by an experienced rock and tree climber. The climber/trapper should climb different sites, depending on the species to be trapped, e.g., cliffs for Long-billed vulture and trees for White-backed and Slender-billed vulture. Duffle bags are carried to the nest by the climber. The nestling is collected and put upside down in the bag and then lowered down with the help of a rope, where another person holds the bag before it touches the ground and transfers the nestling in a box, at the base of which an anti-slip mat is placed.

Nestling in a vulture box

Precautions

The vulture nests are located at difficult sites like tall tree tops or inaccessible cliffs, so the climbers should be skilled and should take all precautions.

Older nestlings could jump out from the nests when the nestlings are collected. So nestlings which are around 45 days old should be picked up. The nestling's thermoregulation is well developed by this time.

Rock bee attacks could be a serious problem. Rock bees nest on cliff facies and tall trees. The bee hives should be carefully avoided, as disturbing them could prove fatal to nestling and climber.

Capturing foraging birds

The technique mainly involves capture of birds when they are busy feeding on a lure carcass. It is suitable for capture of all age groups of vultures. Two methods are commonly used : snake-trap method and clap-trap method.

Snake-trap method

Equipment required

7 pieces of 10' long bamboo sticks, 2 cm diameter.

Bait carcass.

Vulture capture net.

Glue made of mustard oil and Ficus latex.

Petrol, diesel or vegetable oil.

Vulture box with anti-slip mat at the base.

Method

The trap incorporates the use of long, collapsible bamboo sticks, which can be joined together to get a long bamboo pole. The terminal end of the pole is bifid, and glue made of mustard oil and Ficus latex is applied to it. The Ficus latex is collected early in the morning and is then mixed and heated with mustard oil. When it gets to the right consistency, it becomes very sticky. The pole is slithered along the ground to where the vultures are foraging, and stuck to the wings of an unwary vulture. The trapped vulture is thus unable to fly, and the trapping team then rushes to the vulture and catches it. After catching the vulture, the glue can easily be removed with the help of petrol, diesel or vegetable oil. Many individuals can be caught by this method if a number of traps are available. This is the most non-invasive and safe method for trapping.

Clap-trap method

Equipment required

Fishing net
Bait carcass
Towels
Vulture box with anti-slip mat at the base

Method

The clap-trap is a large net attached to ropes on all sides, and spread on a bamboo structure. It claps shut when the rope is pulled and the net closes like an umbrella.

A skinned carcass is placed in the middle of the net. When the vultures are feeding, the ropes are pulled, clapping the trap shut. The trapped vultures are then removed from the net and placed in vulture boxes. This method can be used to trap several vultures at a time. However, care must be taken while removing the trapped vultures from the net, as a large number of vultures trying to escape can seriously injure themselves as well as the trapping team.

A trapper preparing the snake-trap

Laying a snake-trap to trap a vulture

Capturing vultures while held in captivity

The vulture capture net consists of a 6' long bamboo pole attached to an iron ring of 2' diameter, to which the netting is attached. The iron ring is covered with cloth to prevent injury to the bird while catching it. The netting must be made of strong, multiple fibres of cotton tightly wound together, forming a 4"mesh size. Volleyball net can

Vulture capture net

be cut and used to prepare the net for capturing vultures. The bamboo pole, ring and net must be devoid of any protrusions which could injure the vulture. Vultures are chased in the aviary and when one comes down the net is thrown over it. The vulture can then easily be removed.

Method of holding a vulture

Vultures have a very strong bill, wings and legs. Most of the power generated by the bird lies in its wings and legs. Hence a firm but gentle grip while catching the bird is essential. One hand should firmly grip the neck between the head and neck joint. This prevents the vulture from biting the handler. The other hand should secure both legs near the thigh region. The middle finger of the hand must be placed between the two legs, to prevent injury by friction.

Safety precautions for vultures

The vulture must be held in a firm but gentle grip. The bird should not be allowed to flap its wings, to prevent injury. The serrated tongue could get entangled in the net or the threads of the bag. Care should be taken to prevent that, and if it does get entangled, then it should be gradually removed. The bag containing the vulture nestling could be used upside down, so that the tongue does not get entangled with the stitching. The vulture should be allowed good ventilation to prevent asphyxiation. Putting on a sock or hood over the vulture's neck is known to calm nervous birds. Vultures have a tendency to regurgitate, letting out foul smelling meat. The vulture should not be gripped tightly in such conditions, as it may choke the bird. Loosening the grip just enough to enable the bird to throw up would be good, but the neck should not be released completely, as the bird will bite the handler. The bite is very painful and it can take a chunk of flesh off.

Holding a vulture

Hazards of incorrect handling of vultures

Hyperthermia – increase in the body temperature by upto 5°C.

Fracture of legs or wings.

Dislocation of joints.

Skin laceration, brushing and feather loss.

Compression of the fixed trachea and internal organs.

Tight grip near the chest region may put pressure on the sternum, as diaphragm is absent, and thus cause the lungs to collapse.

A sick bird if handled incorrectly may even die.

Precautions for safety of handler

Firm grip on head and neck to prevent the vulture from turning around and biting.

Firm grip on legs to prevent the talons ripping open the skin of the handler.

The handler should wear welder's gloves, mask, goggles and cap.

Wearing a cap provides an extra protrusion, which the vulture catches onto, in case it frees its neck. Thus no harm comes to the handler.

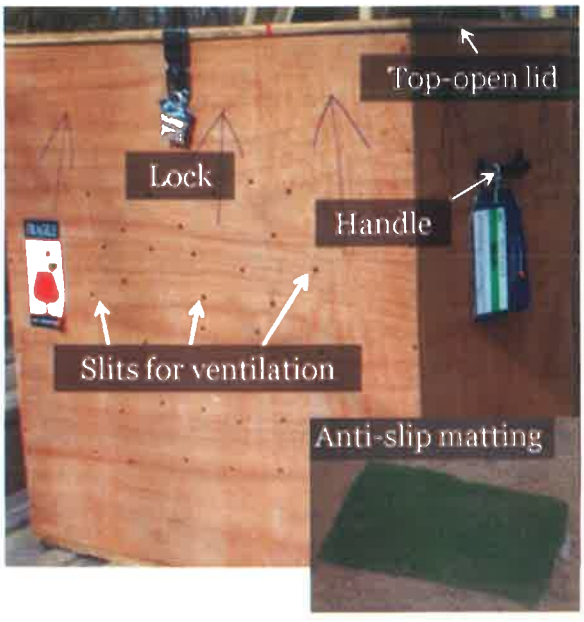
Post capture procedures

Health check of vultures

This should be performed by a qualified veterinarian or a biologist experienced in handling vultures. It involves checking the musculature and feather quality to assess the health status of the bird. Signs of bleeding or any other external injuries to the bird, prior to or during capture, should also be checked for.

Vulture transport box

A wooden box should be used for transportation of the vulture. Size of the box should be based on the species to be housed. For White-backed vulture, the size should be 2.5 x 2 x 1.5', for Long-billed and Slender-billed vulture, it should be 2.5 x 2.5 x 2'. Size of the box should be just large enough to enable the vulture to stand and sit, but not to flap its wings or turn around. There should be a rough mat placed at the bottom of the box prior to placing the vulture. The mat provides anti-slip surface to the vulture during transport. The box should have a lid at the top as it is not easy to restrain a vulture kept in front/side open box. It is easy to catch the neck first of these long-necked species from the top.



Vultures can bite as well as attack with their legs, unlike other raptors which do not bite after getting a grip with their feet. Top-open box facilitates the use of a net to restrain the captured vulture.

Ventilation should be in the form of holes along the four sides of the box. No slits should be made on the top or the base of the box, as they could weaken the surfaces. 20-25 slits should be made on each side. Slit width should not exceed 0.5", to prevent the little finger of the handler to pass through. Ideal slit size would be made by passing a drill machine through the wood just once. Also, the slits should not allow light to pass through, as vultures remain calm in a dark box.

For provision of food and water to the vulture enclosed in the box without actually opening the box or catching the vulture several times, a food and water hatch should be made near the base of the box. The hatch should be 6" x 3", which is just large enough to pass a small bowl of meat or water through. The vulture should, however, not be fed while travelling. The lid must be closed with a bolt, and locked. This is important, because if the lid is not properly closed, the powerful vulture can easily open it and escape.

The box should be placed in the transport vehicle in such a way that the vulture is facing the direction of the vehicle's movement. Correct orientation of the box is extremely important, because birds are known to get disoriented if they are carried in a backward direction.

Legal requirements for Transportation of vultures

Letter from Chief Wildlife Warden permitting the transport of vulture.

Veterinary certificate stating that the vulture is fit to be transported and does not harbour any infectious diseases.

Transit pass from Divisional Forest Officer.

Modes of transport

Selection of the modes of transport depends on the length/duration of the journey. While transporting a vulture, prime importance should be given to its safety, ensuring that the vulture is transported as quickly as possible. Three modes of transport are available:

Road transport

Suitable for short distances.

Vulture transport box to be loaded in the carrier compartment of the vehicle, isolated from the passenger compartment.

The vehicle must be air conditioned.

Rail transport

Although a cheaper way of transport and suitable for short as well as long distance travel the vulture transport box has to be carried in the brake van. Hence not a preferred route of transport, as the vulture has to be kept away from the handler for a long time.

Air transport

Fastest and ideal for long distance travel.

Accepted by airlines flying aircraft of the size of Boeing 737 or larger.

Vulture transport box can be transported as check-in baggage in the pressurized holding compartments in the aircraft.

Can be transported unattended.

Transport by road from the airport nearest to the Centre.

Legal requirements before introducing the vulture into the Centre

After the capture and transport of the vulture, it will be finally received at the Conservation Breeding Centre. Before introduction of the vulture into the actual breeding programme, the following formalities must be completed. A letter of intimation should be sent to the Chief Wildlife Warden regarding the arrival of vulture and enclosing prior permission letters from other authorities.

The letter should be marked to the Divisional Forest Officer and the Wild Life Inspector also.

The Central Zoo Authority should also be intimated regarding addition of vulture to the Conservation Breeding Programme.

Quarantine

It is important to prevent transmission of infectious diseases from the captured wild vulture to other vultures at the Centre and vice versa. Hence the incoming vulture must be quarantined at a separate facility housed atleast 5 km away from the actual Captive Breeding Centre. Ideal duration for quarantine is 45 days, which is equivalent to the incubation period for one of the prevalent diseases called Ranikhet disease which has the longest incubation period.

The quarantine facility should be temporary, and a rule of 'All in, all out' must be followed. So all the birds must go in at one time, and come out together after 45 days. In case a few birds are kept in a quarantine facility at an earlier date and some birds are kept later, incubation period of 45 days should be considered from the date of entry of the last entered birds. If this has to be avoided, a separate quarantine facility must be set up for the birds coming in later.

Health check in quarantine

A periodic check to assess the health status of quarantined bird and to ensure that it is not suffering from infectious disease should be performed by a qualified veterinarian or an experienced biologist. Blood for hematology and swabs for microbiological analysis should be taken every 15 days till the time of release into the captive programme. If any quarantined bird is found ill, treatment should be commenced immediately. After completion of the treatment, the bird should be quarantined for a further 45 days to ensure complete fitness, before it is to be introduced into the Captive Breeding Programme.

Quarantine aviary

Health check involves checking the following parameters:

Weight of the bird.

Musculature and feather quality.

Moult pattern.

Presence of bumble foot.

Presence of ectoparasites.

Hematology and blood biochemistry.

Identification

After the bird goes through the quarantine and passes the health check, it may be introduced into the captive breeding programme. Before introduction, it is important to place identification devices to give each bird a unique identity. The following identification devices could be used:

Wing tag : This is a plastic tag attached to the patagium below the radius and ulna with the help of a rivet. It is like the ear tag used for cattle. The patagium is free of feathers and has few blood vessels and hence puncture of blood vessels and injuring the bird while tagging is minimised. Wing tags are large, colourful and are prominently visible from a distance.

Leg ring : A plastic ring is attached to the metatarsal region of the leg, and tightened with the help of super-glue like Fevikwik® or Araldite®. It is strong and visible from a distance with binoculars.

Microchipping : It consists of a microchip with a unique code, which is implanted in the pectoral muscle of the vulture. The chip is read with the help of a microchip reader, which displays the unique code when held close to the pectoral region of the vulture. Although not used for day to day identification, it is a fool-proof method of identification. As the chip is inside the body, it does not fall off or get degraded. Hence it is a permanent identification device and stays on the bird forever.

Wing Tag

Leg Ring

Microchip applicator

Application of microchip

Microchip Reader

Release of vultures into the aviaries

After completion of the quarantine period, and on passing all the health checks, the vulture can be released into the aviary. The type of aviary for the vulture to be introduced into depends on the age of the vulture :

Nestling : nursery aviary

Juvenile and sub-adult : holding aviaries

Adult : colony aviary

Post release monitoring is routinely carried out to ensure the settling of the vulture with others in a new environment.

A Long-billed vulture released in colony aviary

HUSBANDRY AND CARE

Husbandry and care is possibly the most important component of any Conservation Breeding Programme. Correct procedures followed ensure a healthy population in captivity. The protocols for husbandry and care observed at the Pinjore Centre have been developed in consultation with international organizations with expertise in captive management of birds. A number of modifications have been made, based on our experience and local circumstances.

Components of Husbandry and Care

Daily monitoring

The vultures should be monitored directly by going near the aviaries as well as through the CCTV camera monitors.

Visual monitoring at the aviaries

Monitoring should be done by only one person and in no case by more than two persons. The observer should visit the aviaries three times a day, morning, afternoon and evening. He could carry a pair of binoculars with him.

He should visually check all perches, nest ledges, the netlon for any damage or breakage. If so, it should be immediately reported and replaced as soon as possible.

The food status should be noted. The amount of food consumed after a feeding day should be assessed. It could be graded on a scale of 0-4 where

Grade 0 - food not consumed,

Grade 1 - 25% food consumed,

Grade 2 - 50%, food consumed,

Grade 3 – 75% food consumed,

Grade 4 – 100% food consumed.

The entire pattern of food consumption should be documented daily and the pattern should be analyzed over different seasons. Crops of every vulture should be checked to ensure that everyone has fed. This could be done with the help of binoculars.

The observer should also pay attention to all the water troughs in the aviary for the quantity and quality of water in the trough. Presence of algal growth on the surface of the trough, presence of sand, leftover carcasses dragged by vultures while feeding or decayed leaves are pointers to the necessity of cleaning frequency.

The health status of the vultures should also be assessed by noting the posture of birds. A normal and healthy vulture will be alert and active, will not be found at a given position for long periods of time, and will be involved in activities like feeding, drinking water, sunning and wing exercise on a regular basis. On the contrary, a sick bird will appear dull and will isolate itself from the flock.

Monitoring through CCTV Camera monitors :

The activities of the vultures should be monitored through the CCTV camera atleast 4 times a day. Recording and documenting of important activities like feeding, bathing, sunning, wing exercise, pair formation and coitus, nesting, egg laying and incubation, hatching of egg, brooding the nestling and fledging, should be carried out. All observations can be made without disturbing the birds. It is also possible to see the ring number of each bird by zooming in the camera. Datasheets for perch utilization, nest observation, daily activities should be filled to document all the activities.

Monitoring nest observations through CCTV camera monitors

It is very important to document and analyze breeding activity of captive vultures. This helps in developing measures to improve their breeding success. Through CCTV camera, the breeding can be monitored throughout the day without disturbing the birds. Activities like nest attendance, coitus, nest building, incubation, brooding, feeding the nestling, change over, participation of both partners and many more such behavior can be documented and analyzed. The general well-being of all the nests should be checked three times a day. A full day observation of nests should be done once every week, where all the activities are recorded in detail.

Provision of food to vultures

Vultures are obligate scavengers and feed only on dead animals. Only mammalian meat should be given in captivity. Avoiding avian meat also reduces the chances of transmission of avian diseases. For captive vultures, goat meat is preferred to that of cow and buffalo as the quality of goat meat is better with lower fat content compared to larger cattle. Retention time of diclofenac is 3 days in goat as compared to atleast 7 days in cow and buffalo. Hence it is much safer for vultures. Goats are easier to house and keep compared to cow and buffalo. Goat meat has no socio-religious issues like there are with cow and buffalo.

Before slaughtering, goats should be quarantined in a separate facility for 10 days to ensure that they are free of diclofenac. The goats should be slaughtered, skinned and their gut contents should be removed before the entire carcass is fed to vultures. Skinning is preferable for better cleaning and management of the aviary. Gut contents should be removed as goats tend to swallow nails, plastic material, and other non-biodegradable waste, which if ingested will be harmful to the vultures. However, washing the gut is not recommended as it may render the gut devoid of certain vitamins and minerals which may be useful to vultures.

Meat should be provided twice a week. Any two days could be chosen according to convenience. However, while choosing the feeding days, it must be ensured that a gap of three days is maintained, so that the digestive system of the vultures remain in optimum condition. Daily feeding is not recommended, as vultures store food in the crop during each feed, and do not feed for the next few days. Also overfeeding captive vultures could be disastrous, as they would accumulate fat and would not remain fit for breeding or to be released back in the wild.

During each feed, each vulture should get meat equivalent to 5% of its body weight. So for a 4 kg bird, 200–250 gm meat is required per day. However, considering the weight of bones and wastage, 500 gm meat would be required per day. So, meat equivalent to 1.5–2 kg per vulture is offered on every feeding day. Hence in a Captive Breeding

Food preparation for vultures

Goat carcasses passed through food hatch

Centre housing 150 birds, an average of 300 kg meat will be required on every feeding day. Meat should be offered in such a way that the vultures do not realise who is feeding them. Hence it is recommended to throw in the skinned goats through a 2 x 1.5' food hatch, made 5' above the ground near the middle of the aviary's 100' wall.

Provision of water

Vultures require water for drinking and bathing. Water should be provided in the water troughs in each aviary. A colony aviary should have four water troughs and two troughs should be alternately filled every week. This is important to check algal growth. It has been observed that vultures do not take a bath if the water is not topped every day. To encourage bathing, water troughs should be topped with fresh water every day. Two water troughs should be emptied on every feeding day while the other two should be filled. The troughs should be emptied and

Emptying of water from water troughs

window for providing nest material

filled from outside as this minimizes human contact. The dirty water from the aviaries should be taken to a soak-pit located outside the aviaries.

Provision of nest material

The breeding season of vultures starts from September when the birds start occupying and defending the nest ledges. Frequency of copulation increases and they start nest building. By the end of November, egg laying starts and by the middle of January the eggs hatch.

Nest material should be provided in the colony aviaries, so that the birds build their own nests. The nest material offered is a mixture of twigs from locally available large trees. The amount of nest material to be provided depends on the number of breeding pairs in the aviary. In an aviary housing 15 breeding pairs, 35–40 kg nest material should be provided at a single time. It is good to give a mixture of leaves, twigs and branches of various diameters of large trees growing within the vicinity of the Centre. Twigs of thorny species should be avoided. In the wild, it has been observed that vultures utilize the twigs of Neem, Amaltas, Silk cotton, Peepal, Banyan, Kadam, Acacia and even Lantana.

The frequency of providing nest material depends on the phase of the breeding season. For the first 3 months, nest material must be provided every week. This is the time when all birds build nests vigorously. After egg laying and hatching, the frequency can be reduced to once in 15 days, just enough for maintenance of the nest. Fresh green twigs with leaves should be provided.

Nest material should be dropped on the ground in the aviary through a window made for the purpose. The dimensions of the window should be 3 x 2'. The window can be made in the huge windows provided on the 100' walls. There should preferably be two windows, one each on opposite 100' walls. Nest material should be alternately provided through these windows to prevent pile up at one place.

Cleaning of aviaries

Aviaries should be cleaned regularly to maintain their hygiene. As a routine, aviaries are cleaned once every week while a thorough cleaning is done bi-annually.

Bi-annual cleaning

Bi-annual cleaning involves cleaning once after the breeding season i.e. post breeding and the other before the breeding season i.e. pre breeding

Post breeding cleaning

This cleaning should be undertaken in July or early August, after all the nestlings have fledged, signaling the end of the breeding season.

A lot of man power is required as there is a lot of hard work involved during cleaning a large aviary. At least 5–6 persons are required for a single aviary. All the persons involved must be physically fit. There should be a team leader who should channelize work through smaller groups. He need not be highly educated, but should have leadership qualities and should be fully aware of the aviary designs and its functions.

A wooden perch completely stripped off coconut rope by vultures

Winding coconut rope on perches

A finished and repaired perch

Repair of perches

support. This is done in a similar way to the tightening of the perches. Coconut ropes should not be removed or wound during this operation. The netlon fitted below the coconut matting should also be checked for any loose ends.

Other tasks: Removal of the upper layer of sand is done to ensure all the waste is thrown out of the aviary. The top six inches of sand is removed. Removal ensures exposure of the lower layer of sand to sunlight, which prevents build up of bacterial load beneath sand cover. Removal of sand is followed by sprinkling of lime powder in the aviary. Lime is a very good disinfectant and mixes quickly with the sand. Hence it does not harm the vultures in any way, as opposed to other chemical insecticides and pesticides which may poison the vulture on ingestion. It also efficiently kills insects, which are important vectors of pathogens.

After the cleaning is completed, it must be ensured that no foreign objects are left on the ground like pieces of iron, glass etc. The vultures may ingest these which could eventually cause mortality. Hence, any metal particles on the ground should be scouted for using a metal detector, and they should be removed.

Pre breeding cleaning

This cleaning is done before the onset of the breeding season. It should be performed during late September to early October. It is a major cleaning event requiring 2–3 days for each colony aviary.

Checking wooden cots in an aviary

Newly installed wooden cot in the aviary

At least 7–8 persons are required per aviary. An experienced team leader to assign the work is essential. The workers must be physically fit. They should not be suffering from infectious diseases. Two persons should be dedicated to repairing the perches, two for removing the wooden cots and the rest should work on cleaning the floor.

Implements required

Most of the equipment required will be the same as that required for the post breeding season cleaning. The following additional material will be required :

Lime, at least 5–6 sacks as compared to 2–3 during the post breeding season cleaning.

Hose pipe with continuous water supply for washing the walls.

Wooden frames of dimensions 5 x 4' for preparing the Jute ledges .

20–25 large bundles of coconut rope for winding the perches and cots.

100 m iron wire to hold the netlon mesh together.

1 ton of sand per aviary (one round of a tractor trolley).

Netlon mesh, 50 pieces of size 5 x 4'. Mesh size not more than 2".

Atleast 20 prepared wooden cots wound with coconut rope and secured with the help of iron wire and netlon at the base.

Activities during pre breeding cleaning

Removal of top six inches of sand and replacing with fresh sand : It should be carried out to reduce the buildup of microbial load by removing the soiled sand and exposing the lower layers of sand to the sun. Putting fresh sand further improves hygienic conditions. Six inches of the top layer of sand should be removed and replaced with fresh sand. The sand used as filling material on concrete nest ledges, especially used by Long-billed vulture, should also be replaced with fresh layer of sand.

Removal of wooden nesting ledge and replacing with nesting ledge netted with fresh jute rope : Jute nesting ledges undergo a lot of wear and tear during the breeding season, and also loosen from their wall support. The jute netting also breaks at several places accessible to the vulture's bill. During the cleaning, two persons should be dedicated to the removal of the jute nesting ledges from the wall support. Removal involves hammering of the wooden pieces, so that they come loose and can be pulled out. The nesting ledges can then be tied to a strong rope, pulled out and brought to the ground by controlling the ropes with pulleys. The task of removing the jute nesting ledges must be completed within the first day itself.

After removal of the nesting ledges, the coconut ropes must be taken off with the help of a sickle and the iron wires holding the netlon mesh underneath should be cut with pliers. The netlon mesh will come off as soon as the wires are removed. The nesting ledges should then be sprayed with F10 solution containing 1 mL F10 in 500 mL water. F10 is a veterinary disinfectant and safe for humans and animals. If it is not available locally, a 1 in 200 dilution of Pursue, a disinfectant from Amway Co. can also be used. If that is also not available, a 1 in 100 dilution of Savlon can be used. However, Dettol should be avoided as some organisms have developed resistance to it. No phenol-based disinfectant should be used.

A wooden frame of 5 x 4' could be used for making a new ledge. The wood used for the frame should measure 3 x 3". The frame must be strong and not creaky at the edges. The nesting ledge is then netted with jute strings. It is

important that the netlon netting is attached to the base of nesting ledge and secured with the help of an iron wire wound tightly around the frame. This is a precaution against the nest falling down in case the vultures cut the jute netting.

Cleaning off algae and vulture defecation from the walls and painting with lime : Algal growth and vulture faecal remains are particularly heavy on the wall close to the perches and wooden cots frequently used by the vultures. They must be cleaned to maintain hygienic conditions in the aviary and to reduce the buildup of microbial load.

This exercise should be carried out by two persons working in tandem. One person should brush off the algae and faeces from the walls, while the other should wash off the dirt with a continuous supply of water. The walls should then be allowed to dry for atleast an hour. A suspension of lime should then be prepared and applied over the walls as a thick coat.

After the cleaning is completed, it must be ensured that no foreign objects are left on the ground like pieces of iron, glass etc. The vultures may ingest these which could eventually cause mortality. Hence, any metal particles on the ground should be scouted for using a metal detector, and they should be removed.

Routine cleaning

This phase of cleaning is carried out more regularly to prevent accumulation of carcass remains, spread of vegetation and to prevent buildup of bacterial load. The frequency of cleaning depends on whether it is carried out during the breeding season or outside it.

Algae on the walls and ground in the aviary

During breeding season

This cleaning is carried out once a month, to minimize disturbance to breeding vultures. The only activities performed during this cleaning are :

Removal of carcasses.

Cleaning of water troughs from outside.

During non-breeding season

This cleaning should be performed every week.

A clean colony aviary

Basic Veterinary Care of Vultures

It is important that all staff at the Centre should be aware of the basic veterinary care of vultures as the availability of a veterinarian may not always be possible. This will help in initiating first aid measures before the expert veterinary help is made available. This will keep the breeding stock healthy and will minimise mortality. The biologists who frequently observe birds are familiar with normal behaviour of the birds and can identify sick vultures if it shows abnormal behaviour. It is important that the biologists and vulture keepers are aware of the first aid measures and are able to treat vultures in an emergency.

Identifying a sick vulture and isolating it from the flock is of utmost importance for keeping the breeding stock in good shape for the breeding programme. This is possible by regular monitoring of vultures.

Routine monitoring of vultures

Monitoring from the aviary

The monitoring from the aviary should be a routine for the biologist and should be done three times a day. When the routine observations are conducted, the vulture keeper may also assist the biologist, which helps in sharing observations between two persons with different orientation. But the biologists must also follow the routine monitoring protocols.

Ideally there should be a uniform for the staff (the colour of the uniform should merge with the surroundings). If uniforms are not available, then dull coloured clothes should be worn to minimize disturbance to the vultures. No caps should be worn (as caps are worn during annual health check, when the vultures are captured). No camera should be carried near the aviary (except when it is essential). Silence should be maintained while observing the vultures. Monitoring could be done with the help of a binocular.

Monitoring through the CCTV camera monitors

The observations from the CCTV camera monitors must be recorded by the biologist four times a day. During this, all the vultures in the aviary should be counted.

Activity of the vulture should be recorded and Perch substrate utilised should be noted. For this purpose, numbering the perches, wooden jute ledges and concrete ledges in the aviary is recommended. The behaviour of the vultures should also be observed and noted down. The biologist should also look for vultures on the ground, as sick vultures generally tend to come to the ground.

Important note : All the above data should be entered in the Perch Utilization Datasheet (Appendix 5).

Major clinical signs of sickness

Major signs of sickness include the following :

The vulture looks dull.

Droops its neck while sitting quietly

Body feathers appear ruffled.

Its body posture is not normal. It is squatting on the ground (i.e. sitting on hocks) or lying sprawled on the ground for long hours.

Shows deviations from normal activities :

Not feeding.

Not bathing.

Not preening.

Not sunning.

No wing exercise.

No movement from one place to another.

Important note : It should be understood that a normal healthy bird may also behave in a similar manner, hence if a vulture shows the above symptoms it can be called a suspect and it has to be continuously monitored through the CCTV cameras for confirmation of sickness.

A healthy vulture : Alert

A sick vulture : Neck drooping, feathers ruffled, looking dull

As mentioned above, the confusion between a healthy vulture and a sick vulture must be avoided. The best way to do it is to record the behaviour of healthy vultures and compare it with the suspected sick vulture. If there is a clear difference in the behaviour then the suspected vulture should be shifted to the hospital aviary.

A healthy vulture and a sick vulture are shown in the following pictures. The difference in their posture and plumage can be observed very distinctly.

Restraining a sick vulture

After spotting a sick vulture, it is recommended that it is immediately caught and transferred to hospital aviary which will allow monitoring and treatment with out disturbing other vultures.

Important considerations while restraining the vulture

A capture net should be used.

Only two persons should enter the colony aviary and should approach the sick vulture. A normal healthy vulture will fly and perch on the topmost perch at the sight of a human approaching, but a sick vulture will sit down and would be easy to catch.

The handler should be very gentle during catch up and should make sure that no further injuries are inflicted to the vulture. At the same time, the handler should not allow the vulture to escape or injure the persons involved in catch up. The captured vulture should be shifted into a vulture transport box and should be transferred immediately to the Hospital aviary.

Important note : This exercise must be done as quickly as possible, to minimize disturbance to other vultures in the colony aviary.

Clinical examination of the sick vulture

After the sick vulture is restrained and brought to the hospital aviary, a clinical examination should be done in order to find out any obvious symptoms of sickness. For this, the vulture should be weighed. Its body condition should be checked. This includes examination of pectoral

and femoral muscles and other body parts. Condition of feathers should be checked. Thorough examination of different body parts like eyes, nares, beak, neck, crop, abdomen, cloaca and feet should be carried out. Heart rate and respiratory rate should be monitored. Presence of ectoparasites should be recorded.

All data including any abnormalities or deviations from normal should be noted down in the Clinical Examination form (Appendix 1)

The blood and fecal samples should be collected during clinical examination to carry out hematology, blood biochemistry, microbiology and parasitology of the vulture.

Blood collection

Blood is required to carry out hematology and blood biochemistry which can indicate or diagnose the sickness of the vulture.

Requirements

Sterile syringes (2 mL or 3 mL) and sterile needles (24 or 23 gauge), cotton, spirit, EDTA vacutainer, microfuge tube, glass slides.

Procedure

Blood collection should be done by a veterinarian or under his/her supervision. Three persons are required to handle the vulture while collecting the blood. One person holds the vulture while the second person holds the leg or the wing depending on the choice of blood collection site, and also presses the vein above the blood collection site.

The third person should wipe the blood collection site with spirit and draw the requisite amount of blood (approx. 2 to 3 mL is enough).

Before removing the needle from the vein, the person pressing the vein above the collection site must release the vein (still holding the leg or wing firmly). Then the dry cotton is put over the needle and it is withdrawn carefully. This precaution minimizes bleeding.

The person withdrawing blood must immediately transfer

Sites of blood collection

Ulnar veins : These are the wing veins present near the elbow joint. They are very delicate and require high expertise while drawing the blood, as there is a risk of hematoma formation.

Metatarsal veins : These are the leg veins seen on the metatarsal region, sometimes very difficult to spot, but safer as compared to ulnar veins for drawing blood.

approximately 0.5 mL of the blood to the EDTA (anti-coagulant) vacutainer by removing the needle and cap of the EDTA vacutainer and must mix the blood well with EDTA after recapping the vial. (This blood should be used for hematology and DNA work). The remaining blood should be transferred to the microfuge tube. This blood should be allowed to clot at room temperature and serum should be separated by centrifugation of the blood at 10,000 RPM for 10 minutes.The separated serum should be collected in another microfuge tube and should be sent to a pathology laboratory for routine blood

Hemocue (automated quantification)

biochemistry. The remaining blood in the syringe should be used for preparation of blood smears which should be stained and observed for Differential Leukocyte Counts (DLC) under microscope.

Transferring blood from syringe to the EDTA vacutainer

Hematology

The hematological parameters to be examined are

Hemoglobin

Hemoglobin is the iron-containing oxygen transport metalloprotein in the red blood cells. Hemoglobin levels help to determine the health status of bird. Low hemoglobin levels could signify anemia, which is a condition when the oxygen carrying capacity of the blood is reduced to low levels. This could be quantified with the help of **Hemocue (automated quantification)**

Procedure

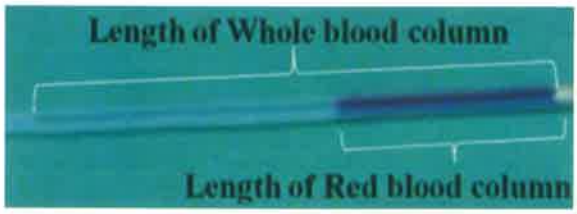
Switch on the HemoCue, pull the microcuvette holder outside; the HemoCue will show three hyphens.

Take a microcuvette and draw blood into the microcuvette by capillary action. Put the microcuvette in the holder and put the holder back inside the HemoCue, and wait for some time. The HemoCue will show the reading displaying hemoglobin in g/L.

Packed Cell Volume (PCV) estimation

Packed cell volume is the proportion of the total blood volume that is occupied by the red blood cells.

Besides general health condition, detection of dehydration, detection of anemia, and rough estimation of the liver condition can be gauged with the help of PCV estimation.



Procedure

Draw blood into a capillary tube until it is 75% full.

Seal the end with stopper material (plastic stopper or clay or soap can be used).

Centrifuge at 10,000 RPM for 5 minutes.

After centrifugation, measure the length of red cell column and whole blood column.

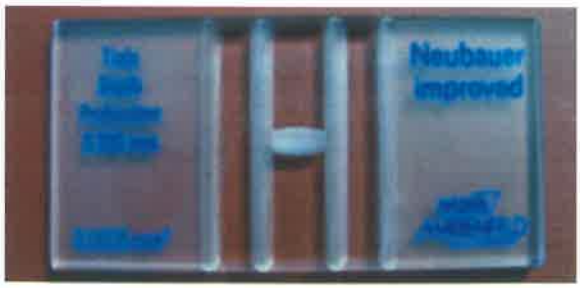
Use the formula given below to calculate the PCV.

$$PCV = \frac{\text{Length of red cell column (A)} \times 100}{\text{Length of whole blood column}}$$

Total Red Blood Cell count (RBC count)

RBC count calculates the number of RBCs in 1 litre of blood.

The RBC count is done by using the Neubauer's hemocytometer.

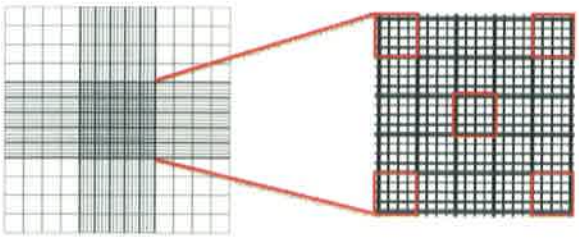


The blood to be tested is first diluted in RBC diluting fluid; the dilution is 1:200.

The resultant diluted blood is charged onto the hemocytometer and the RBCs are counted.

RBCs should be counted in the RBC chambers of the hemocytometer (shown below).

Counting in 5 squares marked in red is enough.



Hemocytometer Grid *RBC Counting Chamber*

$$\text{RBC count} = \frac{\text{total number of cells counted} \times 10^{12}/L}{100}$$

Total White Blood Cell count (WBC count)

Count calculates the number of WBCs in 1 litre of blood.

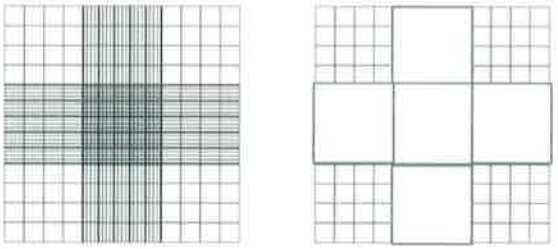
The WBC count is done by using the Neubauer's hemocytometer.

The blood is first diluted in either ammonium oxalate (1%), Natt-Herrick's Solution or Rees-Eckers fluid, diluting the blood to 1:20.

The resultant diluted blood is charged onto the hemocytometer and the WBCs are counted.

WBCs should be counted in the WBC chambers of the hemocytometer (shown below).

Counting in 4 WBC squares is enough.



Hemocytometer Grid *WBC Counting Chamber*

$$\text{WBC count} : \frac{\text{total number of cells counted} \times 10^{9}/L}{20}$$

Preparation and staining of blood smears for DLC is as follows:

Put a drop of blood on a clean microscopic slide (at one edge). Then place another slide on top of the blood drop at an angle of 45°, let the drop spread along the edge of slide held at 45° angle.

Then drag the upper slide at the same angle along the lower slide to the opposite corner to make a thin smear.

After the blood smear dries in the air, put the slide in Rapidiff methanol for 10 seconds, remove the slide and rinse in water & let it dry.

After drying, put the slide in Rapidiff A solution (Field's stain A, red colour) for 10 seconds.

Remove the slide, rinse it in water and put it in Rapidiff B solution (Field's stain B, purple colour) for 1–2 minutes.

Rinse the slide, and let it dry.

After drying, observe the smear under the oil immersion objective of the microscope.

Examination of blood smear

This includes the following :

Differential Leukocyte Count

- Granulocytes

- Heterophils (acute bacterial infection)

- Basophils (anaphylaxis, viral infection, chronic infection)

- Eosinophils (allergic reactions, parasitic infection)

- Agranulocytes

- Lymphocytes (chronic viral disease, neoplasms, stress)

- Monocytes (phagocytosis, chronic infections, neoplasm, auto immune disorders)

Detection of blood parasites.

Valuable information on RBCs (i.e., morphology of RBCs and presence of young RBCs)

Platelet count.

During the count 100 WBCs are counted and finally every WBC's concentration is given in percentage.

Faecal sample collection

Fresh droppings can be used for faecal sample examination. The droppings can be collected with a spatula and can be transferred to a vial before processing. While collecting the faecal material it is very important to avoid contamination of faeces with urates as it may interfere in the faecal sample analysis.

Faecal sample examination

Macroscopic examination involves checking

Colour : normally blackish brown

Odour

Consistency

Microscopic examination

Faecal wet mount

This method is used for examining a drop of faeces from a live bird, or a sample of distal large intestine contents from a postmortem specimen. This method helps in detection of high load of parasitic eggs (helminth ova and coccidia).

Procedure

Place a drop of Lugol's iodine (1%) on a clean slide. Add about 2 mg of faeces and mix. Cover with coverslip and examine under low magnification.

The same method can be performed using physiological saline (NS) but it is less sensitive.

Faecal floatation technique

This method is used for examining a drop of faeces from a live bird, or a sample of distal large intestine contents from a postmortem specimen. This method allows detection of low load of parasitic eggs (helminth ova or coccidia).

Procedure

Take a 4 mL plastic vial, and add 1 mL of faecal floatation fluid to it. Add a small amount of faeces (1-2 mg) and add it to the vial. Mix the contents thoroughly by shaking the vial. Leave the suspension as it is for a few minutes, to allow bubbles on the surface to clear. Carefully and slowly fill the vial until the meniscus (layer) bulges just above the vial rimPut a coverslip onto the vial and allow it to stand for 10 minutes (avoid spillage). Transfer the coverslip to the slide and observe under low magnification.

Blood biochemistry

The collected serum (as described in the blood collection section) can be sent to a pathology laboratory and the following parameters listed below can be studied which interned provides information about the health status of the vulture.

Kidney function tests

- Uric acid quantification (µmol/L)
- Potassium ion quantification (mmol/L)
- Sodium ion quantification (mmol/L)

Liver function tests

- AST/SGOT (iµ/L)
- ALT/SGPT (iµ/L)
- Alkaline phosphatase (iµ/L)
- Bilirubin quantification
- Fibrinogen

Heart function tests

- Creatinine Kinase (iµ/L)
- Cholesterol (mmol/L)

Pancreas function tests

- Amylase (iµ/L)
- Glucose (mmol/L)

Other tests

- Calcium
- Phosphate

As mentioned the tests are organ specific, which reflects the health status of the vulture.

Microbiology

Microbiology is done when an infection is suspected. The microbiology analysis can provide information about the bacteria causing infection and can suggest an appropriate antibiotic for treatment. Samples for microbiology analysis can be collected from the site of infection or from the reference site.

Important note : After performing the hematology, faecal sample analysis, blood biochemistry and microbiology, the results have to be noted in the Clinical Pathology Form (Appendix 2).

Parasitology

Parasite can be detected from examination of vulture Faeces

Vulture postmortem

Postmortem should be carried out by the veterinarian or under his supervision. It is done to investigate the causes of mortality. Postmortem gives an idea of the gross changes occurring in the various organs which helps in finding the cause of mortality.

Protocol for the postmortem examination:

Take a photograph of the vulture carcass in its original posture before postmortem.

Weigh the carcass.

Put the carcass on a plastic sheet and then spray diluted F10 (1:500) or Pursue or normal water onto the carcass, so that the feathers do not interfere during the dissection.

Record all the morphometric measurements like body length (beak to vent, and head to tail), wing span, carpus to wing tip length, beak length, breadth, metatarsus length and diameter.

If any case history is available then it has to be mentioned before starting with the postmortem.

After the carcass is opened different organs in the carcass have to be spotted, so that they can be removed and stored appropriately for performing the requisite investigations.

Protocol for postmortem examination

Vulture carcass prior to postmortem

Diluted F10 sprinkled over the vulture carcass

Metatarsus length

Wing span being recorded

Various steps during post mortem are as follows :

1

2

Remove the skin layer of thorax region

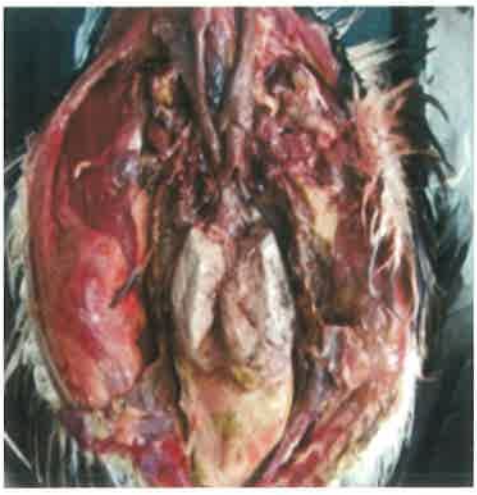
3

Cut the muscular mass and keel bone

4

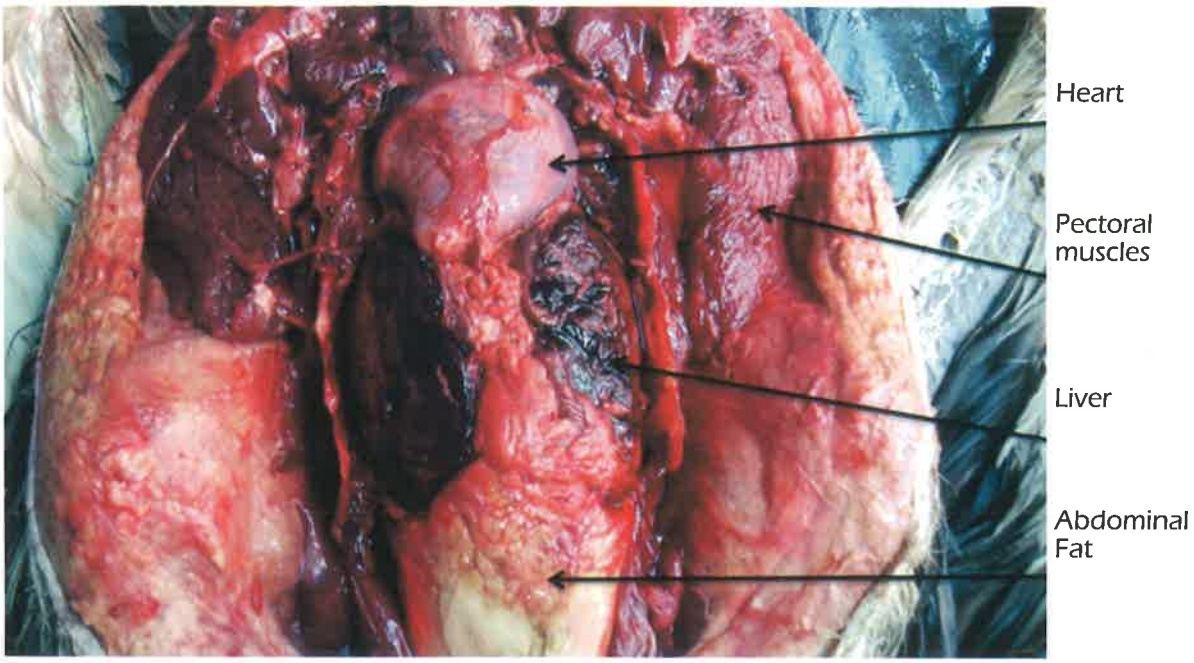
Remove the pectoral mass and keel bone

5

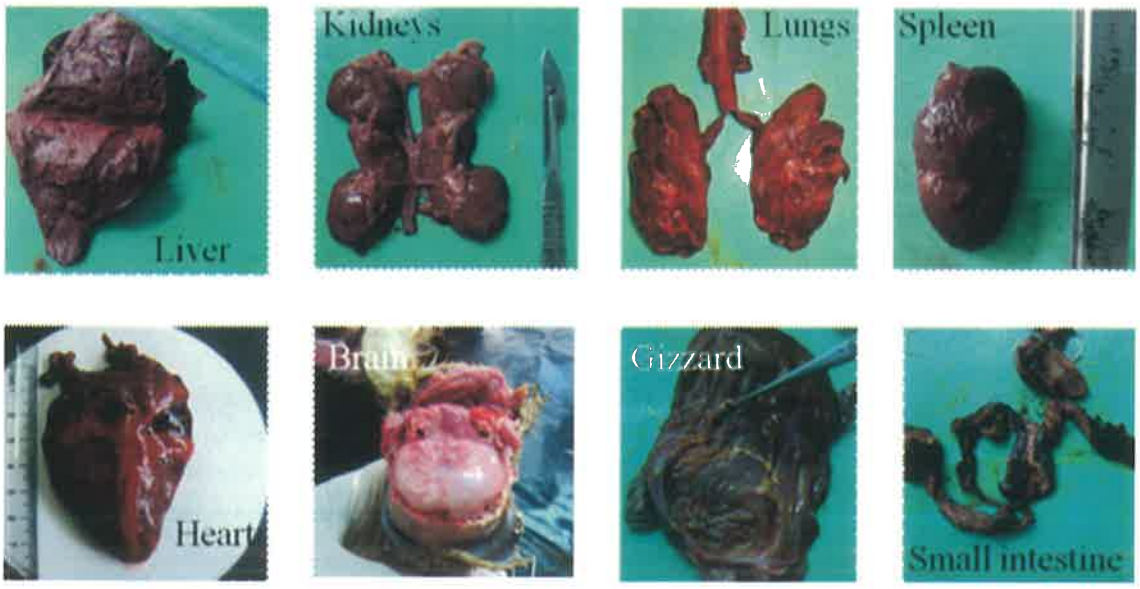


Open the vulture carcass for further investigations

After spotting the organs in the carcass the organs are removed and are photographed before being stored for further investigations. The outer appearance of the organs, shape and size also reflect the status of the organ and possible relation with the death of the vulture.



Different organs removed from a vulture carcass for investigations



Sampling from a vulture postmortem

Instrument requirements :

Scalpel, scissors and forceps.
Measuring scale.
Zip-lock bags : small, medium and large.
Cellotape : small and large.
Vials : 4 mL, 20 mL, and 100 mL.
Aluminum foil.
Labels : small, medium and large.

Procedure

Take small pieces as samples from the removed organs for toxicology, virology and histopathology studies.

Use the scalpel and the scissors for collecting the desired size of the tissue from a particular organ. Generally, a tissue of dimensions 1.5 x 1.5 cm is enough for the virology and toxicology studies. The remaining tissue can be stored for histopathological examination.

If a small organ like spleen is being dissected, take only small pieces 0.5 x 0.5 cm for the virology and toxicology studies. The rest of the tissue can be stored for histopathological examination.

Virology : The tissue pieces collected from the organ should be kept in 4mL vials. The vials can then be sealed with cellotape and can be stored at -20° C, before processing.

Toxicology : The tissue sample should be collected from the organ and should be wrapped in aluminum foil, which can be stored at -20° C, before processing.

Histopathology: The tissue sample collected from the organ (the size should be slightly bigger than the toxicology and virology samples) should be kept in 20 mL vials. The tissue can then be rinsed in 10% formalin and preserved in 10% formalin at room temperature. If required the vials can be sealed with cellotape.

Preparation of 10% formalin: Commercially available formaldehyde is of 40% concentration. This can be diluted 1:4 times to get 10% formalin.

Microbiology: Swabs/smears for bacteriology during postmortem examination should be taken if bacterial infection is suspected.

Inference

Tentative diagnosis of the death can also be reported after the postmortem.

The collected samples can then be sent to Indian Veterinary Research Institute for further investigation of the vulture death.

All the collected information, sample storage, number of samples stored, result and inference should be noted in vulture postmortem form and it should be archived (Appendix 3).

Annual Health Check

The annual health check enables to investigate the health status of every bird housed. It is generally done before the onset of breeding season which starts from late September to early October.

The annual health check also helps in identifying injured birds which look normal during routine observations and ensures breeding of healthy individuals.

It involves capturing, restraining and clinically examining all the vultures housed at a Vulture Conservation Breeding Centre.

Four persons are required during vulture capture. The personnel involved must be strong and fit, as the process involves lot of running with the vulture capture net and then restraining the vulture of at least 4 kg body weight. It becomes even more difficult to handle the vulture, if it flaps its wings. Infirm persons should be excluded from the exercise.

Restraining vultures is a difficult task, as the vulture can get injured or it can badly injure the handler. Hence it is very important to use the right equipment to restrain the vultures and to follow certain instructions which minimize the chances of injury to the bird and the handlers.

Preparation of health check

Throwing a net on the vulture

Equipment required during restraining and health check

Vulture capture net.

Vulture transport boxes.

Weighing scale (spring balance) and gunny sack.

Vernier calipers.

Measuring tape.

Camera.

Microchip reader.

Note pad.

Vulture clinical examination forms.

Vulture moult record forms.

Protective gear like

Masks.

Welder's gloves.

Cap (with flap).

Goggles.

Aprons or different overalls.

Clinical kit :

Antiseptic cream for treating minor injuries.

Sterile syringes (2 mL) and needles (23 or 24 gauge, 15 Nos. each).

EDTA vacutainers (15 Nos.).

Microscopic slides.

Spirit.

Cotton wool.

Tissue paper roll.

Method of handling vultures

Vultures have a very strong bill, wings and legs. Most of the power generated by the vulture lies in its wings and legs. A firm but gentle grip is very essential while catching the bird. One hand should firmly hold the neck between the head and neck joint. This prevents the vulture from turning around and biting the handler. The other hand should secure both legs at the thigh region. The middle finger of the hand must be placed between the two legs, to prevent injury by friction. Then the vulture should be clinically examined and should be kept in a vulture transport box before releasing it into the aviary.

(1) Restrained vulture : neck firmly held
(2) Restrained vulture : firmly held legs
(3) A restrained vulture

Parameters of health check

Examining the musculature: pectoral muscles and the femoral muscles.

Examination of body parts: eyes, nares, ears, beak, neck, crop, wings, abdomen, cloaca, uropygial gland, legs, feet, talons.

Weighing the vulture.

Examining the moult pattern.

Examining the feather conditions.

Recording the morphometrics.

Checking for the presence of ectoparasites.

Checking the microchip.

Random blood sampling.

Different body parts being examined

Examining musculature : pectoral muscles and the femoral muscles.

The musculature is examined by palpating the muscles in the thorax and thigh region.

This procedure helps to understand the muscle mass a bird is carrying, and also defines the health status of the bird.

Examination of body parts : eyes, nares, ears, beak, neck, crop, wings, abdomen, cloaca, uropygial gland, legs, feet, talons.

All the body parts mentioned above are examined by the veterinarian for injuries, infections, cysts, tumors etc.

If any small injury is reported then the vulture is treated with antiseptic.

Weighing the vulture

The vulture should be weighed using a spring balance (Pesola spring balance recommended).

Weighing should be done by wrapping the vulture in a gunny cloth and then weighing it with the spring balance.

After the weight is recorded, the weight of the gunny cloth should be deducted from the recorded weight to obtain the actual weight of the vulture

Weighing

Examining moult pattern

Moult pattern should also be examined during the health check as this exercise enables us to record various stages of fresh emerging primaries and secondary feathers.

Primary feathers : They are the outermost long feathers on the wing and they point away from the bird's body. They are usually 11 in number, the outermost being very small. They are located on the carpal and metacarpal bones. The primaries are numbered from inside out, i.e., the first primary is nearest the bird's body and the tenth is farthest from the body.

Secondary feathers : These feathers run along the arm of the wing, pointing towards the vulture's body, and sustain the bird in the air during flight. These feathers are on the ulnar bone of the wing. Their number is not constant.

Coding for moult pattern:

0 – Old feather remaining.
1 – Old feather missing or new feather completely in pin.
2 – New feather just emerging from the sheath up to one third grown.

Examining the feather condition and moult pattern

3 – New feather between one and two thirds grown.

4 – New feather more than two thirds grown and with remains of waxy sheath at its base.

5 – New feather fully developed with no trace of waxy sheath remaining at base.

Examining the feather condition

Checking the condition of the feather is of prime importance, because damaged or irregular number of feathers may indicate injury or sickness.

Important note : All data should be recorded in Clinical Examination Form and Moult Record Data Sheet (Appendices 1 & 4).

Recording morphometrics

Morphometrics involve measuring the lengths, diameters and depths of body parts which include the following :

– Beak length and depth : should be measured using Vernier calipers.

– Metatarsus length and height : should be measured by using Vernier calipers. While recording the length it is very important to measure the metatarsus from the posterior centre of the tibiotarsal-tarso metatarsal joint to the dorsal base of the central toe.

– Wing and body length : Wing length should be measured from the carpo-metacarpel to the tip of the longest primary feather with the help of a metal scale or measuring tape. The body length should be measured from the middle of the head to tail tip.

Recording Morphometrics

Recording metatarsus length

Recording metatarsus height

Recording wing length

Recording body length

Checking the presence of ectoparasites

The presence of ectoparasites like ticks, mites and lice should be checked on the feathers specially upper and under wing coverts. If there is heavy infestation, the bird should be treated with antiectoparasitic spray like Frontline.

Checking the microchip

The microchip which is planted in the pectoral muscles for identification should be checked with a reader. A microchip has a unique identifications code which gets displayed on the reader when held near the body. The leg ring or the patagium tag can fall off but a microchip is a permanent marker.

Random blood sampling

Random blood sampling should be done in atleast 20% of vultures for monitoring the blood parameters of that colony.

The drawn blood samples should be processed for hematology and biochemistry.

Inference

During the annual health check if any vulture shows the following symptoms, it should be shifted to the hospital aviary and should be treated accordingly:

–Presence of bumble foot.

–Weight loss (more than 500 gm), compared to the previous records.

–Secretions from ears, nares or eyes.

–Severe external injury.

–Low hemoglobin count.

–High WBC and monocyte count.

Examination of underwings for the presence of ectoparasites

Venipuncture : metatarsal vein

Venipuncture : ulnar vein

Artificial Incubation and Double Clutching

The need for artificial incubation

To save eggs from parental abandonment

Some pairs, especially those breeding for the first time, abandon their eggs due to inexperience and do not incubate. Such eggs can be rescued by artificial incubation. This way the eggs could be saved and production could be increased.

To attempt double clutching

Vultures are known to lay only one egg per year, but if the egg is removed within a couple of weeks of laying, they may lay again. Hence, if the first clutch of eggs is removed for artificial incubation, the female may lay a second clutch. The second clutch will be incubated by the parents. This is called double clutching and by this method it is possible to double the breeding success.

Infrastructure required

Incubator room

The incubator room 12 x 10 x 10' should be thermo-controlled and without any windows. To minimize microbial growth and for the optimum functioning of the incubators, the room should be maintained at a temperature between 19 to 21°C throughout the incubation period. The preferred temperature can be achieved with the help of an air conditioner with heating mode feature. Relative humidity in the room should be as low as possible. Dehumidifiers could be used to control humidity. An "L" shaped working top at a convenient height of 3' and depth of 2½', made of solid stable material like marble should be installed in the room. The top should be smooth, strong and stable.

The room should be constructed with materials that allow all surfaces including the walls, flooring and ceilings to be easily washed. The working top, the wall above the working top and the flooring should be tiled or marbled. Carpets or curtains in the room should be strictly

Incubator room

prohibited as they are reservoirs of pathogens. There should be no cabinets in the room as it is difficult to keep them clean. Only equipment and supplies in current use should be kept in the room. Clutter should not be allowed to accumulate as eggs are vulnerable to infections and disturbances.

Entry into the incubator room should be through a single door. The incubator room should open into an anteroom which could open outside, as well as into the brooder room. The anteroom should have facilities for a changing area as well as a store to stock up spares.

Electrical supply

Fluctuation in electrical supply can be detrimental to the eggs. The room should be equipped with uninterrupted power supply. Ideally there should be a dedicated inverter of 1400 VA. The room should have a connection to an 8 KV generator as the air conditioner cum heater has to run continuously. Incubators should always run with stabilizers to take care of electrical surges. The room should have convenient electrical points to be used for incubators and atleast four extra points. The electrical points should be of good quality to avoid fire hazards.

Forced air incubator

Table top hot air incubators are found to be good for vulture egg incubation. Brinsea's Octagon incubators with forced (moving) air heating are simple and highly efficient in temperature and humidity control, which are essential for successful incubation. The incubator rests on an automatic egg turning cradle which rocks the whole incubator from side to side, thus turning the eggs every hour. There should be a minimum of eight hot air octagon

A forced air Incubator

incubators. Upto four vulture eggs can be incubated in an incubator at a time.

Brooder room

The brooder room 12 x 10 x 10' should be utilized for hatching eggs and raising newly hatched nestlings. It is very similar to the incubator room except that the brooder room has a window which should remain closed unless the room requires to be aired as the shell waste of the eggs, the feather dander, faeces and food can be a source of contamination.

Electrical supply

Continuous electrical supply to brooder room is as critical as it is to the incubator room.

Hatchers

Hatchers are placed in the brooder room to rear freshly hatched nestlings. Once an egg pips externally (egg cracks), it should be shifted from an incubator to a hatcher set at 36°C in the brooder room. High humidity conditions are required to hatch; hence water should be filled up to the brim in the capillaries below the steel mat. The hatcher should run dry after the egg hatches. A newly hatched nestling should be kept at 36°C in the hatcher and the temperature should be reduced by a degree every day. Hourly temperature of the hatcher should be noted.

In the hatcher, the nestling is reared in wooden conical tray covered with rough towel to provide a rough surface to prevent the development of splayed legs. The newly hatched nestling is not fed for the first 12 hours as it draws

Newly hatched nestling in hatcher

Externally pipped eggs in hatcher

food from its yolk sac. Thereafter, it is fed three times a day as per the feeding protocol mentioned in the section - Feeding protocol for the nestlings - at the end of the chapter.

Brooder box

The nestling should be moved to a brooder box 1.5 x 2.5 x 2.5' when it is five days old. Temperature in the brooder box should be set at 32°C which should be reduced by a degree every day till it reaches 21°C. (Thereafter, they continue to be reared at 21°C till they are shifted to nursery aviaries).

Brooder boxes

This could be done by adjusting the proximity of a heat lamp inside the brooder box from the nestling. The heat lamp should be placed on one side of the box, which would enable the nestling to move towards the lamp if it is cold or move away otherwise.

In the brooder box, the nestlings should be kept in long conical wooden trays which are narrow at the bottom and broad at the top, to prevent the problem of splayed legs.

Conical wooden trays to prevent splayed legs

The trays should be lined with rough towel to provide rough substrate which should be changed after every feed.

The nestlings should be kept in groups to make sure that they do not get imprinted on humans. Hourly temperature should be noted all through brooding.

Nursery aviaries

The Centre should have eight nursery aviaries with a capacity to rear up to 24 nestlings at a time. The nursery aviaries should be 10 x 12 x 8'. The three walls should be all solid and wire mesh netting should be fitted in front. The aviary should open into a common passage. Nestlings should be kept in groups to avoid imprinting on humans.

The nest

Each aviary should be provided with a nesting ledge of dimensions 12 x 6' situated 4' above the ground. The nest ledge should have a base of jute netting and a thick frame on the sides to prevent nestlings from falling down. It should be covered with layers of sticks and twigs and then

Nestlings reared in groups to avoid imprinting on humans.

should be lined with green leaves. Fresh green leaves should be added every week to ten days. Utmost care should be taken to prevent injury to birds if they dash against the mesh by providing a lining of bamboo.

The nestlings should be shifted to nursery aviaries when they are two weeks old and ambient temperature is around 20°C. The temperature during the day should not fall below 18°C. Initially the nestlings should be kept out during daylight hours and should be shifted to brooder boxes in the brooder room in the evening. The nestlings should be left in the aviaries during the night after they are forty days old.

When in nursery aviaries nestlings should be fed only twice a day. There should be hatches just above the nesting ledges from where the food could be passed inside. Water in earthen bowls should be introduced on the nest ledge when the nestlings are 90 days old. A perch

The nest in nursery aviary

Water provided in earthen bowl on nest

wound with coconut rope should be fitted a foot above and perpendicular to the nest ledge for the nestlings to jump on when they are more than three months old. Once the nestlings fledge or become 16 weeks old, they should be transferred to the holding aviaries.

Holding aviaries

The Centre should have two small holding aviaries 20 x 20 x 14' with a capacity to hold 6 birds in each and one big holding aviary 60 x 40 x 14' with a capacity to hold 20-24 birds. Nestlings should be kept in groups to avoid imprinting on humans. Each aviary should be covered on the top with iron wire mesh and a layer of netlon underneath. Utmost care should be taken to prevent injury to birds if they dash against the mesh by providing a lining of bamboo. The main feature of these aviaries is perches, wound with coconut ropes, located at various heights. Flat ledges of dimensions 2.5 x 2.5 should also be provided as perches.

Removing eggs

The process of artificial incubation begins with the removal of eggs from the vulture nests. Eggs should be removed between 10-14 days of natural incubation. This incubation is sufficient to assure optimum hatchability and establish an appropriate egg weight loss trend. Chances of double clutching would reduce if eggs are left on nest for 21 days and beyond. However, eggs could be removed at any stage of incubation. At the Pinjore Centre, a two day old egg as well as a month old egg has been removed and hatched successfully by artificial incubation and double clutching

Removing an egg from colony aviary

had been observed in case of the respective vultures. The procedure of egg collection described below has been used for collecting 9 White-backed vulture eggs and 7 Long-billed vulture eggs, out of which 7 White-backed and 6 Long-billed have hatched successfully. All but 2 of the White-backed pairs and 1 of the Long-billed pairs recycled within three weeks.

Equipment required for egg collection

A ladder to climb up the nest to remove the egg. At the Pinjore Centre, all colony aviaries have a ladder each kept inside round the year.

Egg boxes (approx. 6x6") with a thick layer of sterilized cotton wool lined inside with a hollow depression in the centre where the egg is to be placed.

A soft and blunt non-toxic pencil for marking the egg.

A hand sanitizer to clean hands before handling eggs.

Keys to the aviaries.

Procedure of egg collection

Egg collection operation should be swift and smooth. The operation should be carefully planned by marking the nests from where the egg is to be removed. A team of 5 persons should be formed of which one should be designated the team leader. The team leader should lead the operation and under his supervision the team should operate. Of the remaining 4 persons, one should be responsible for climbing the nest to remove the egg and put it in a box, second person waiting down should climb half way up to receive the box containing the egg and give it to the third person waiting outside the aviary to receive the egg box and carry it to the incubator room. The fourth person should be monitoring and recording the whole operation in the CCTV cameras for future reference. All movements of the people inside the aviary should be smooth. Unplanned movements should be avoided to minimize stress to birds.

Egg handling

Many factors influence hatchability once the egg is laid and before incubation begins. Microbial contamination of the shell could occur from faeces, nest material or human hands. Cracking, breaking, shaking or vibrating could cause egg mortality. Hence egg should be handled with utmost care. The egg should be numbered with a blunt pencil at the nest itself. It could be the nest no. or an individual code. The egg should be collected, handled, carried and kept in the incubator in the same position as it was found in the nest.

Egg box

Storage of eggs

Eggs have been transported in several different types of transport containers. Cardboard boxes, buckets, small ice chests lined with cushioning material such as clean paper, millets, cloth lining, waterfowl downs could be used. Hot water bottles or chemical warming packs are used if transport time is longer. For longer trips, portable electronic incubators or brooders made for nestlings are useful. It also has an option for recharging the batteries for power. The container should be handheld to reduce the risk of shaking and jarring. Eggs may be stored up to 7 days without significant decrease in hatchability at ideal parameters of 13-15°C and 70-80% RH. Stored eggs should be allowed to warm gradually, usually overnight to room temperature before being set in the incubator. At VCBC, Pinjore, egg boxes (wooden or cardboard) (approx. 6x6") with a thick layer of sterilized cotton wool lined inside with a hollow depression in the centre are used for the transport of eggs from aviary to the incubation room.

Egg examination

An egg if very dirty may be rubbed dry with 'scotch brite' or paper towel. No liquid should be used for this purpose. Wet feces, urates or blood should be allowed to dry. Egg should be examined carefully, both visually and as well as with the candler. Egg may be marked for convenience on two sides or all four sides. All information pertaining to the egg should be recorded in the egg log sheet.

Initial care of eggs

Eggs which have had some natural incubation should be placed in the incubator immediately, after being brought

Eggs in a dry incubator

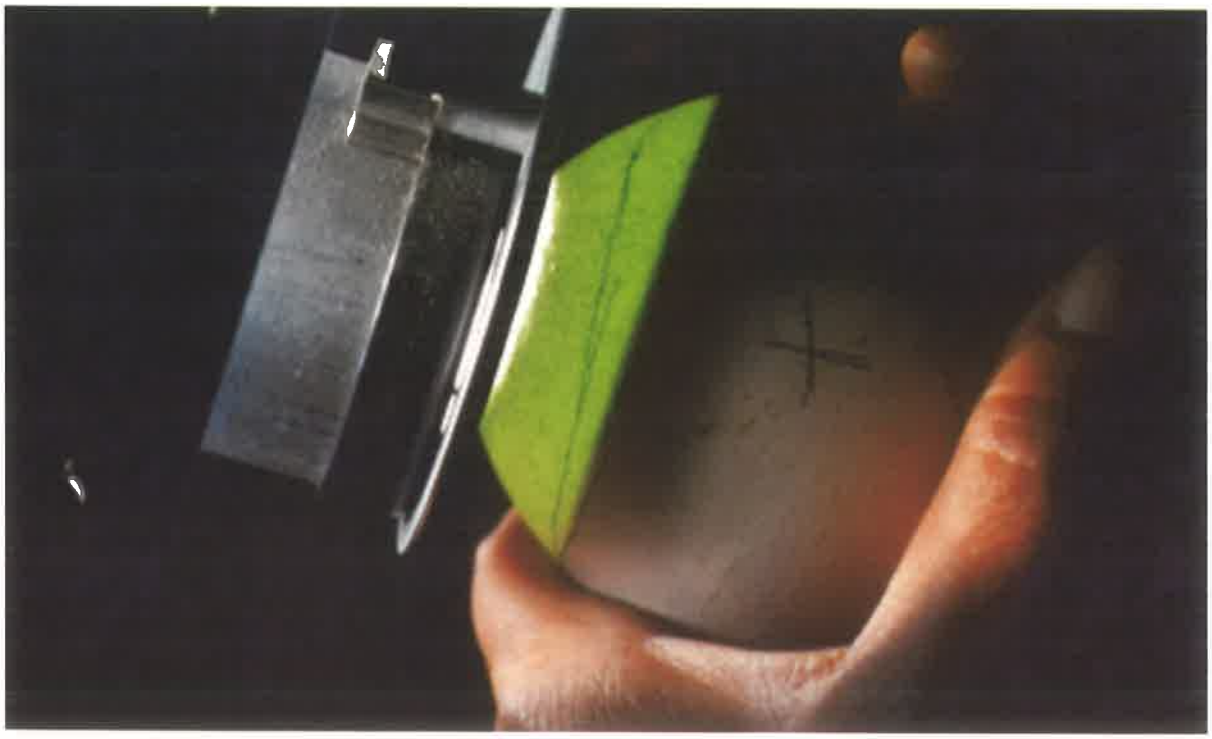
in to the incubator room. An egg which has had no natural incubation or has been abandoned by the parents and has gone cold should be kept aside on a small rubber ring to prevent it from rolling or toppling in the incubator room for eight hours to bring it to room temperature and then should be kept in an incubator running at 30°C which will be increased by a degree every 6 hours till it acquires the required temperature for incubation. Initially, all eggs should be run in a dry incubator for an hour to ensure that they are warm. They may be candled thereafter.

High-intensity candler

Incubation parameters

Candling

Candling is the primary method for monitoring embryonic development. After darkening the incubator room, eggs are placed in front of a source of high intensity beam of light. The candler lights up the contents inside and is useful in determining the stage of incubation, progress of the air cell formation and its position, helps evaluate the egg shell quality, flaws, cracks and yolk quality and mobility.



Candling an egg to determine the development of the embryo

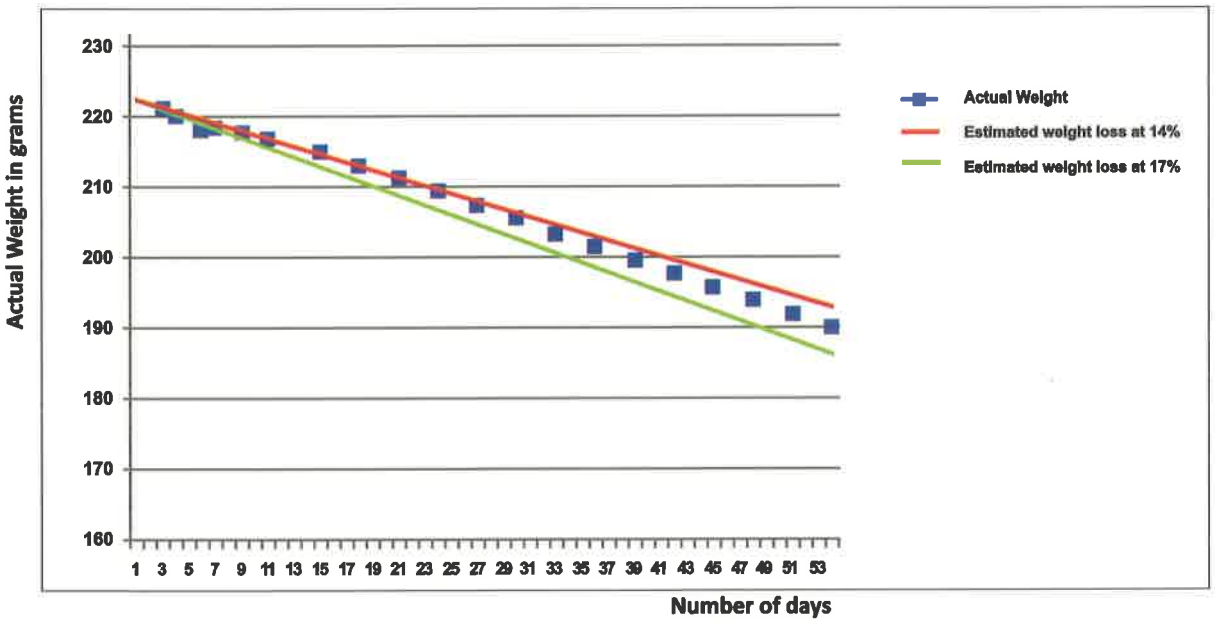
Eggs should be candled once after removing from the nest and then on every sixth day. The high-intensity beam is very effective in lighting up the contents of the egg but the bright light is very hot. Eggs should not be held against the light for more than a few seconds at a time.

Weighing

Eggs should lose between 14 to 17% of fresh or initial egg weight at laying, during incubation, for successful hatching. Weight loss is not a metabolic function but a physical process of water evaporation through the pores of the egg shell. Weight loss can be manipulated by increasing humidity in the incubator if the weight loss is more than 17% by adding water in the capillaries. All eggs are initially set in incubators running dry i.e. without water.

Eggs should be weighed after removing from the nest to know their current weight and to estimate their fresh weight. They should be weighed once every three days thereafter. Once the fresh egg weight is known, the expected weight loss can be calculated and the actual weight loss can be tracked graphically.

Weight loss graph of a successfully hatched egg



Formula for estimation of fresh weight

$$\textit{Fresh weight estimated} = \frac{\textit{Current weight}}{1-\left(\frac{\textit{Days incubated from setting to current}}{\textit{Total Days of expected incubation x 0.15}}\right)}$$

Temperature

The incubators should be set in the range of 36.3°C to 36.9°C or 97.5°F- 98.5°F for all the three species. It would be good to use Zeal mercury thermometers with centigrade calibration. The digital display is not found to be reliable and should not be used without the support of mercury thermometers. Temperature should be recorded every hour to keep a check on voltage fluctuation. Once incubation begins, embryo can survive temporary drops in temperature but an increase of even 0.5 °C for a few hours can prove fatal.

Humidity

The eggs should be incubated in dry incubators initially. The humidity could be increased by adding water to the capillaries if the eggs are found to lose more weight than expected i.e. 17% and decreased if the eggs are not losing enough weight.

Turning of eggs

The Octagon incubators rest on an automatic egg turning cradle, which rocks the whole incubator from side to side, turning the eggs every hour. The eggs should also be turned manually three times a day along the longest axis to facilitate normal membrane development and nutrient uptake and to prevent the embryo from sticking to the inside of the shell.

The hatching process

Internal pipping of eggs

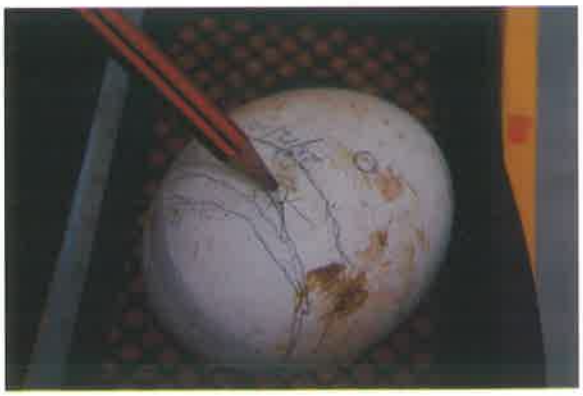
Internal pipping is when the embryo can be heard calling from inside an intact egg. As the time of hatching approaches, the embryo attains its maximum size and occupies all space within the egg except the air cell. The gas exchange capacity becomes insufficient resulting in decrease of oxygen in blood (hypoxia) and increase in carbon dioxide (hypercapnia). Pulmonary respiration is initiated by contraction of hatching muscle causing egg tooth to pierce the inner membrane of the air cell. This becomes audible by vocalisation. Once an egg pips

An internally pipped egg is audible

internally, it does not require any turning. The cradle from the incubator should be removed to prevent it from rocking. The average period for internal pipping in White-backed vultures is between 48-54 days (n= 9) from the day of laying, while that for Long-billed vultures is between 50-58 days (n= 7).

External pipping of eggs

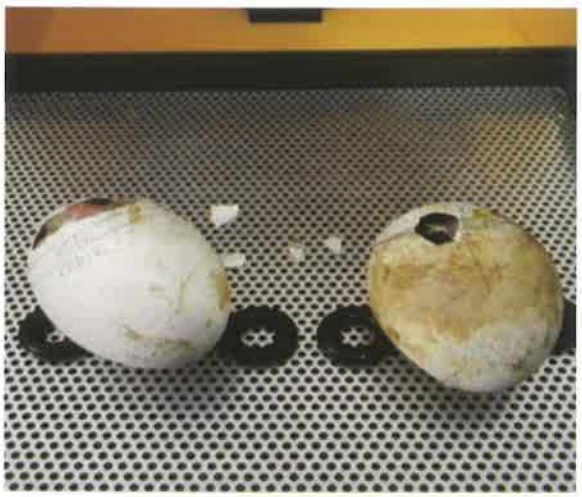
This process occurs when the egg tooth pierces the shell, which leads to a crack in the shell. The egg should be shifted to the hatcher set at 36°C in the brooder room. The hatcher should be filled with water in the capillaries to limit the drying of shell membranes which could restrict the embryos' movement. External pipping occurs between 21-52 hours of internal pipping in White-backed vultures (n= 9) and 29-104 hours in Long-billed vultures (n= 7).



An externally pipped egg

Hatching

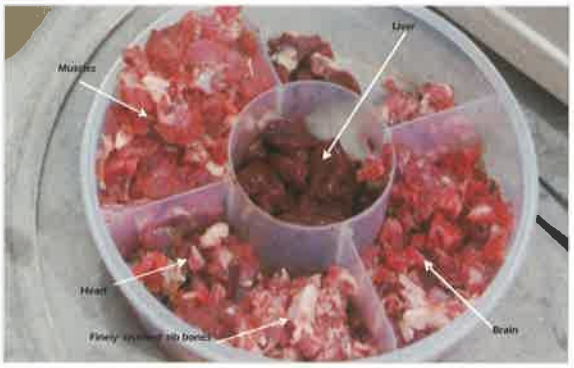
Hatching occurs as the embryo pushes out of the shell. The process is very long and exhausting for the hatchling. In some cases assistance is required for the egg to hatch. The hatchling is wet and exhausted during the process of hatching. It should be given enough time to recuperate and dry off in the hatcher. Hatching occurs between 43-86 hours of external pipping in White-backed vultures (n= 7) and 44- 120 hours in Long-billed vultures (n= 6).



Feeding protocol for the nestlings

A newly hatched nestling should not be fed anything for the first 12 hours as it draws food from its yolk sac.

On the 2nd day it should be fed only 2 grams of minced goat meat three times.



Nestling should be weighed before feeding and after every meal.

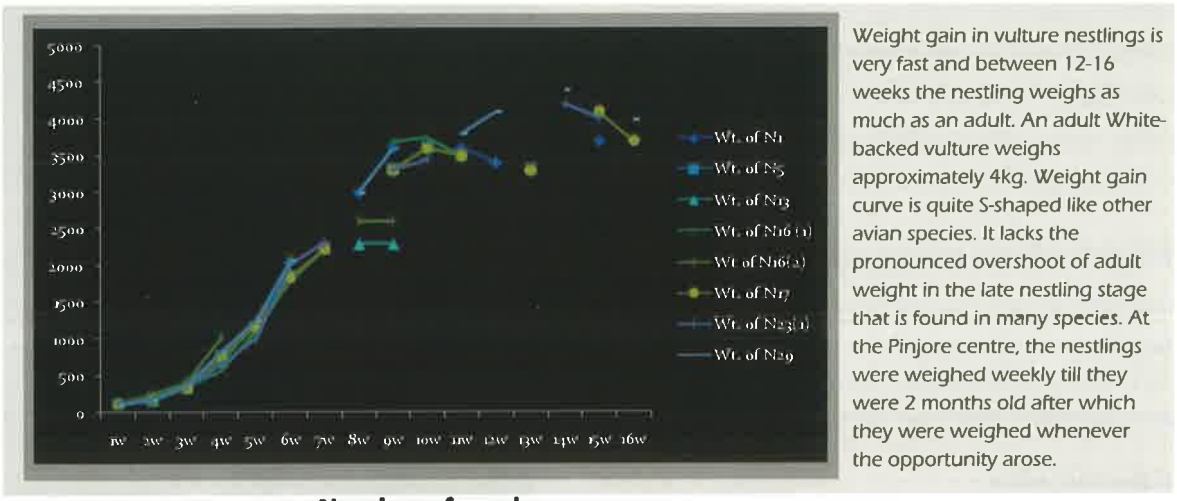
Feeding times should be fixed and strictly followed.

Over feeding could be more harmful than under feeding.

From 3rd day onwards finely crushed rib bones should be introduced in the diet to supplement calcium requirement.

Hatching

Weight gain in grams of eight captive reared White-backed vulture nestlings through the nestling period



Weight gain in vulture nestlings is very fast and between 12-16 weeks the nestling weighs as much as an adult. An adult White-backed vulture weighs approximately 4kg. Weight gain curve is quite S-shaped like other avian species. It lacks the pronounced overshoot of adult weight in the late nestling stage that is found in many species. At the Pinjore centre, the nestlings were weighed weekly till they were 2 months old after which they were weighed whenever the opportunity arose.

The diet consists of parts of heart, liver, brain, muscles and finely crushed rib bones of goats.

Nestlings should be fed 10-12 gm/feed or 30 gm/day to approximately double their weight by the 10th day. The feed should increase by 3 gm per day from 2nd day onwards and from 11 day by 6 gms every day.

Nestlings older than 10 days should be fed to a full crop thereafter..

Staff

A minimum of 2 and at the most 3 persons should be involved in the team, a biologist and two assistants. Incubation is a very intensive and time consuming work so the staff should be dedicated to the whole of the incubation exercise. They should organise daily work to minimize the potential of contaminants from entering the facility.

Sanitation

Sanitation protocols developed should be rigorously adhered to during incubation. Entry into the incubation room should be restricted to essential personnel only. The incubators and accessories should be thoroughly cleaned and sanitised using a 1:500 dilution of strong disinfectant like F10. Incubation personnel should be instructed to wear hand gloves, face mask, apron while in incubator room. There should be dedicated footwear for incubator and brooder rooms.

Preventing human imprinting

Human imprinting happens when the nestling starts recognising the person taking care as their kind, due to which they want to remain in human company rather than stay with their kind.

Since the conservation breeding project's final objective is to release vultures in the wild, the captive vultures should be kept as wild as possible. Hence human imprinting of captive bred nestlings should be avoided.

Nestling's eye sight develops by the 10th day. After this stage, the staff feed the nestlings after wearing a special hood which masks their identity. Also, hand feeding should be avoided.

Nestlings should be kept in groups of 2-3, so that they imprint on each other.

MOLECULAR SEXING OF *GYPS* VULTURES

The *Gyps* species of vultures are not sexually dimorphic and it is impossible to tell sexes apart morphologically. Sexing of individuals is of prime importance in a Conservation Breeding Programme.

Hence, molecular sexing technique was considered as a tool for gender identification in *Gyps* vultures.

Molecular sexing of vultures

Molecular sexing can be defined "as use and the study of a specific molecule (Protein, Nucleic acid, Hormone etc.) to sex individual of a particular species". For vultures the molecule used to determine sex is genomic DNA.

Genomic DNA

DNA is the acronym for Deoxyribose Nucleic Acid. It is the genetic and hereditary material present in all kinds of life forms. Genomic DNA makes the genome of a life form. Genomic DNA is packed in chromosomes and is present in the nucleus of a eukaryotic cell. Genomic DNA is a very long molecule, contains almost billions of bases. Length of stretched DNA is more than height of a human; and contains information to carry out all the basic cellular functions.

PCR

PCR is **P**olymerase **C**hain **R**eaction, an in vitro technique to amplify a part of interest from the genomic DNA. To perform PCR, an instrument known as thermal cycler is required.

Primers

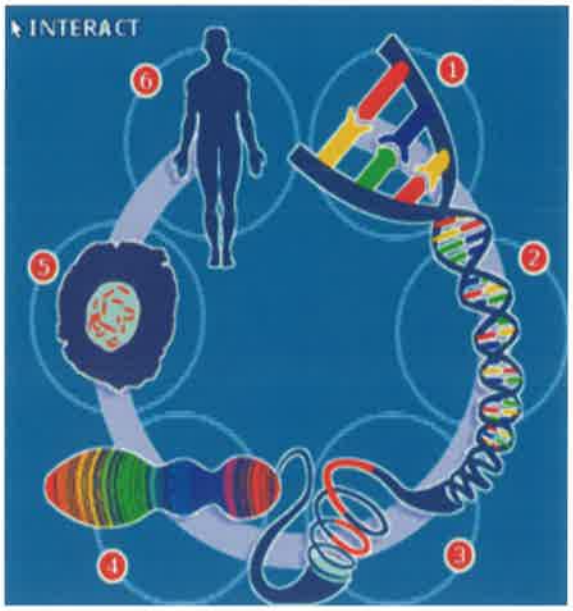
Primers are short sequences of DNA also known as oligos used in PCR, which mark/flank the area of study or the area of interest in the genomic DNA.

Gel electrophoresis

It is the technique used to visualize and separate DNA, on a gel matrix under the influence of electric current.

Basis of molecular sexing

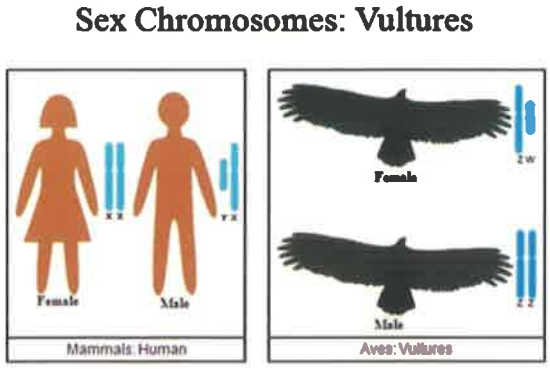
As in all the eukaryotes, the DNA in birds is also present in



the nucleus and is packed in chromosomes and they also have the two types of chromosomes, the autosomes and a single pair of sex chromosomes. In birds the females have Z and W as the sex chromosomes; while the males have 2 copies of Z chromosomes. The presence of W chromosome in females and the difference between the Z and W chromosomes is of importance, the study and analysis of this difference is the basis of molecular sexing.

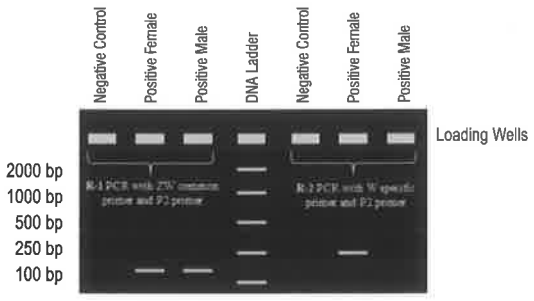
Molecular sexing in vultures

During the late nineties, Griffith *et. al.*(1998) found a gene known as Chromo-Helicase DNA binding protein



This is only a schematic representation and the chromosome sizes may vary from what is shown

gene (CHD binding protein gene) on the sex chromosomes of birds, a conserved gene which differs on the Z and W chromosomes underlying the difference between male and female individuals, hence the difference in this gene can be used for molecular sexing in almost all the species of birds. The difference in the CHD gene of Z and W chromosome can be amplified or focused using PCR, and the PCR product can be further analyzed to determine the gender of the vulture. For amplification of only the CHD gene from whole genomic DNA specific primers for sexing are used. Three primers are used for sexing studies in vultures. Out of the 3 primers one set (Primer A and Primer B) are common for CHD gene present on both the Z and W chromosomes while the other set (Primer A and Primer W) are highly specific for CHD gene on W chromosome. Hence, a genomic DNA sample from a vulture which has to be analyzed for gender identification would require 2 separate PCR reactions, one using primer A and primer B and another using primer A and primer W. The first set of PCR with Primer A and primer B will function in presence of both Z and W chromosomes and will give a PCR product of ~150 bp for both male as well as female samples. On the other hand the second primer set of primer A and primer W, due to its high specificity, will function only if W chromosome is present and will give PCR product of ~260 bp only for the female samples. If W chromosome is absent no PCR product will be seen in this reaction. Hence all the male samples will have PCR products in primer A and primer B reactions while all the female samples will have PCR products in primer A and Primer B reaction as well as primer A and primer W reaction. This presence of specific PCR product in an individual describes the sex of the individual being tested.



Schematic representation of agarose gel showing PCR products for male & female samples after molecular sexing

Number of samples processed

A total of 42 vulture DNA samples inclusive of 25 from dead vultures and 17 from live vultures were analysed using this method. All the initial standardization and validation of the method was carried out at Indian Veterinary Research Institute.

Standardization of molecular sexing method at Vulture Conservation Breeding Centre, Pinjore

The described method was standardized and used at VCBC, Pinjore, wherein the positive male and female DNA samples were sexed successfully. The same method will be used for sexing all the individuals housed at VCBC, Pinjore.

Sexing of vultures at other Vulture Conservation Breeding Centres

Sexing of vultures at the other VCBCs can be carried out through coordinated efforts.

Live vulture samples like blood and feathers can be collected at the respective VCBCs and can be sent to Central Zoo Authority's Vulture Conservation Breeding Programme Coordinating Zoo VCBC, Pinjore for sexing.

For the same purpose following section describes the methods of sample collection, storage and packaging for sending them to the VCBC, Pinjore.

Sample collection

The most preferred samples are blood and feathers. But there are certain difficulties encountered while collecting these samples from the vultures which are listed as follows:

Blood sample collection involves trained personnel to handle the bird and to draw the blood.

Shed feathers are good source of genomic DNA. But getting such feathers from specific vulture is very difficult in a colony aviary.

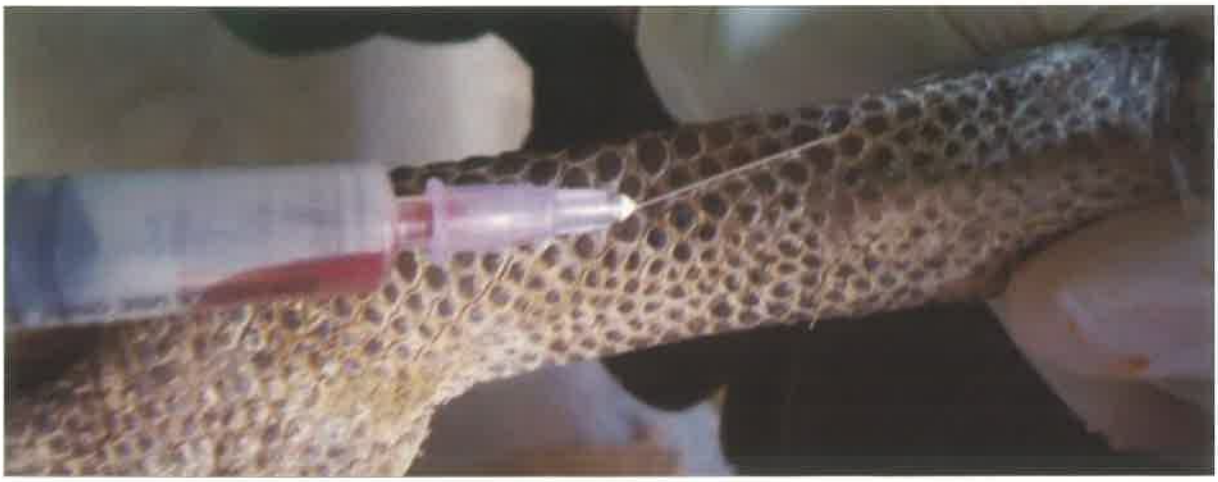
Blood collection

Blood collection should be done by veterinarian or under veterinarian's supervision.

Medial Meta-tarsal, R-ulnar, L-ulnar, Jugular either of these veins can be used as site of blood collection.

For venipuncture use of syringes (2 mL or 3 mL), sterile needles (24 or 23 gauge) is recommended.

Ulnar vein



Metatarsal vein

Processing the blood sample after collection

The blood samples which are collected from the vultures need to be processed and stored in a way to keep them useful for further processing and isolating DNA. The processing and storage of the collected blood sample is shown in a pictorial representation as follows:

After processing the blood samples are stored at 4°C in a refrigerator. If refrigerator is not available then the same can also be stored on ice.

Precautions to avoid cross contamination

Sterile syringe and sterile needle must be used every time while venipuncture is attempted.

The syringe and the needle must be discarded immediately after use; it is recommended not to keep any of them near the EDTA vacutainers.

The personnel involved must change the gloves before handling the next vulture.

Take the syringe after blood collection

Carefully remove the needle

Carefully remove the needle

Take an EDTA Vacutainer

Remove the cap of EDTA vacutainer

Slowly push the blood into the vacutainer

Recap the EDTA vacutainer

Label the sample before storage

Blood samples stored at 4°C

Feather collection

Feather collection is possible; if a single bird is kept in an aviary. This can be done by just picking up its shed feather.

No feather collection should be done from the aviary where a number of birds are housed.

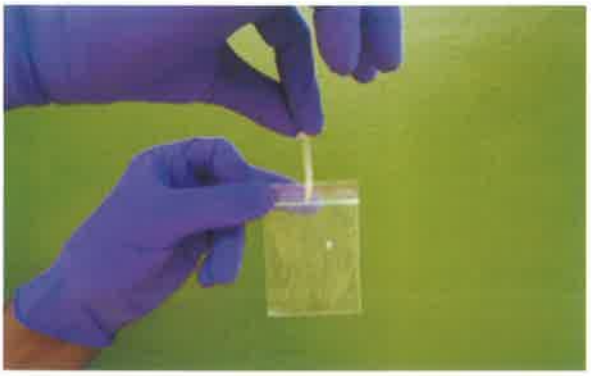
The collected feather should be dry.

Collected feather can be stored at room temperature in a sealed polythene bag.

The collection and processing of feather sample is shown in a pictorial representation as follows:

Collected feather

Cut the distal end of the feather



Put cut portion of feather in a zip lock pouch

Put a label inside the zip lock pouch

Seal the zip lock pouch before storage

The processed feather sample can be stored at room temperature.

Sending samples to Vulture Conservation Breeding Centre, Pinjore - Coordinating Zoo

Legal formalities

For sending the collected blood samples to VCBC, Pinjore, permission must be acquired from the Chief Wildlife Warden.

An intimation letter should be sent to the Coordinating Zoo and it should be copied to Central Zoo Authority.

Sending the blood samples and feather samples

The EDTA vacutainers or the eppendorf tubes should be sealed with a cello tape or parafilm.

The contents should be wrapped in a polythene bag.

Then the ready bag should be kept in a thermocool box containing cool packs and the box can be sealed with cello tape which helps in maintaining low temperature inside the box for almost 24-48 hours.

Feathers can be sent without any cooling after initial packaging. The sealed box can be sent to VCBC, Pinjore through speed-post or courier (DTDC, Track On).

Transport of samples

STUDYING VULTURE MICROFLORA

Bacteria are prokaryotic organisms, i.e. unicellular, simple forms of life, which do not have a distinct nucleus and have very limited basic functions. There are innumerable different types of bacteria, present in almost every naturally occurring climatic condition. Bacteria have a very short multiplication time. For example, a bacterial species named Escherichia coli which is found in the faeces of most animals can double its population in 20 min.

Studies of microflora

Bacteria are omnipresent, hence are also found on the body surfaces of all the life forms. Microflora is the microbial composition of the body surface of any living thing. Components of microflora also contain fungi and viruses, but they will not be discussed in detail in this manual, as they require specific laboratory conditions to study. Sometimes, bacteria from the environment are also present on the skin surface of the organism. Such bacteria need not necessarily be constituents of the organism's microflora, and often give false results in such studies.

Bacteria/components of microflora share the following relationships with the host:

Mutualism : both host and the bacteria benefit from the relationship.

Commensalism : bacteria benefit from the host but the host neither benefits nor is affected.

Parasitism : bacteria benefit from the host while the host is adversely affected.

These relationships are collectively known as symbiosis (sym- together, bios- life)

Importance of studying microflora

Microflora of an individual indicates the microbial contents and types on the body surface of the individual. It gives an indication of the feeding and living habits of the individual. Establishing a statistically significant database of bacteria present in individuals of the same species will provide a platform to point out at potential pathogens. It also helps in studying the host-bacterial relationships.

The microflora of resident *Gyps* vulture has not been studied till date. Vultures being scavengers, will probably have a unique microflora, as they are routinely exposed to scavenging bacteria in dead animals. They are resistant to many common bacterial pathogens which can cause diseases in humans and other animals. Studying the normally found bacteria in vultures will help in finding out potential pathogens, which will eventually help in managing wild and captive vulture populations to prevent transmission of diseases.

Methods of sampling for studying microflora

Invasive sampling

Trachea.

Gizzard.

Crop.

Intestines.

Surfaces of other internal organs like liver, kidney, heart and lungs.

This kind of sampling can be done only during a vulture post- mortem.

Non-invasive sampling

It is the only available method for taking vulture samples, due to its critically endangered situation. This form of sampling involves swabbing of the following sites:

Cloaca

Choanae

Faeces

Feathers and skin

The method involves the use of sterile cotton swabs which are inserted into the body cavity to be sampled/ touched on the faecal specimen. The swabs are made of absorbable cotton ball attached to the base of a 4" long

plastic stick. The swab is presterilized or can be purchased non-sterile and autoclaved. These swabs can then be used to inoculate bacterial culture media, which help in the growth of bacteria. The advantage of this sampling technique is that it is absolutely painless to the bird and can be done within a few seconds.

▸Sampling sites for studying microflora

Cloaca

It is a Part of the uro-genital tract in vultures and other birds.

Vultures also pass faeces through cloaca.

Sampling cloaca gives an indication of the gut flora of vultures.

Samples should be taken by inserting a sterile swab about 1 cm deep in the cloaca and rotating it once.

Precautions should be taken to not touch the surrounding feathers or outer skin of the vulture while swabbing, as it will lead to erroneous results.

Choanae

It is a part of the upper respiratory tract in birds. It can be seen as a double flap at the maxillary side of the vulture's oral cavity, when the bill of the vulture is opened. Samples should be taken by inserting a sterile swab inside the double flap and rotating it once. While sampling it must be ensured that the swab does not touch the oral cavity, tongue or regurgitated fluid (if any) in the mouth of the vulture. The handler and the person sampling should take

care in opening the bill of the vultures, as they do not like being touched at the choanae and tend to jerk their bill violently, which may end up injuring the handler/sampler. It is preferable to have three persons while taking choanal swabs, one to hold the vulture, another to open up the bill and the third to take the swab.

Faecal samples

Faeces are the blackish brown part of the excreta of a vulture. They give an indication of the gut flora of the vultures. The faeces are sampled by lightly touching a sterile swab at the centre of the faecal part of the excreta. The white part is the urates, which should be avoided as they are antibacterial in action, and will kill the bacteria sampled by the time they are cultured. Fresh faeces should preferably be taken. Partly or completely dry faeces get mixed with the soil and/or air and hence may not give correct results. If fresh faeces are not available, cloacal swabs can be used as a substitute.

Feathers and skin

Studying the microflora of the feathers and skin indicates the surroundings of the vulture.

Skin and feathers can be sampled by rubbing a sterile swab moistened with sterile normal saline.

Skin flora often does not give a true picture because the organisms encountered change with the vulture's activities. For example, if the vulture has just taken a bath, bacteria observed will be different from those if the vulture has been feeding.

Sampling

Sampling can be done during the annual health check. Cloacal, choanal and if fresh faeces are available, faecal swabs give sufficient information about the vulture microflora. After the swabs have been taken, they should be immediately transferred to a sterile tube. The tube should be labeled with details like vulture ring number, species, date of sampling and site of sampling.

Labeling a sample tube

Setting up a basic microbiology laboratory

Specifications of room required

The room for microbiology may be small, but it should be isolated. A 100 sq. ft. room would be sufficient for setting up the microbiology laboratory. The room should have a large sliding door for entry and exit. Flap doors should be avoided, as they force air inside or outside the room, which leads to transfer of bacteria from the lab to the outside or vice versa. The room should always remain closed. Having an air conditioned room is ideal but not necessary. Air conditioning reduces the chances of contamination and also creates comfortable working conditions for the technician working in the lab. However, the air conditioner should not be placed directly opposite the working area. The room should have two working platforms of sizes 6 x 2' and 3 x 2'. The larger one can be used for keeping the incubator and hot air oven, with some space for setting of solid media in plates, etc. On top of the smaller platform, two Bunsen burners can be placed 6" apart and connected to a gas supply. Ideally, a laminar air flow cabinet with class II HEPA filters should be fitted for working in sterile conditions. However, it is very expensive and can be

substituted with a non-absorbable working bench if appropriate precautions are taken. All the benches should be of non-absorbent material, to enable easy cleaning. There should be cupboard type racks for storage of media and autoclaved glassware.

Basic instruments for microbiology

Autoclave: for sterilization of many media, glassware and instruments using steam at 121°C and 15 lb pressure.

Incubator: for incubation of bacterial cultures at a desired controlled temperature.

Hot air oven: for sterilization of glassware and instruments using dry heat at atleast 200°C.

Microscope: for magnification of bacteria from a smear to study their morphology and other characteristics.

Weighing balance: for accurately weighing exact amounts of culture media and reagents during preparation.

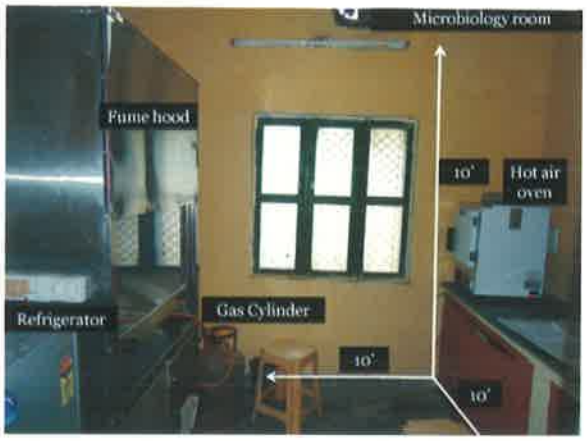
Distillation apparatus: for converting normal tap water to distilled water.

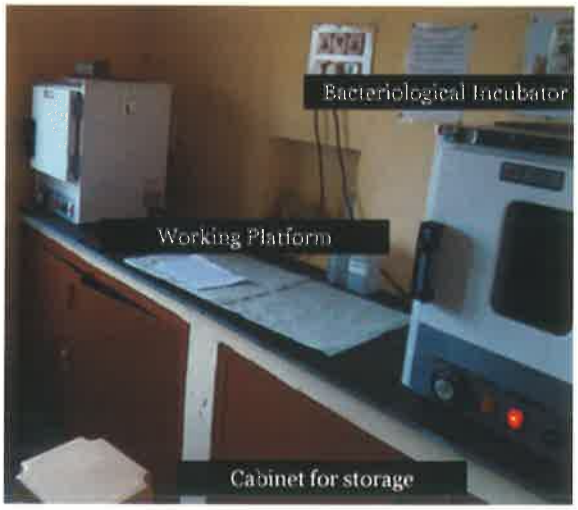
Refrigerator: for storage of prepared and sterilized media and cultures.

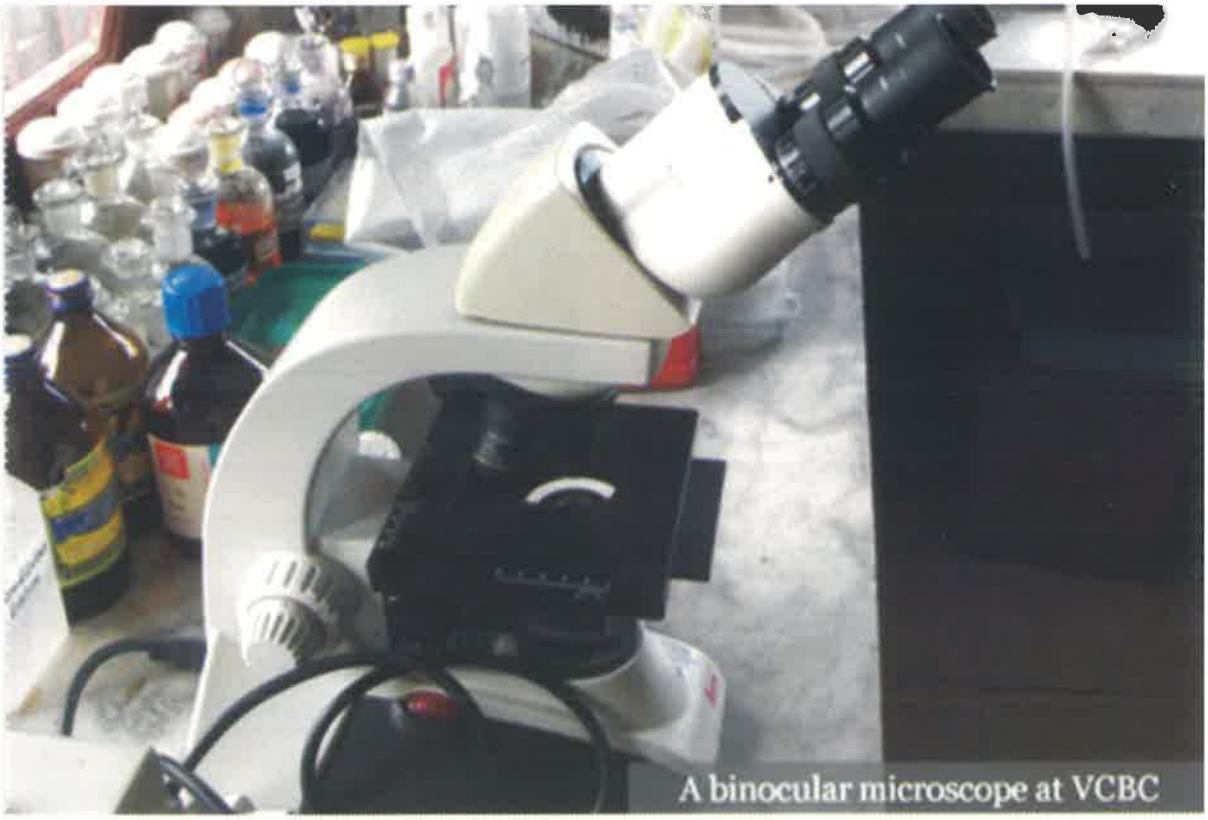
Sources of equipment for microbiology laboratory

Incubator, hot air oven, autoclave, laminar air flow cabinet (if purchased), can all be procured from several Indian companies like Labomed, either in preset specifications or custom made. Approach to these companies can be made through local laboratory supplies dealers.

Microscope can be purchased from Labomed (Indian) or Olympus (imported). A trinocular microscope with a camera attachment would be ideal for photographing and documentation of data. Microscopes can also be purchased through local laboratory supplies dealers after considering factors like availability of service before choosing the make.







A binocular microscope at VCBC

Sample processing

Processing of the collected sample (swab) should be done according to the following procedure:

The labeled tube should be taken immediately to the laboratory and should be ideally processed within two hours.

Metal wire loop for streaking

Flame sterilization of wire loop

The initial processing involves dipping the swab in an enrichment medium, which supports the growth of all the organisms present, and hence whatever is present in the sample grows in the medium. Soyabean casein digest broth can be used as an enrichment medium. The inoculated medium should then be incubated at 40°C for 18–24 hours.

After this, 0.1 mL of the culture should be plated onto a non-selective solid medium in a petri plate, e.g., nutrient agar, blood agar, which supports the growth of all the organisms. Plating should be done with the help of a non-reactive metal wire loop attached to a 6"long metal/plastic handle. The loop should be sterilized by incineration, i.e., by holding the loop over a flame till it becomes red hot. Plating follows a specific streaking pattern onto the solid medium. The streaking should be such that the culture gets diluted with every zone. In between every zone, the loop should be flame sterilized. After plating, the plates are incubated at 40°C for 18–24

hours. The colony characteristics of the bacteria growing on the surface should be noted and gram staining should be performed for each colony. Based on the gram nature and morphology of the organism, it should be sub-cultured on either blood agar (Gram positive) or MacConkey agar (Gram negative).

Growth of bacteria on media

On liquid media, the bacteria grow either as a sticky gelatinous mass, or as dispersed particles throughout the medium. The entire medium appears turbid due to bacterial growth.

On solid media, the bacteria grow in the form of colonies. Each colony contains millions of organisms which are basically clones or generations of the same organism. The characteristics of the colony for some bacterial species often indicate the species to an experienced microbiologist.

Types of bacteria encountered

On the basis of morphology

All the bacteria are classified as following on the basis of their morphology:

Cocci

Appear under the microscope (1000 x magnification) as small dots.

Different arrangements depending on species.

e.g., Staphylococcus aureus

Bacilli

Appear under the microscope (1000 x magnification) as elongated rods.

Mostly single but some species occur in chain arrangement.

e.g., Bacillus subtilis

Coccobacilli

Appear under the microscope (1000x magnification) as small rounded rods.

Mostly occur singly.

e.g., Escherichia coli.

On the basis of their cell wall composition

Gram positive

– Cell wall is made up of a carbohydrate called peptidoglycan.

– Occur as cocci as well as bacilli.

– Appear under the microscope as purple dots or rods, when a smear is subjected to gram staining procedure.

– Susceptible to antibiotics which inhibit the production of peptidoglycan, e.g., penicillin and its derivatives.

Gram negative

– Have a very complex cell wall, of which the major percentage is lipid.

– Occur as coccobacilli, bacilli and a few species as cocci.

– On subjecting the smear to gram staining, appear pink under the microscope as with shape depending on the morphology.

– Require antibiotics which inhibit important cellular metabolic functions, e.g., chloramphenicol inhibits protein synthesis.

Rapid method to treat a vulture having an infection

If a vulture is suspected to have an infection, its blood should be taken and hematology should be checked. If the infected vulture also has secretions from nose, ear or eye, the secretion should be swabbed and gram staining should be performed on a smear prepared by rubbing the swab on a clean slide. Depending on the gram nature of the organism, the most primitive generation antibiotic effective against the group should be used. Broad spectrum or new generation antibiotics should be avoided if the sensitivity is not known, as they can create resistant bacterial strains. If facilities are available, a range of commonly used antibiotics can be used to perform sensitivity testing on a bacterial culture from the swab of the secretion. The antibiotic to be used must be decided by a qualified veterinarian and can be administered by a veterinarian or an experienced biologist.

Procedure of gram staining of a bacterial smear

A bacterial smear should be made by transferring a small amount of culture from a solid medium or a liquid medium onto a clean slide and moving the loop in a circular fashion. If culture from solid medium is used, it should be mixed with a small drop of water on the slide.

The smear should then be allowed to dry. It should then be heat fixed. This may be done by quickly passing the slide over a flame only twice.

To the smear, 2–3 drops of crystal violet should be added and left on for one minute.

The excess stain should be drained off and 2–3 drops of Gram's iodine should be added to it and left for 45 seconds. Gram's iodine forms a complex with crystal violet, which binds tightly to the peptidoglycan layer in the bacterial cell wall. As a gram negative bacterial cell wall has only 5% peptidoglycan, the complex is weaker.

After this, the excess stain should be drained off and the slide should be washed under a thin flow of tap water.

The slide should then be decolorized by adding a decolorizing solution till no purple color comes off. The decolorizer removes the primary stain from all the weak complexes. The slide should again be washed, and 3–4 drops of a solution of safranin should be added as a counter stain and left for one minute.

The counter stain will colour all the cells which have been decolorized by the decolorizer.

The slide should again be washed, and allowed to air dry.

After the slide has dried, a drop of cedar wood oil should be placed on the smear and it should be observed under a 100x oil immersion lens of a microscope.

Commercial gram staining kits manufactured by HiMedia laboratories are easily available and give good results.

Species identification

Using biochemical testing

Certain bacteria perform specific metabolic reactions which help them utilize certain products for their growth. If these products are coupled with chromogenic reagents, they give a colour change when they are acted upon. This gives an indication of the substrate utilizing capacity of the bacteria, on the basis of which they are identified. The substrate utilization patterns of several bacteria have been documented in standard references, and can be used for identification.

Molecular methods

Every bacterial species has its unique sequence of DNA. This unique sequence can be targeted using PCR, which amplifies the target sequences into millions of copies. The amplified sequences are then sequenced, and thereafter compared to databases available online to identify the bacterial species. A very common target gene for this technique is the gene responsible for producing 16s rRNA.

Limitations

The procedure of complete identification of a bacterium upto species level is a long and tedious process, involving intensive laboratory work. An array of instruments, reagents and chemicals are required to grow and identify the bacteria, which becomes very expensive. The work requires skilled personnel and many precautions need to be taken to prevent contamination of pure cultures with other bacteria, which will lead to wrong interpretations.

Microbiology work at VCBC

VCBC, Pinjore has recently developed a basic microbiology laboratory for the culture and identification of bacteria commonly encountered in the cloaca, choana and faeces of vultures. Several reagents for biochemical identification upto species have also been acquired, and have been used for a few gram negative bacteria. The DNA isolation from bacterial cultures and amplification of the 16s rRNA gene will be carried out soon. The work is being carried out by personnel trained in microbiological techniques, with technical guidance from experts at the School of Science, NMIMS University, Mumbai. All the requisite biosecurity measures are in place, and have been approved by the faculty at the School of Science, NMIMS University.

Sending samples to Vulture Conservation Breeding Centre, Pinjore, Coordinating Zoo, for bacteriology

Cloacal, choanal and faecal swabs from healthy vultures can be sent to the Centre for identification of the bacteria present. The swabs should be sterile and should be collected cleanly, taking care to not touch any surrounding areas which would lead to picking up of wrong bacteria. After collection, the swabs should be immediately transferred to a sterile tube. It is highly recommended that the tube should contain a small amount of semi-solid transport media to maintain the viability of all the organisms during transport. The tube should be labeled with details like vulture ring number, species, date of collection and site of collection. It is extremely important to label the samples accurately to avoid wrong interpretation.

Transport media

Helps in maintaining viability of organisms during transport, and hence bacteria can withstand the duration of transport. Most of the bacteria stay stable in the transport media for 3–7 days. Amies transport media with charcoal from HiMedia laboratories (pre-dispensed in sterile plastic tubes with a sterile swab) is recommended. This medium is usually made available within two weeks of the placement of order and costs around Rs. 25 a piece. The media should be stored according to the manufacturer's instructions.

Transportation of sample to Vulture Conservation Breeding Centre, Pinjore, Coordinating Zoo

The labeled tube with the swab can be placed in a thermocol box containing ice packs, sealed and sent to the Coordinating Zoo, Vulture Conservation Breeding Centre, Pinjore, preferably on the same day of collection. The box should also contain a label with details like the sender's name and address, along with contents of the tube label. Number of swabs in the box should also be mentioned. The box should be sent to VCBC Pinjore on the same day through a professional courier service via air. Courier services operating in Pinjore are DTDC and Trackon. Other services in neighboring areas are Gati and Blue Dart.

Representation of transport media in sterile tube with swab

REINTRODUCTION PLAN OF THE THREE RESIDENT *GYPS* SPECIES OF VULTURES

The Centre should prepare a reintroduction plan of the three species of resident Gyps, White-backed, Long-billed and Slender-billed vulture. The release programme should commence around 15 years after the founder stock has been obtained. Nestlings and juveniles should be caught as founder stock (F1) and they will start breeding only when they are 5–6 years old. The offspring will be kept at the Centre and would be included in the founder stock. The offsprings of F1 generation will be kept for two years and then released in the wild. The birds should be released in flocks of not less than 20. Most of the released birds should be captive bred at the Centre but a few (25%) could also be wild caught adult birds. The wild caught adult birds know the tricks of survival in the wild and hopefully will act as guide birds to the captive bred birds.

The areas where the birds will be released should be monitored from atleast a year before release and it should be made sure that no diclofenac is used in a radius of 100 km of the released sites. The release site should be close to the Centre or to a place where vultures are present in good numbers. This should be achieved by high level advocacy in these areas. The birds will not be released if it is found that diclofenac is still being used in the areas. All released birds should be satellite tagged and should be monitored till atleast the time they start breeding in the wild.

The soft release method should be followed. A big temporary aviary should be constructed at the release site and the vultures should be kept there for six months. The netting of the roof should be removed after six months and the birds would have the option of flying out. Food should continue to be provided in the aviary for the next two months. The food should then be provisioned partly outside and partly within the aviary for another two months. Hopefully, the birds will start feeding outside the aviary also. Gradually the food will be provided only outside the aviary, and then away from the aviary. The food provisioning will be done for another year. Once the vultures start locating natural carcasses themselves, the food provisioning will be stopped. Any mortality will be thoroughly investigated.

Awareness programmes will continue in the regions for many years and finally locals will be asked to watch the vultures and make sure they do not disappear again. The project will be considered successful once the released birds start breeding in the wild.

An adult White-backed vulture in flight

ADMINISTRATION

Office and staff

Office

The administrative section of the Centre should be located close to the Centre. Usually two rooms of 15 x 15 x 12' are enough for the administrative section.

The Vulture Conservation Breeding Centre should be a collaborative project of the State Forest Department and executing agency.

Staff at the Centre

The following minimum staff is required to run a Vulture Conservation Breeding Centre for about 100 birds. The Chief Wildlife Warden of the State should be the Project Leader and the Zoo Director should be the Project Manager. They should be responsible for getting the necessary permission and funding for running the Centre. The Centre Manager could either be a biologist or a veterinarian and should be responsible for the day to day running of the Centre. An experienced veterinarian should be employed full time. An administrative assistant is a must for the smooth running of the Centre. There should be atleast five trained vulture keepers, two watchmen and a driver to complete the team.

Governing Council for the Centre

The Centre should have a governing council consisting of highly technical people for providing guidance. The council should be chaired by the Secretary, Environment and Forests of the State. Its Member Secretary should be the Chief Wildlife Warden of the State. It should have representatives from the Ministry of Environment and Forests, Government of India, Central Zoo Authority, Wildlife Institute of India, Director or his representative of the local veterinary college, Director of Bombay Natural History Society, the Project Manager and Centre Manager.

It should ideally meet once a year and review theprogress of the Vulture Conservation Breeding Programme.

Capacity building of staff

The staff should be periodically sent for training in specialized institutions. The main thrust areas where the staff will require training are husbandry and veterinary care. The staff will also periodically require training in molecular biology, pathology, artificial incubation and rearing of vulture nestlings.

The Centre should work in close collaboration with expert international and national organizations. The Vulture Conservation Breeding Centre, Pinjore could be contacted for any problems related to the breeding programme. The staff should be sent there regularly for training or experts should be called for training. The Veterinarian should be sent to Indian Veterinary Research Institute for training. The Zoological Society of London, UK and International Centre for Birds of Prey, UK could provide training to staff on veterinary care and animal husbandry. Experts from these institutions could periodically visit the Centre and impart training to the staff. The staff could also visit various captive breeding facilities of birds of prey for training.

Training of Centre Manager

The Centre Manager of each Centre should undergo a rigorous training in running the Centre atleast for three months at the Vulture Conservation Breeding Centre, Pinjore, Haryana. This training will have a cascading effect as the Centre Manager will be able to pass on the training to his staff. The Centre Manager should be given hands-on training in all aspects of running the Centre including selection of site, aviary design, husbandry and care, trapping and transporting vultures, veterinary care and feeding the vultures.

Training of Veterinarian

The veterinarian should also be trained at Vulture Conservation Breeding Centre for at least three months. The veterinarian should work under the senior veterinarian of the breeding facility and should learn all aspects of veterinary care including clinical examination, surgical intervention, reading of x-rays and postmortems.

Training of Biologist

The biologist should be sent for training in Animal Record Keeping System (ARKS) software, a product of International Species Information System (ISIS), which is periodically organized by Central Zoo Authority. He should learn about the navigation through ARKS, maintenance routines, addition of specimens to a collection, setting up of enclosures, entering animal transactions, addition of animal identifiers, etc.

The biologist should spend at least a month at the VCBC, Pinjore for training in behavioural observations.

Workshop on Training on SPARKS Software of ISIS, December 2010

Disaster Management Plan and Preparation of Contingencies

Disaster management

The vultures are critically endangered and are on the verge of extinction. A good number of them will be housed in Conservation Breeding Centres. The staff of these Centres should be prepared to face any emergencies which could strike any time and could harm these extremely valuable brids. This chapter discusses the potential calamities that could strike and the preventive measures to minimize the damage.

The Centre could be located within the seismic zone and it could be near a river. So there could be problems with earthquake and flooding. The Centre could be close to forest area which could harbour a good number of rock bee hives which could make the Centre prone to rock bee attack.

The main worry during a disaster is the safety of birds. All the staff should be trained in catching and handling vultures. The Centre should always have 50 vulture transport boxes ready to immediately shift the vultures in case of an emergency.

Line of command during a calamity

In times of a calamity, there should be a strict line of command. The crisis should immediately be informed to the Supervisor, who ideally should reside close to the Centre. It should also be informed to the Centre Manager over the telephone. The Supervisor should immediately reach the Centre to assess the damage or problem and inform the Centre Manager. The Centre Manager should inform the Project Manager who in turn should inform the Project Leader and rush to the Centre.

All vulture keepers should immediately be called to the Centre. The Supervisor should start the rescue work according to the protocol. One of the vulture keepers should live on the premises of the Centre. The mock drill should be done every three months when all the staff should participate in full preparedness.

Earthquake

The aviaries should be made earthquake proof by putting iron rods in the foundation. However, in the event of damage to the aviaries by earthquake, every aviary should be equipped with instruments to cut open the wire and break the brick wall to remove the vultures like a set of wire cutters, spade, hacksaws, hammers, pliers of different sizes and screw drivers. Ten sets of hand held nets should be kept ready to catch the vultures. The first aid box should also be kept handy close to the aviaries. The electricity connection should immediately be disconnected.

There should be over fifty vulture boxes to transfer vultures. The wooden boxes should be big enough to keep vultures for a day or two if required. In case of earthquake damage, the vultures should be kept in the boxes till temporary aviaries are erected. The material for temporary aviaries like netlon should be cut to the size of the aviary, pipes with hooks and other material required should be kept ready. The aviaries should be erected within four to five hours. There should be a portable diesel generator which should be in ready to use condition. Rechargeable torches and battery operated torches should be kept ready with the watchmen.

Floods

Concrete spurs should be erected along the river to divert flood waters away from the Centre.

If the water does enter the Centre, the birds are unlikely to be affected. The aviaries may get flooded, so there should be an efficient drainage system to drain out the water. Efforts should be made to make sure that the water does not stagnate in the Centre. When the water recedes a lot of debris will need to be cleaned and repairs would need to be made to the fence and sometimes to the walls.

The birds should be kept under observation, but no attempt should be made to catch them as they remain perched at a height.

Spurs on the river bed prevent inflow of water to the Centre during floods

Rock Bee Attack

Rock bees could potentially be very dangerous to vultures, especially if the hive is nearby and it gets disturbed. There have been instances when a swarm of wild rock bees have attacked captive vultures after they were disturbed by a Crested Honey Buzzard and a number of vultures died due to bee stings. So it would be advisable to remove bee hives from the surroundings.

Contingency plan to address emergencies

Dealing with bird escape

If a bird escapes from the Centre, the only way to get it back is to catch it. The bird should be located and then should be lured on a carcass. It should then be caught by the Centre's trapper. Snake trap method is the best method. A fresh cattle or goat carcass is used as bait and the trapper sits in a grass hide some 30–45' from the carcass, waiting for vultures to feed. He uses a long bamboo pole which is about 60' long and collapsible. The terminal end of the bamboo, about 3' long, is very supple, thin and bifid. It is coated with very sticky glue, which is a mixture of the latex of Peepal tree Ficus religiosa and mustard oil. When the vultures start feeding on the carcass, the bamboo pole is gradually slithered on the ground towards the foraging vultures by the trapper, sitting in the grass hide. When the bamboo is c. 5'away,

the trapper swiftly thrusts it on the body of the feeding vulture. The vulture is then unable to fly. The trapper then rushes and grabs the bird. The glue does not damage the plumage and comes off easily with any vegetable oil.

The trapper should be employed by the project and should always be available.

If the bird is in captivity for a long time, it is very likely that it will hang around in the vicinity of the Centre and would be easily caught. The bird which has recently been caught will fly away immediately and will be difficult to catch. Wild vultures regularly hang around the aviaries where vultures are kept. The food available and the company of other vulture could be attracting them to the vulture aviaries. So it is possible that the escaped vulture could also come back and could be easily identified with its ring number and wing tag.

The Chief Wildlife Warden and Central Zoo Authority should be immediately intimated about the escape of the bird.

Food when there is a strike

The vultures should be fed on freshly slaughtered goats. The goats should be kept with the Centre for ten days before they are slaughtered. So the Centre should always have food supplies for more than a week and sometimes for more than two weeks. This way, it is unlikely that the Centre will ever face a food shortage due to strike.

In the eventuality of food shortage due to strike, goats could also be purchased locally from the villages around. Goat herders should be identified locally and their location should be always known to the Centre Manager.

Infighting among birds

Vultures are social birds and live in big flocks. They do not defend territories and do not have any serious fights. However, the vultures should constantly be under CCTV camera observation and if a serious fight does break out, the keepers should immediately go in and separate the birds. The problem bird should be isolated from the flock.

Snake bites

There could be a number of snakes within the compound of the Centre. The Bronze Keelback, Wolf snakes, Cat snake, Rat snake and Python are all likely to be there at most of the places. There would also be a possibility of poisonous snakes like Krait, Cobra and Russel's Viper. At least 10 vials of the anti-venom serum prepared by Haffkine Institute, Mumbai, should be kept in stock. The vials should be kept at a cool and prominent place in the custody of the Veterinarian. The instructions of use should also be pasted on the board. The doctors in the nearby hospitals should also be informed about the anti-snake venom stored at the Centre.

The staff should be trained in simple steps to avoid contact with snakes.

Epidemics

Vultures are susceptible to many avian diseases like Ranikhet disease, Avian Influenza, etc. All the bio-security measures should be taken to prevent the spread of disease. Blue Rock Pigeon should be kept away from the aviaries by plugging all the holes in the aviaries. Foot baths should be kept at the entrance of the aviaries to prevent the spread of any pathogens. The birds should be visually checked by the Veterinarians three times a day. Any bird showing abnormal behaviour should be immediately isolated and its blood and faecal samples should be taken for analysis. Treatment should be started immediately. The Veterinarian should take advice from IVRI which is a referral Centre of Central Zoo Authority in case of any problem. All the birds should be caught once a year and should be given a thorough health check. Haematology on the blood of 10% birds in an aviary should be carried out to get an idea of the health status of the flock.

In case of epidemic, the affected birds should be isolated and should be sent to the quarantine facility which should be 5 km from the Centre. The resident veterinarian should supervise the operations.

Power breakdown

The Centre should have a three phase power connection. It should also have an 8 KV generator and two inverters for back-up power. Power breakdowns could be frequent, but the back up should be enough to tide over the situation. Constant power supply is vital for incubation, running of CCTV camera and freezers.

Monkey and dog menace

The eight feet high perimeter fence should keep dogs away. It should be made sure that the dogs do not get any food near the Centre

There should not be any fruiting trees at the Centre and the staff should be strictly advised not to throw food around.

All the aviaries should be made monkeyproof by putting a welded iron mesh on the top and a layer of tough plastic netting, a foot below it. The double door protection should also make it impossible for the monkeys to enter the aviaries.

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Appendix 1

Vulture Clinical Examination Report

Vulture Conservation Breeding Programme
Bombay Natural History Society

Vulture ring number :
Date :
File number : VCC
Species :
Age :
Exam number :
Exam Reference number :
Person performing Exam :

Examination
Heart rate :
Respiratory rate :

Body condition (please circle any one)
Pectoral muscles : emaciated / thin / normal / fat
Femoral muscles : emaciated / thin / normal / fat
Plumage damage : minimal / moderate / severe

Morphometric measurements (only on admission) in mm :
Beak :
Wingspan :
Beak-tail :
Carpus-wing tip :
Metatarsus :
Body weight (Kg) :
Checked (please tick and note any abnormalities) :
Eyes :
Abdomen :
Beak :
Uropygial (Preen) gland :
Nares :
Cloaca :
Neck :
Wings :
Crop :
Legs :
Feet :
Bumble foot severity: none / Type I / II / III
Affected foot and region:

Attempts at regurgitation: none / attempted / regurgitated fluid / regurgitated food. Escape attempts and struggling : none / weak / moderate / strong

Any injuries seen :
Ectoparasites :
Other abnormalities :

Samples
Faeces sample : Floor / freshly passed / cloaca / cloacal swabs / none
Faeces stored frozen : Yes / No

Blood sampling site : L-ulnar vein / R-ulnar vein / Jugular vein / Metatarsal vein / other
Samples taken : 2 blood smears / EDTA / Heparin / Serum / Na-citrate / other
Frozen serum banked : Yes / No
Other samples :

Notes :
Please use the reverse side of the sheet if additional space is needed

Appendix 2

Vulture Clinical Pathology Report

Vulture Conservation Breeding Programme
Bombay Natural History Society

Vulture ring number :
File number :
Exam number :
Person performing exam :

Date :
Species :
Exam ref. number:

Haematology

Blood sampling site : L-ulnar / R-ulnar / Jugular / Medial metatarsal / other
Anticoagulant used : EDTA / Heparin / none
Delay : < 1 hr / < 3 hrs / < 6 hrs / < 24 hrs / > 24 hrs
Sample refrigerated : Yes / No
RBC (x 1012 /L) :
PCV (%) :
Hb (g/dL) :

MCV (fL) :
MCH (pg) :
MCHC (g/dL) :

WBC (x 109 /L)
Heterophils (%) :
Lymphocytes (% :
Monocytes (%) :
Eosinophils (%) :
Basophils (%) :
Thrombocytes (x 109 /L) :

(x 109 /L) :
(x 109 /L) :
(x 109 /L) :
(x 109 /L) :
(x 109 /L):

Smear stain : Diff-quick / Giemsa / Wright's / Field's / other
Smear quality : Good / Reasonable / Poor
Abnormalities or inclusions :

Biochemistry

Delay : < 1 hr / < 3 hrs / < 6 hrs / < 24 hrs / > 24 hrs
Sample : Fresh / Frozen
Frozen serum banked : Yes / No
Uric acid (umol/L) :
Albumin (g/L) :
Globulin (g/L) :
Total Protein (g/L) :
Fibrinogen (g/L) :

Date performed (if stored) :
Frozen cell plug banked: Yes / No
AST (iu/L) :
CK (iu/L) :
Ca (mmol/L) :
K (mmol/L) :

Faecal examination

Please sketch any parasite ova, oocysts, or protozoa seen
Faeces sample : Old in cage / fresh in cage / freshly passed / cloaca / cloacal swab
Faecal wet mount :
Stained smear :
Faecal flotation :
Faeces stored frozen : Yes / No

Microbiology

Samples : Faeces/other :
Check culture after : 24 hrs / 2 days / 5 days
Gram stain :
Isolates (strong / moderate / weak growth) of :

Media:

API result:

Please use the reverse of the sheet for any additional notes.

Appendix 3

Vulture Postmortem Form

Vulture Conservation Breeding Programme
Bombay Natural History Society

ID No :		PM ref No:	
Species :		Location:	
Age :	Date of death:		
Sex:	Date of PM:		
Weigh t:	Pathologist:		
Gout :	Present/Absent		
Morphometric measurements (mm) :			
Beak :		Wingspan:	
Metatarsus:		Carpus - wing tip:	
Body length (beak tip to vent):		Body length (head to tail):	

History

Gross Post Mortem Examination

Carcass : Fresh / Refrigerated / FrozenCondition of the carcass:

External Examination

Body condition : Very poor / poor / fair / good / very good

Body orifices :

- eyes	NAD A NE
- nares	NAD A NE
- mouth	NAD A NE
- cloaca	NAD A NE

Beak/Cere	NAD A NE		
Feathers (Condition, ectoparasites etc):	NAD A NE		
Skin:		NAD A NE	
Preen gland:		NAD A NE	
Feet:		NAD A NE	
Alimentary tract		**Respiratory system**	
Mouth	NAD A NE	Choana	NAD A NE
Oesophagus	NAD A NE	Trachea & bronchi	NAD A NE
Crop	NAD A NE	Lungs	NAD A NE
Proventriculus	NAD A NE	Air sacs	NAD A NE
Gizzard	NAD A NE		
Duodenum	NAD A NE	**Cardiovascular system**	
Small intestine	NAD A NE	Pericardium	NAD A NE
Caeca	NAD A NE	Myocardium	NAD A NE
Large intestine	NAD A NE	Endocardium	NAD A NE
Cloaca	NAD A NE	Blood vessels	NAD A NE
Ingesta:	Yes/No		

Fat :	**Abdominal fat : Present/Absent**		**Perirenal fat : Present/Absent**	
Endocrine & Lymphoreticular				Urogenital tract
Thyroid glands		NAD A NE	Ovary/testes	NAD A NE
Adrenal glands		NAD A NE	Oviduct	NAD A NE
Liver		NAD A NE	Kidneys	NAD A NE
Spleen		NAD A NE	Ureters	NAD A NE
Bursa of Fabricius:	Present /Absent	NAD A NE		

Nervous System	**Musculoskeletal system**		
Brain	NAD A NE	Muscles	NAD A NE
Cerebellum	NAD A NE	Skeleton	NAD A NE
Spinal cord	NAD A NE	Joints	NAD A NE
Sciatic Nerve	NAD A NE		

NAD - No Abnormalities Detected

A - Abnormal (please describe in detail in attached form)

NE – Not Examined

External	**P**	**B**	**H**	**O**
Samples taken :				
Histology :				
Virology :				
Toxicology :				
Parasitology :				
Microbiology :				

Alimentary tract	**P**	**B**	**H**	**O**
Samples taken :				
Histology :				
Virology :				
Toxicology :				
Parasitology :				
Microbiology :				

Respiratory system	**P**	**B**	**H**	**O**
Samples taken :				
Histology :				
Virology :				
Toxicology :				
Parasitology :				
Microbiology :				

Cardiovascular system	**P**	**B**	**H**	**O**
Samples taken :				
Histology:				
Virology :				
Toxicology :				
Parasitology :				
Microbiology :				

Urogenital tract	**P**	**B**	**H**	**O**
Samples taken :				
Histology :				
Virology :				
Toxicology :				
Parasitology :				
Microbiology :				

Endocrine & Lymphoreticular	**P**	**B**	**H**	**O**
Samples taken :				
Histology :				
Virology :				
Toxicology :				
Parasitology :				
Microbiology:				

Nervous system	**P**	**B**	**H**	**O**
Samples taken :				
Histology :				
Virology :				

Toxicology :

Parasitology :

Microbiology :

Abdominal cavity : **P** **B** **H** **O**

Samples taken: Histology: Virology: Toxicology: Parasitology: Microbiology:

Musculoskeletal system: **P** **B** **H** **O**

Samples taken :

Histology :

Virology :

Toxicology :

Parasitology :

Microbiology :

P – Parasitology

B – Bacteriology

H – Histology

O – Other

Haematology : No blood sample possible.

Blood taken :	Ante-mortem / postmortem	
Blood sampling site :		
Anticoagulant used :		
Delay :	Sample refrigerated: Yes/No	
RBC (x 10^{12} / L) :	WBC (x 10^{9} / L):	
PCV (%) :	Heterophils (%):	(x 10^{9} / L):
Hb (g/dl) :	Lymphocytes (%):	(x 10^{9} / L):
MCV (Fl) :	Monocytes (%):	(x 10^{9} / L):
MCH (pg) :	Eosinophils (%):	(x 10^{9} / L):
MCHC (G/DL) :	Basophils (%):	(x 10^{9} / L):
	Thrombocytes	(x 10^{9} / L):

Smear stain :

Smear quality :

Abnormalities or inclusions

Samples taken for investigation into Vulture Mortality :

PM ref No.:

Please circle samples taken.

No.	Histology	Virology	Toxicology		
1	Lung	+	+		
2	Trachea	+	+		
3	Heart	+	+		
4	Blood vessels	+	+		
5	Thyroid		+	+	
6	Liver	+	+	+	
7	Gall bladder	+	+		
8	Pancreas	+	+		
9	Spleen	+	+		
10	Kidney	+	+	+	
11	Urethra	+	+		
12	Adrenal gland	+	+		
13	Ovary/Testes	+	+		
14	Oviduct		+	+	
15	Vagina	+	+		
16	Oesophagus	+	+		
17	Crop	+	+	+	
18	Proventriculus	+	+	+	
19	Gizzard		+	+	+
20	Duodenum	+	+		
21	Small intestine	+	+	+	
22	Caeca	+	+		
23	Large intestine	+	+		
24	Bursa of Fabricius	+	+		
25	Brain	+	+		
26	Sciatic nerve	+	+		
27	Spinal cord	+	+		
28	Feathers	+	+	+ (whole carcass)	
29	Skin	+	+	+ (whole carcass)	
30	Muscle	+	+	+ (whole carcass)	
31	Femur	+	+	+ (whole carcass)	
32	Fat	+	+	+ (whole carcass)	
33	Stomach contents	+	+	+	

Tentative Diagnosis

Vulture Moult Recording Data sheet

Vulture Conservation Breeding Programme
Bombay Natural History Society

Species | Ring Number | Wing-tag Number

Sex | Recorders | Locality

Appendix 4

Sr. No.	Date	Age	Primaries (Right)												Primaries (Left)												Tail (Right)								Tail (Left)								Remarks
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	

Appendix 5

Perch Utilization Data Sheet

Vulture Conservation Breeding Programme
Bombay Natural History Society

Date of Observation: _____

Name of Observer: _____

Time of Observation: _____

Aviary number: _____

Sl. No.	Perch No.	Species	Number of vultures	Activity/Remarks

A Report of the Workshop on Vulture Conservation Breeding Programme

20th to 22nd April 2011

Venue
Vulture Conservation Breeding Centre, Pinjore

Organised by
Haryana Forest Department
and
Bombay Natural History Society

Sponsored By
Central Zoo Authority

Inauguration

The Workshop on Vulture Conservation Breeding Centre was held from 20th to 22nd April 2011 at Hotel Budgerigar, Yadavindra Gardens, Pinjore, Haryana. It was inaugurated by the Honorable Mr. Prahlad C. Gillakheda, Chief Parliamentary Secretary, Government of Haryana on 20th April 2011. The Honorable Minister of Forests, Haryana, Captain Ajay Singh Yadav was to inaugurate the workshop but due to his busy schedule was unable to do so. The inauguration function was attended by Dr. R. D. Jakati, IFS, Director, Indira Gandhi National Forest Academy, Dehradun, Dr. Parvez Ahmed, IFS, Principal Chief Conservator of Forests , Haryana, Mr. R. K. Sapra, IFS, Chief Wildlife Warden, Haryana, Mr. P. N. Pardhi, IFS, Principal Chief Conservator of Forests (Wildlife), Odisha, Mr. J. B. Jauher, IFS, Principal Chief Conservator of Forests (Wildlife), Jharkhand, Directors of five state zoos, Mr. J. S. Chauhan, IFS, Director, Van Vihar National Park, Bhopal, mp, Mr. S. Panda, IFS, Director, Nandankanan *Zoological* Park, Bhubaneshwar, Odisha, Mr. Malikarjuna Rao, IFS, Director, Nehru Zoological Park, Hyderabad, Andhra Pradesh, Mr. V. J. Rana, Director, Sakkarbaug Zoo, Junagadh, Gujarat, and Mr. A. T. Mishra, IFS, DFO, Ranchi Division, Jharkhand, being funded by the Central Zoo Authority to run the Vulture Conservation Breeding Centres, Forest Officials of Haryana state, Mr. Naim Akthar, Scientific Officer, Central Zoo Authority, members of the press and media and officials of Bombay Natural History Society. In all, there were around 60 people during the inauguration.

Mr. Gillakheda arrived at the scheduled time of 10:30 a.m. Dr. Parvez Ahmed and Mr. R. K. Sapra along with senior forest officials of Haryana welcomed Mr. Gillakheda with bouquets of flowers.

Mr. Jagdish Chandra, IFS, Conservator of Forests (Wildlife) invited Mr. R. K. Sapra to welcome the guests. Mr. Sapra welcomed and thanked Mr. Gillakheda for kindly inaugurating the workshop. He thanked Mr. P. N. Pardhi and Mr. J. B. Jauher for attending the workshop. He welcomed all the participants of the five zoos. Dr. Vibhu Prakash, Deputy Director, Bombay Natural History Society, then read the speech of Mr. B. S. Bonal, Member Secretary, Central Zoo Authority, on his behalf as he was unable to attend the workshop due to personal problems. Mr. Bonal, at the onset, apologized for his inability to attend the workshop and thanked all the participants for attending the same. He emphasized the importance of the workshop being conducted to review

Mr. Prahlad C. Gillakheda, Chief Parliamentary Secretary, Government of Haryana

the progress made by the five states being funded by the Central Zoo Authority. He said that the review workshop is going to be an annual affair and an annual report will be the outcome of this workshop which will highlight the progress made by the states.

Dr. Parvez Ahmed then welcomed the guests and thanked the Chief Guest for inaugurating the workshop. He informed the audience that it was Dr. Jakati, the then Chief Wildlife Warden, Haryana, who was instrumental in initiating Vulture Conservation Breeding Programme in Haryana, the first of its kind in the country. He spoke of the rapid progress made by the Vulture Conservation Breeding Centre, Pinjore, which is being jointly run by the BNHS and Haryana Forest Department. He appreciated and thanked the Royal Society for the Protection of Birds, UK for funding the Vulture Program and the Zoological Society of London, UK for their technical inputs. He thanked the Central Zoo Authority for sponsoring and funding the workshop. Dr. R. D. Jakati then addressed the august gathering. Dr. Jakati welcomed the Chief Guest and the participants of the workshop. He said that he was very happy to see the progress of the Centre which had a small beginning but today it has become the pioneer in vulture conservation. Finally, the Chief Guest, Mr. Gillakheda gave his inaugural address and formally inaugurated the workshop. Mr. Gillakheda reminiscised his childhood days in his village, when vultures were seen circling down on the dead animals and polishing off the carcasses in no time thus keeping the environment clean. He also informed the audience of the progress made at the Centre by initiating artificial incubation and double clutching to increase the production rate of the three critically endangered resident *Gyps* species of vultures. He said that Haryana is proud to take the initiative of establishing the first Vulture Conservation Breeding Centre in the country which has put Haryana on the world conservation map. He spoke about the Centre's efforts in finding a substitute for the drug diclofenac which has killed millions of vultures in the subcontinent. He said that meloxicam was declared a safe drug for vultures after the safety testing was done at the Centre in collaboration with the Indian Veterinary Research Institute. Dr. Vibhu Prakash in his address on the vote of thanks expressed his gratitude to the Chief Guest, the Haryana Government, the Haryana Forest Department, the representative of Central Zoo Authority and all the participants of the workshop and his own team of staff

members of the Bombay Natural History Society.

The Chief Guest was invited to the High Tea organized at the restaurant of the hotel. The Chief Guest also visited the Vulture Centre where he was given a guided tour by Mr. Sapra and Dr. Prakash. He was shown the aviaries from inside through the CCTV camera monitors and also the behaviour of vultures. He was shown the work being carried out at the Centre. Mr. Gillakheda was very happy with the visit and wished the program a big success. He also promised a donation of Rs. one lakh to the Centre.

The first formal presentation of the inauguration session was given by Dr. R. D. Jakati. He gave an enlightening presentation on 'Need for synergy between Government Organizations and Non-Government Organizations in Conservation Breeding Program'. He emphasized the need for both organizations to work hand in hand to achieve success as both the set ups have their strengths and weaknesses. He recounted the setting up of the Vulture Centre at Pinjore and the swift action by the Haryana Government in releasing land and according permissions to set up the Centre.

A very informative talk followed thereafter by Mr. Jagdish Chandra who spoke on 'Vulture: Past, Present and Future'. He traced the role of vultures in Hindu mythology, and spoke about their economic importance in our environment. He described the nine species of vultures found in our country and gave their geographic distribution. He also discussed the decline in vulture population and the impact of other mortality factors on the population apart from diclofenac. He mentioned that there are other NSAIDs which may also be harmful to birds. The efforts of Haryana Government in setting up of the first Vulture Conservation Breeding Centre were also highlighted in this presentation. His presentation was very well received.

Mr. A. T. Mishra, IFS, DFO (Wildlife) Jharkhand gave a presentation on the conservation of vultures in Jharkhand. He presented information on the ex-situ facility developed at Muta near Ranchi. Mr. Mishra talked about the exchange of vulture safe drug meloxicam with the killer drug diclofenac at Hazaribaugh as a measure taken by the Forest Department in saving the vultures.

Technical Session : I
Day 1 : 20/04/2011
14:30 to 17:30 hrs

Chairman : Dr. S. Panda, IFS, Director, Nandankanan Zoological Park, Bhubaneshwar, Odisha

First Speaker : Dr. Naim Akthar, Scientific Officer of Central Zoo Authority

He spoke on the Conservation Breeding Program in Indian Zoos initiated by the Central Zoo Authority. He said that the Central Zoo Authority has identified 73 endangered species for Conservation Breeding Program. He said that Conservation Breeding Program for 17 species has already been initiated. The Central Zoo Authority funds the capital cost of the program but the recurring cost has to be borne by the State Governments. He said that Central Zoo Authority has given funds to the tune of 41 Lakhs to five different zoos in the country to set up Vulture Conservation Breeding Centres. He said that the Pinjore Centre is the Co-ordinating Zoo for the Vulture Program and the five zoos are the participating zoos.

Second Speaker : **Ms. Nikita Prakash**, Technical Assistant, Vulture Conservation Breeding Centre, Pinjore, BNHS

Nikita gave a presentation on the 'Vulture Conservation Breeding Program in India'. She traced the history of vulture decline in the country and said that there were an estimated 40 million vultures in the country during the early eighties. The crash in the population of the three *Gyps* species of vultures was first documented at Keoladeo National Park, Bharatpur, Rajasthan in the early nineties by the BNHS. She also discussed the steps taken by the BNHS, the Ministry of Environment and Forests and the Central Zoo Authority for vulture conservation.

Third Speaker : Dr. Vibhu Prakash, Deputy Director, BNHS

He gave an illustrated and exhaustive presentation on 'Identification of the five *Gyps* species of vultures'. The *Gyps* species of vultures are true raptors and have variable plumages which make identification difficult. Dr. Prakash gave a detailed presentation on the field characteristics of the *Gyps* vultures, tips to identify them, comparison between species, and comparison at different age classes viz. nestlings, juveniles, sub-adults and adults.

The presentation was appreciated by all and thereafter, several doubts and misconceptions among the audience on identification in field were cleared by him.

Fourth Speaker: **Mr. Mandar D. Kulkarni,** Centre Manager, Vulture Conservation Breeding Centre, Pinjore, BNHS

He spoke on the 'Molecular Sexing of vultures'. Mandar explained the need to identify the sex of vultures as they are not sexually dimorphic. They are monogamous birds and it is imperative to have a fairly equal sex ratio to increase the chances of pair formation, nesting and breeding success. He explained in detail the molecular sexing method of vultures including sample collection. Terms like DNA, chromosomes, primers and the entire sexing method was explained in a very simple and easy to understand language. The molecular sexing technique has been developed in collaboration with Indian Veterinary Research Institute, Izzatnagar.

Technical Session II
Day 2: 21/04/2011
09:30 to 12:30 hrs

Chairman: Mr. P. N. Pardhi, IFS, Principal Chief Conservator of Forests (Wildlife), Odisha

First speaker: Mr. Rohan Shringarpure, Research Biologist, VCBC, Pinjore, Bombay Natural History Society

He spoke on the 'Husbandry and Care of vultures practiced at VCBC, Pinjore'. He explained the different protocols followed during cleaning of aviaries, whether it was annual, monthly or weekly, the health check of birds, all aspects noted in daily observations of birds and so on. He emphasized the importance on following these protocols for a successful captive breeding program. The presentation gave a direction of work to the participants for their Centre.

Second speaker: Mr. Mandar D. Kulkarni, Centre Manager, VCBC, Pinjore, Bombay Natural History Society

He spoke on the topic 'Veterinary care as done by a biologist'. The presentation was mainly given to emphasize the role and responsibility of a biologist in helping the veterinarian at the facility. It was made clear that there are a number of things a biologist can monitor which will help the veterinarian in treating the birds. All aspects of vulture health care were explained in detail. It was emphasized that any activity which required any intervention should be carried out by a veterinarian or in the presence of a veterinarian.

The session ended with a half an hour break for tea.

Third speaker: Ms. Nikita Prakash, Incubation In-charge, VCBC, Pinjore, Bombay Natural History Society

She gave a presentation on 'Artificial incubation, double clutching and rearing of vulture nestlings'. She explained the need for double clutching to increase the rate of production in rare and critically endangered *Gyps* vultures. She explained to the participants the artificial incubation of vulture eggs in forced air heating octagon table top incubators, the incubation parameters of candling, weighing, temperature, humidity, turning the eggs in the incubators, the hatching process and feeding and rearing of the nestlings. The participants found the presentation very interesting as all the Centres are aiming for a successful breeding program at their Vulture Conservation Breeding Centres and can embark upon artificial incubation and double clutching to increase the production rate in vultures.

The interesting talk was followed by lunch.

Technical Session: III
Day 2: 21/04/2011
14:00 to 17:30 hrs

Hands on Experience at Vulture Conservation Breeding Centre, Pinjore

The participants were taken to the Vulture Conservation Breeding Centre for hands on training on all aspects of Vulture Conservation Breeding Program. At the Centre, the participants were demonstrated the technique of capturing and holding a vulture on a Himalayan Griffon, *Gyps himalayensis*. The two birds are held in captivity at the Centre but are not part of the breeding program. They were shown the different aviaries from outside. They were taken to the incubation and brooder facility. The functioning of the octagon incubators, hatchers, candlers, monitoring of temperature in incubator, turning of eggs, monitoring humidity in an incubator and weighing of eggs were all explained and demonstrated. The required data sheet was provided with. They were shown the nursery aviaries in detail and nestlings that hatched during the current breeding season. They were taken inside the laboratory building housing the CCTV camera monitors, the microbiology lab, the hematology lab and the molecular lab. Participants were shown vultures through the CCTV camera monitors and the observations to be taken were explained with the help of a data sheet used at the Centre. The functioning of all the three laboratories was explained. The participants found the hands on training very interesting and felt confident about putting their knowledge into practice at their respective Centres.

The second day ended here and the participants were transported back to their hotel.

Technical Session IV
Day 3 : 22/04/2011
09:30 to 12:30 hrs

Presentations from various Zoos Directors

As a number of participants were leaving after lunch, it was decided to pre-pone the session on presentations from various zoos and conclude the workshop before lunch. Some presentations by the Coordinating Zoo which could not be given were presented after lunch to the remaining participants.

Chairman: Mr. R. K. Sapra, IFS, Chief Wildlife Warden, Haryana.

First speaker : Mr. V. J. Rana, Director, Sakkarbaug Zoo, Junagadh, Gujarat.

The Sakkarbaugh Zoo is well known for the captive breeding program of Asiatic Lions, Indian wolf, Indian wild ass, Asiatic cheetah, Four horned antelope, Chinkara and the *Gyps* vultures.

Two *Gyps* species of vultures are housed at the Vulture Conservation Breeding Centre of the Zoo of which 47 are White-backed vultures and 3 Long-billed vultures. An Egyptian vulture is also held in captivity in the facility. The two *Gyps* species of vultures have been acquired mainly from Ahmedabad (35 nos.). All the birds from Ahmedabad have injuries inflicted by Kite strings during Uttran festival; some have serious injuries and cannot fly now. Rest have been brought from Mahuwa and Surat after they were rescued as sick or injured. The Centre has one breeding aviary/colony aviary of dimensions 30m length x 15m width x 7.5m height. Vultures were released in the aviary in April 2009 and two pairs bred during 2009-2010. Both the eggs were infertile. Six pairs laid in 2010-2011 of which two hatched successfully. They hatched on 1/2/2011 and 21/2/2011 respectively. However, both survived only for 72 days and 36 days respectively.

Second Speaker: Mr. J. S. Chauhan, IFS, Director, Van Vihar National Park, Bhopal, Madhya Pradesh.

It was an impressive presentation with objectives clearly defined. The Centre had submitted a project proposal for setting up a Vulture Conservation Breeding Centre to the Central Zoo Authority in January 2007 following the workshop organized in November 2006 at Pinjore by the Wildlife Institute of India and supported by Central Zoo Authority. The main objective of the proposal was setting up a Conservation Breeding Program for two resident *Gyps* species of vultures viz. the White-backed vulture and the Long-billed vulture. The proposal was accepted by the Central Zoo Authority and Rs. 41 lakh were released. An MOU was signed with the BNHS and 2.240 hectares of land was transferred to Van Vihar National Park by the Madhya Pradesh Forest Department in September 2008. Permission to capture 100 birds from the wild was received in January 2009.

The land allocated for the Centre is about 5 km from the Van Vihar National Park on the Kerva Dam road. The water and electricity connection has been extended up to the Centre. The infrastructure has been developed including a colony aviary, hospital aviaries, nursery aviaries, 2 quarantine aviaries and an office building.

Two advisory committees have been constituted, one in June 2008 by the Chief Wildlife Warden to monitor vulture conservation related activities in Madhya Pradesh and the other by the Government of Madhya Pradesh to oversee implementation and functioning of Vulture Conservation Breeding Centre as per the MOU signed in August 2007.

The future plans of the Centre are to get the birds to form the breeding stock, as soon as possible.

Third speaker: Dr. S. Panda, IFS, Director, Nandankanan Zoological Park, Bhubaneshwar, Odisha.

He said that Odisha state has three species of vultures, the White-backed vulture, Long-billed vulture and King vulture. The vulture population in the state has declined by more than 90% within 15 years and the sightings of the White-backed vulture and the Long-billed vulture have become rare. According to a recent survey there were an estimated 150-200 vultures left in the state.

A technical advisory committee has been constituted to monitor the status of vulture populations. Measures taken by the Forest Department include protecting nesting colonies and vulture nests by the field staff, protecting tall trees and preparation of an action plan for conservation of vultures. The state veterinary department has prohibited the use of diclofenac in the state.

The Vulture Conservation Breeding Centre has been developed in an off exhibit area located in the Nandankanan *Zoological* Park on 0.3 acres of land surrounded by 7 acres of forested area. Only the White-backed vultures will be housed for the Conservation Breeding Program. The facilities developed included construction of two nursery aviaries of dimensions 10 x 12 x 8' with perches and water troughs, a colony aviary 100 x 40 x 20' nearing completion, a boundary wall around the breeding Centre and a watchman's shed. Chain link mesh has been procured. A total of Rs. 27, 71, 059 have been utilized of the Rs. 41 lakhs sanctioned by the Central Zoo Authority.

The major problem in starting the breeding program is the non-availability of breeding stock. It is very difficult to catch them from wild in the state as very few are left. The Centre has requested Forest Department of Madhya Pradesh for permitting them to catch the birds from their state to which it has agreed.

Fourth speaker : Mr. Mallikarjuna Rao, IFS, Director, Nehru Zoological Park, Hyderabad, Andhra Pradesh

Mr. Mallikarjuna said that six species of vultures are found in Andhra Pradesh. They were the White-backed vultures, Long-billed vultures, Indian Griffon, Egyptian vulture, King vulture and Cinereous vulture. A recent survey in 2007 conducted by LACONES, Hyderabad, revealed only 20 individuals (13 Long-billed vulture, 1 White-backed vulture and 6 Egyptian vultures after covering 4070 km.)

Five White-backed vultures were housed in the Birds of Prey enclosure of the Nehru Zoological Park since last 30 years. In 2009, these birds were introduced into the new breeding aviary. In 2004-05, the LACONES carried out molecular sexing of the vultures. They found there were two males and three females. They found all birds capable of breeding.

Mr. Mallikarjuna said that the Vulture Conservation Breeding Centre has one breeding aviary of dimensions 100 x 40 x 20', one nursery aviary of dimensions 10 x 12 x 8' and one quarantine aviary of dimensions 10 x12 x 8'. 5A 360° rotatable CCTV camera is placed in the breeding aviary for monitoring the birds. The breeding aviary is provided with 27 coconut rope wounded perches, 5 coir nest ledges, 18 concrete ledges, 5 natural trees, 4 water troughs and bamboo thatched windows. A biologist has been recently employed for the Programme.

The Centre is finding it difficult to get the breeding stock for the Programme and has requested Central Zoo Authority for help in procuring the birds.

Fifth speaker : Mr. A T Mishra, IFS, DFO, Ranchi Division, Jharkhand

Mr. Mishra said that Jharkhand has a population of approximately 200-250 White-backed vultures in the state. The Forest Department is creating a lot of awareness through print and electronic media on the vulture situation. These included publications of several pamphlets in local language for general distribution, power point presentations and screening of documentaries during periodic workshops conducted by Forest Department and various NGOs, writing research articles, airing of an audio documentary on radio, displaying information about vulture situation on large hoardings at the entrances of the city council and similar such strategic locations.

To prevent the filtering of human diclofenac in veterinary use, Forest Department of Jharkhand wrote to the Drug Controller General of India, who in turn issued a letter to the State Drug Controller advising them to instruct all the pharmacies to keep a record of all the diclofenac sold. The latter then issued a notice to all the local pharmacy stores to submit a periodic report on every sale of diclofenac to anyone apart from hospital use. The pharmacy dealers

eventually stopped selling diclofenac, as they found sending the reports very cumbersome.

The site for the Vulture Conservation Breeding Centre is at Muta, 35 km from Ranchi. He informed that construction of the colony aviary, nursery aviaries and holding aviary has started and has reached the plinth level.

Sixth Speaker: Dr. Vibhu Prakash, Principal Scientist, BNHS

He talked on the Vulture Recovery Plan. He said that it is now the requirement of the Central Zoo Authority to have a Recovery plan for all the species which are included in the Conservation Breeding Program. It will be the responsibility of the Coordinating Zoo to prepare the recovery plan for the species. The recovery plan for the species should include the distribution, population, threat to the population, its ecology and biology and reintroduction program. The Vulture Recovery plan was discussed during the meeting and was decided to include in the manual.

Concluding Session

12:00- 13:00 hrs

Chairman: Mr. P. N. Pardhi, Principal Chief Conservator of Forests (Wildlife), Odisha

Co-Chairman: Mr. R. K. Sapra, CWLW (Haryana)

Mr. Pardhi summarized the deliberation of all the sessions of the workshop and then requested the participants to express their views on Conservation Breeding Program and the Workshop. Dr. Panda said that there are not enough studies on the basic ecology of vultures and it should be undertaken. Dr. Vibhu explained in detail that enough information is available on the vulture ecology to run a Conservation Breeding Program. Mr. J. S. Chauhan wanted to know whether the vultures which have been fed on goat meat in captivity will be able to feed on other kind of meat. Dr. Vibhu replied that goat meat is closest to the meat of wild ungulate carcasses, which are rich in protein and poor in fat. Hence goat meat is preferable but if goat meat is not available then the vultures will feed on buffalo meat. Mr. Sapra emphasized the need of creating awareness against diclofenac among all the stake holders.

Mr. Pardhi in his concluding remarks said that the workshop was very successful and it gave lot of insight in the Conservation Breeding Program. It will be good to make use of the experience gained at the Pinjore Centre for successful running of other Centers which are in various stages of setting up. He said that the work done at Pinjore should be highlighted in various forums as very few people are aware of the work done at this Centre. He said that the Central Zoo Authority should explore the possibility of funding the entire Conservation Breeding Program. Mr. Sapra emphasized that there should be a strong component of in-situ conservation program. He said every state should make sure that diclofenac is not used in veterinary sector. If the drug continues to be used then it will become impossible to release the birds from the breeding program.

The following action points came out of the discussions:

1. Create awareness about vulture conservation among various stake holders – children, farmers, veterinarians, pharmacists, quacks
2. Create awareness through a website dedicated to vulture conservation and upload the result of recent research on the website
3. Prepare a manual as an outcome from this workshop; add bibliography of all the research papers on vultures at the end.
4. Encourage more basic research on vultures and carry out periodic surveys to determine the population changes.
5. Celebrate Vulture Awareness Day on 3rd September every year.
6. Should have frequent interactions between people involved in ex-situ conservation program.
7. Ensure continuity of staff at the vulture Centres.
8. Wage a war against the veterinary use of diclofenac
9. It would be good to raid the pharmacies by the enforcement agencies including Forest Department to make sure that diclofenac for veterinary use is not being sold.

10. In-situ measures like restoring habitat should be initiated
11. There should be collaboration between Government and Non Government organization in ex-situ conservation efforts.
12. Local communities should be involved in vulture conservation. Joint forest management committees should be involved in the conservation efforts.

The workshop was declared closed after the Chairman thanked all the participants. The session was then followed by lunch.

Technical Session V

Day 3: 22/04/2011
14:30 to 17:00 hrs

Chairman : **Mr. J. S. Chauhan, IFS,** Director, Van Vihar National Park, Bhopal, Madhya Pradesh

First Speaker : **Mr. Rohan Shringarpure,** Research Biologist, Vulture Conservation Breeding Centre, Pinjore.

He spoke on the 'Study of microflora in vultures at the Vulture Conservation Breeding Centre, Pinjore'. He said that nothing much is known about the microflora of vultures. Studying microflora will help identify pathogens of vultures. Rohan elaborated on the importance of the study in a Conservation Breeding Program. He gave details about sample collections and methods of shipping them to Pinjore. Though very technical, Rohan made it simple for everybody to understand the importance of microflora present in vultures.

Second Speaker: **Vibhu Prakash,** Principal Scientist, Bombay Natural History Society

He spoke on 'Housing and infrastructure'. The participants found the talk interesting as each one is in the process of setting up and housing vultures in their respective breeding Centres.

Third Speaker: Rohan Shringarpure, Research Biologist, Vulture Conservation Breeding Centre, Pinjore

He spoke on 'Vulture capture, handling and transport' which the participants found very useful as each one will have to undergo the same in the process of acquiring vultures for their breeding Centres.

The session closed after a round of discussions, with a vote of thanks to the chair.

List of participants for the workshop

Sr No.	Name	Designation
1	Ranbir Singh	DFO (T), HFD
2	Tulsi Mehra	Cameraman (PTC news)
3	Anil Kr. Singh	Engg (VCBC, Ranchi)
4	Paramjeet Sangwan	DFO(Research HFD)
5	Shakti Singh	DFO (W), Hisar
6	VPS Sandhu	DFO (W), Pathankot
7	Vijender Singh	ACF (W), Panchkula
8	Ranjeet Singh	Forest Guard, HFD
9	J.S. Chauhan	Director, VVNP, Bhopal
10	Dr. S. Panda	Director, Nandankannan
11	Vineet Garg	CF, HFD
12	V.J. Rana	Director, Sakkarbaug zoo
13	P.P. Bhijwaid	CCF, HFD
14	Satya Bhan	CF, Gurgaon
15	A.T. Mishra	DFO (W), Ranchi
16	Sk. Narul Amin	Range Officer, Nandankannan
17	Rajeev Garg	Inspector Wildlife, Pinjore
18	Rakesh Sharma	Guard wildlife, Pinjore
19	H.S. Tanwar	CF, Ambala
20	Dr. Naim Akhtar	Scientific Officer, Central Zoo Authority
21	Jagdish Chander	CF (Research), HFD
22	Jagjit Singh	Photographer
23	Hansraj	Forest Guard, HFD
24	Ravi C. Chauhan	Curator/ Biologist, Sakkarbaug Zoo
25	M. Sandeep	Biologist, Nehru Zoological Park
26	R.S. Lamba	CF (T), HFD
27	Tara Chand	HFD
28	S.A. Haque	RFO, Ranchi
29	Jai Bir Singh	Inspector Wildlife, Pinjore
30	P.N. Padhi	Principal Chief Conservator of Forests, Odisha
31	Dr. Parvez Ahmed	Principal Chief Conservator of Forests, HFD
32	Dr. R.D. Jakati	Director, IGNFA, Dehradun
33	J.B. Jauher	Principal Chief Conservator of Forests, Jharkhand
34	Atul Sirsikar	DCF, HFD
35	Rajesh Chahal	Inspector Wildlife, Pinjore
36	R.K. Sapra	CWLW, HFD
37	Ishwer Singh	Wildlife, HFD
38	B.S. Quolala	DFO (F), Pinjore
39	G. Singh	Forester
40	D. Hembram	CF (FC), HFD
41	Rajesh Gul	DFO (T), HFD
42	P. Mallikarjun Rao	Director, Nehru Zoological Park
43	S.S. Rathi	DFO (W), HFD
44	Vinay Vats	APRO, DPR, HFD
45	Dr. Amarinder Kaur	CCF (Admin), HFD
46	K.S. Chauhan	CCF (Dev), HFD
47	Vijay Shrivastava	RFO, VVNP, Bhopal
48	R.S. Sodhi	Superintendent, HFD
49	C.R. Jotriwal	Additional Principal Chief Conservator of Forests, MD, HFDC
50	Sijender	DPO, DIPRO

Progress Report of the Five Vulture Conservation Breeding Centres

Sponsored & Supported By

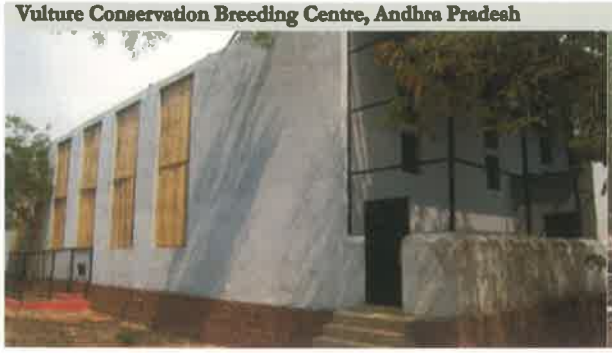
Central Zoo Authority

Vulture Conservation Breeding Centre, Gujarat

Vulture Conservation Breeding Centre, Madhya Pradesh

Vulture Conservation Breeding Centre, Odisha

Vulture Conservation Breeding Centre, Andhra Pradesh



Vulture Conservation Breeding Centre, Jharkhand

Central Zoo Authority supported Vulture Conservation Breeding Centres

Introduction

The Central Zoo Authority has funded 5 Vulture Conservation Breeding Centres in 5 different Zoos of the country. The Centres at Van Vihar Zoo, Bhopal, Nandankanan Zoo, Odisha, Nehru Zoological Park, Hyderabad and Sakkarbaug Zoo, Junagadh, were sanctioned in 2007 whereas the Centre at Muta, Ranchi, Jharkhand was sanctioned in 2009. The Central Zoo Authority provided with an amount of Rs. 41 Lakh for the initial capital cost of the Centre. Earlier, the Wild Life Institute of India, had organized a workshop in 2006 at Pinjore to develop project proposal for setting up Vulture Conservation Breeding Centres at Zoos in various parts of the country.

The five participating Zoos were invited to attend a Vulture Conservation Breeding Programme Workshop at Pinjore from 20 to 22 April 2011. The workshop was sponsored and supported by Central Zoo Authority. The Directors of all the five participating Zoos gave a presentation on the progress made at their respective Centres. The Chief Wildlife Wardens and biologists of the Vulture Centres also attended the workshop.

The report is compiled by the VCBC, Pinjore which is the Coordinating Zoo of the Vulture Conservation Breeding Programme. The Coordinating Zoo has written its comments on the reports of all the Centres and has made suggestions for improvement. Such a workshop is going to be an annual affair on the advice of the Member Secretary of Central Zoo Authority.

Vibhu Prakash
Principal Scientist
Bombay Natural History Society

Vulture Conservation Breeding Centre

Sakkarbaug Zoo, Junagadh, Gujarat

V. J. Rana, Project Leader, Vulture Conservation Breeding Programme,
Sakkarbaug Zoo, Junabarh

Introduction

The Sakkarbaug Zoological Park is one of the large Zoos in our country and mainly known for its conservation and educational programmes. The zoo is currently running Conservation Breeding Programme for Asiatic Lion, Vultures, Indian Wolf, Indian Wild Ass, Asiatic Cheetah, Four Horned Antelope and Chinkara in collaboration with Central Zoo Authority of India.

The Zoological Park is one of the five Centres for Vulture Conservation Breeding Programme in India established with support from Central Zoo Authority to save the two critically endangered *Gyps* species of vultures from extinction. The Centre intends to have the Conservation Breeding Programme for White-backed vulture and Long-billed vulture

Vultures at the Centre

In all, there are 51 vultures at the Centre of which 47 are White-backed vultures, 3 Long-billed vultures and 1 Egyptian vulture. 30 of the White-backed vultures are housed in the breeding aviary (colony aviary), inaugurated in April, 2009.

All the vultures housed at the Centre have been rescued from various places in Gujarat. Majority of the vultures have however, come from Ahmedabad and were injured during the Uttran festival by kite string. Some vultures were rescued as nestlings after they had fallen from their nests or were rescued weak and dehydrated.

Location of the Centre

The Centre is located within the Sakkarbaug Zoo in an off display area.

Infrastructure at the Centre

Breeding or Colony aviary

It is a large aviary of dimensions 30 x 15 x 7.5 m, which has been used for housing 30 White-backed vultures rescued from various parts of Gujarat. The aviary is designed to facilitate breeding activities in the captive vultures.

The aviary has been enriched by wooden perches wound with coconut rope at appropriate sites throughout. Nesting ledges have also been provided. Artificial trees have been placed throughout the aviary to simulate natural conditions for breeding for the vultures.

The aviary consists of water ponds to ensure regular supply of fresh water to the vultures, and feeding platforms, where food for the vultures is placed. The aviary is also equipped with CCTV cameras to continuously monitor the activities of the captive vultures, and to ensure their well being.

Nursery aviary

This aviary is adjoining the breeding aviary and consists of 4 aviary rooms. The aviaries have been enriched with perches and water facilities.

Quarantine aviary

This aviary is used for housing rescued birds for a temporary quarantine period of at least 45 days, before the vultures are deemed fit to be released into the breeding program.

Breeding of vultures at the Centre

Only White-backed vultures have been recorded nesting.

Two of the breeding pairs laid an egg for the first time during the breeding season 2009-10, after the vultures were released in the breeding aviary. However, both the eggs were infertile and failed to hatch.

In the breeding season of 2010-11, a total of 6 eggs were laid, out of which 2 hatched successfully. The 1st nestling hatched on 1st February 2011 while the 2nd hatched on 21st February 2011.

However, none of the nestlings survived. The first nestling died 72 days after hatching, while the second one died 36 days after hatching.

The cause of mortality for both nestlings is not clear, though a ball of hair about 3 inches in size was found in the crop of the second chick during PM examination.

Feeding the vultures

The vultures are fed every day on buffalo meat. The Zoo is confident that the buffaloes are not treated with diclofenac before they are slaughtered.

Comments of the Coordinating Zoo

The Vulture Conservation Breeding Centre has made good progress and has been successful in creating the facility for housing the vultures for the Vulture Conservation Breeding Programme. The following are the main comments of the Coordinating Zoo:

1. The quarantine aviary should be away from the main breeding Centre and it should be a temporary facility.

2. The Centre should have at least four hospital aviaries. The aviaries should be 12x10x8'. They should also have at least one solid wall. It should open in a gallery. The perches should be put based on the requirement of the vultures. The flooring should be of sand. It would be good to have a standoff barrier to the aviary. The design for the same could be obtained from Central Zoo Authority.

3. The flooring in nursery aviary should be of sand and not of concrete.

4. The breeding or colony aviary is good. There should not be any concrete feeding platform as it may cause bumble foot in vultures. It is fine to put the carcass on the sand.

5. The objectives of the Centre are not clearly defined. It should mention the number and species of vulture the Centre wants to hold as founding stock. It appears that the

Centre's role is of a rescue Centre rather than a conservation breeding facility at the moment.

6. The husbandry protocols are not clear. Though cleaning every day in the small aviary is fine but in the colony aviary it should not be more than twice a month outside breeding season and once a month during breeding season. The water troughs should however be topped up every day and should be emptied twice a week. Two troughs should be kept empty every week.

7. The feeding protocols should be clearly defined. The birds need not be fed more than 4 kg of meat per week and should not be fed more than twice a week. The goat meat is preferred but if buffalo meat is offered it should be made sure that the buffalo has remained with the Centre for at least 7 days before slaughtering. It is advisable to make absolutely sure that the buffaloes are not treated with diclofenac before they are slaughtered. The drug is extremely toxic to vultures and can cause mortality in very low concentration.

8. The health monitoring protocol should also be clearly defined. The birds should be caught at least once a year after the breeding season for a thorough check up. The birds should be bled and the hematology and biochemistry should be carried out annually. The fecal samples should be checked randomly for parasites. The birds should be examined visually by going near the aviary by the biologist or the veterinarian at least two times a day. At least four times a day they should be monitored through CCTV monitors.

9. All the birds should be ringed and should also be micro- chipped for identification.

Future plans

It is proposed to build an additional aviary near the breeding aviary.

Breeding at the Centre

Vulture Conservation Breeding Centre

Nandankanan Zoological Park, Odisha

Dr. S. Panda, IFS, Project Leader,
Vulture Conservation Breeding Programme,
Nandan Kanan Zoological Park, Odisha

Introduction

Status and conservation of vultures in Odisha

Three species of vultures are reported from the state of Odisha, namely, White-backed vulture, Long-billed vulture and King vulture. The vulture population in the state has declined by over 90% within the last 15 years. The sighting of once very common White-backed vulture has become very rare. Only about 150-200 vultures are estimated to be present in the state. A species wise census is being done to obtain the exact numbers. Population of vultures is restricted to Hadgarh Wildlife Sanctuary, Debrigarh Wildlife Sanctuary and Bhitarkanika National Park besides Athamallik and Anandapur forest areas.

A technical advisory committee has been set up to monitor the status of vulture populations. Nesting colonies left in the wild are protected by the field staff. Vulture nests are being protected and monitored. Awareness programmes have been launched in association with NGOs. Tall trees used by vultures have been protected.

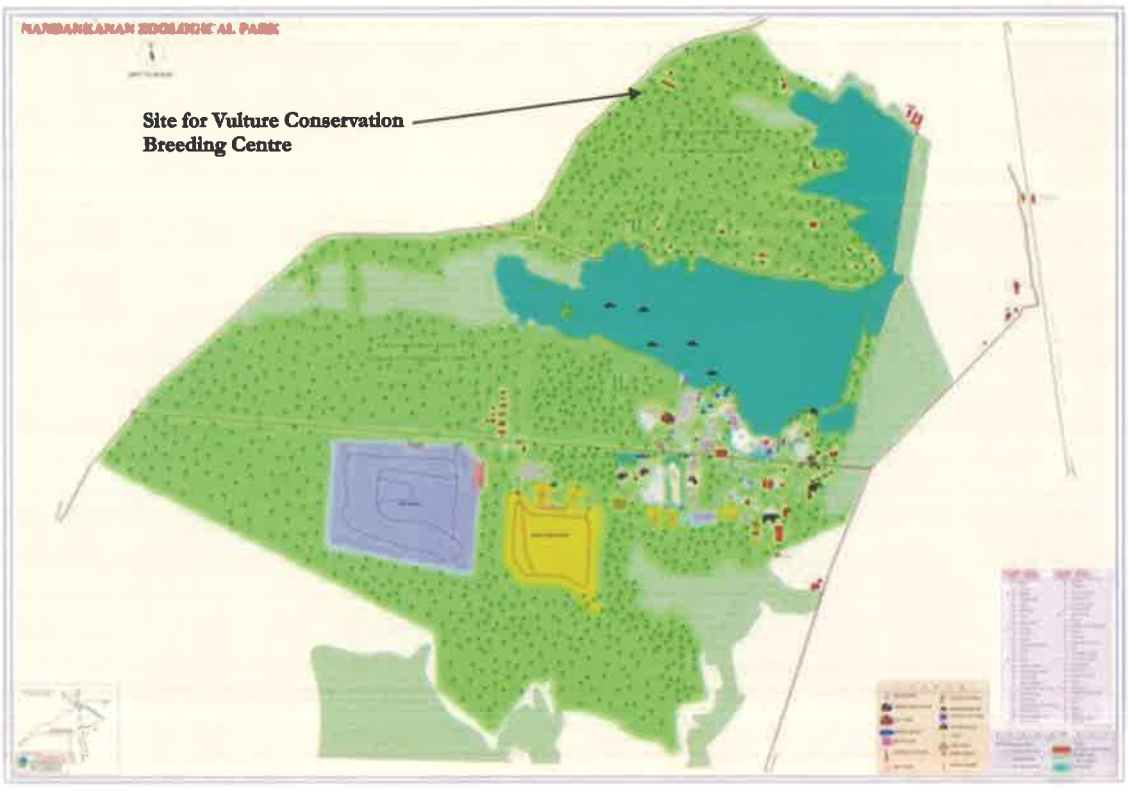
State Veterinary Department has been involved in the programme and has banned the use of veterinary 'diclofenac'. The Centre for Wildlife Health in State Veterinary College is being upgraded to study the diseases and treatment of vultures. An action plan for conservation of vultures has been prepared.

Conservation Breeding Programme of White-backed vulture

Nandankanan is among the five participating zoos for the conservation breeding of White-backed vulture – designated by Central Zoo Authority.

The Vulture Conservation Breeding Centre, Pinjore, Haryana is the Coordinating Zoo for the said purpose.

With the financial support from Central Zoo Authority, Nandankanan has initiated the planned conservation breeding of White-backed vultures in an off-exhibit area located in Nandankanan Sanctuary.



Objectives

• To develop ex-situ conservation breeding Centre to save the species from extinction.

• To develop protocol for captive management and breeding of White- backed vultures.

• To enhance the population by natural and assisted reproduction for reintroduction/release in the wild.

• To generate awareness about the conservation need of the vultures and their role in the ecosystem.

Location of the Centre

A Conservation Breeding Centre for White- backed vultures has been constructed in an off-exhibit area of Nandankanan Zoological Park. About 0.3 acres of enclosed area surrounded by about seven acres of forested area has been used for the purpose.

Components of the breeding Centre

• The breeding Centre has been developed as a satellite campus with all the basic facilities.

• Two nursery aviaries 10 X 12 X 8' have been constructed.

• One colony aviary 100 X 40 X 20' is being constructed.

• Water and electricity supply have been provided.

Number of vultures at the Centre

There is only one juvenile White-backed vulture at the Centre.

The Central Zoo Authority sanctioned an amount of Rs 41.00 Lakhs vide letter no. F.No. 19-64/92-Central Zoo Authority (Vol.IV)(212)(M) dated 15.02.2008.

Colony aviary under construction

Budget Details	
Construction of boundary wall in and around Breeding Centre	5,11,318
Construction of Nursery Aviary	5,64,930
Water supply to the Breeding Centre	15,499
Construction of Watchman shed	89,199
Procurement of Chain-link mesh	60,007
Partial construction of Colony aviary	13,19,047
Enrichment of Nursery Aviary	2,00,000
Contingent expenditure	11,059
Total	**27,71,059**

Difficulties in conservation breeding

•Although the construction of Conservation Centre has already been completed with all the facilities, the conservation work cannot be progressed due to non-availability of breeding stock.

•The birds were once very common are now very rarely seen in Odisha. Capturing the adult birds is again a major constraint for the said purpose.

A proposal has been granted by the Principal Chief Conservator of Forests, Madhya Pradesh for procuring the founder stock for the Conservation Breeding at Nandankanan Zoological Park.

Comments of the Coordinating Zoo

The Vulture Conservation Breeding Centre has made good progress and has been successful in creating the facility for housing the vulture for the Vulture Conservation Breeding Programme. The following are the main comments of the Coordinating Zoo :

1. All efforts should be made to get the founder stock of the birds for the breeding programme.

2. The quarantine aviary should be away from the main breeding Centre and it should be a temporary facility.

3. The Centre should have at least four hospital aviaries. The aviaries should be 12x10x8'. The aviaries should also have at least one solid wall. It should open in a gallery. The perches should be put based on the requirement of the vultures. The flooring should be of sand. It would be good to have a standoff barrier to the aviary. The design could be obtained from Central Zoo Authority.

4. The breeding or colony aviary is good. There should not be any concrete feeding platform as it may cause bumble foot in vultures. It is fine to put the carcass on the sand.

5. The objectives of the Centre are not clearly defined. It should say the number and species of vultures the Centre wants to hold as founding stock.

6. The husbandry protocols should be developed before the birds are kept at the Centre. Though cleaning every day in the small aviary is fine but in the colony aviary it should not be more than twice a month outside breeding season and once a month during breeding season. The water should however be topped up every day and the troughs should be emptied twice a week. Two troughs should be kept empty every week.

7. The feeding protocols should be clearly defined. The birds need not be fed more than 4 kg of meat per week and should not be fed more than twice a week. Goat meat is preferred but if buffalo meat is offered it should be made sure that the buffalo has remained with the Centre for at least 7 days before slaughtering. It is advisable to make absolutely sure that the buffaloes are not treated with diclofenac before they are slaughtered. The drug is extremely toxic to vultures and can cause mortality even in very low concentration.

8. The health monitoring protocol should also be clearly defined. The birds should be caught at least once a year after the breeding season for a thorough check up. The birds should be bled and the hematology and biochemistry should be carried out yearly. The fecal samples should be checked randomly for parasites. The birds should be examined visually by going near the aviary by the biologist or the veterinarian at least two times a day. At least four times a day they should be monitored through CCTV monitors.

9. All the birds should be ringed and should also be micro-chipped for identification.

Vulture Conservation Breeding Centre

Van Vihar National Park and Zoo, Bhopal, Madhya Pradesh

J. S. Chauhan, IFS, Project Leader
Vulture Conservation Breeding Programme,
Van Vihar National Park,Bhopal

Introduction

Sequence of events

In 2005 a project was submitted to Central Zoo Authority regarding involvement of Government of Madhya Pradesh in the conservation breeding of vultures. During the vulture conservation workshop held at Pinjore, Central Zoo Authority asked Government of Madhya Pradesh to submit a project for conservation breeding of three species of vultures viz: White- backed vulture, Long- billed vulture and Slender- billed vulture. In January 2007, a proposal was submitted to Central Zoo Authority for conservation breeding program of two native species i.e. White-backed vulture and Long-billed vulture. In 2008, MOU was signed with Bombay Natural History Society to provide technical support related to conservation breeding of vultures. Central Zoo Authority released Rs 41.00 Lakhs for construction of the conservation breeding Centre and the structures involved.

In Sept 2008, 2.240 ha. area was transferred to Van Vihar National Park for setting up the Vulture Conservation Breeding Centre on the Keru dam road, 5 km from Van Vihar National Park.

Relevant Government permissions

In 2006, Government of Madhya Pradesh granted permission to implement the vulture conservation program. In January 2009, Government of India granted permission for capturing 100 birds (25 pairs of each of the two species) from the wild.

Status of vultures in Madhya Pradesh

Some of the finest vulture habitat still exists in Madhya Pradesh. Most of them is associated with Protected Areas.

Some of the habitats are excellent outside Protected Areas. In a recent survey in Panna Tiger Reserve, 7 species of vultures have been reported. The survey involved various NGO/ NGI/ Researchers/ Educational institutions/ volunteers etc. The total population of vultures in Madhya Pradesh was estimated to be around 1200.

Statewide periodic efforts and orientation of territorial staff are needed for a more accurate estimate of vulture populations.

Prominent habitats for vultures in Madhya Pradesh

Protected Areas :

Bandhavgarh, Kanha, Pench, Satpura, Panna, Kuno, Gandhisagar, Sanjay, Madhav etc. Habitats outside Protected Areas : Tamia, Patakot, Ramnagar, Gwalior, Orchha, Amarkantak etc.

Advisory Committee

Chief Wildlife Warden has constituted an advisory committee to monitor vulture conservation related activities in Madhya Pradesh in June 2008. Government of Madhya Pradesh also has constituted an executive body to oversee the implementation and functioning of the Vulture Conservation Breeding Centre as per the MOU in August 2007.

Progress of Vulture Conservation Breeding Centre, Van Vihar National Park, Bhopal

a.Location of the Centre

The Centre is located on the Keru dam road, about 5 km from the Van Vihar National Park, Bhopal. The area allotted for the setting up of the Vulture Conservation Breeding Centre has been developed to make the land suitable for construction.

Infrastructure

The following aviaries have been constructed at the Centre

1.1 Colony aviary

2.1 Hospital aviary

3.1 Nursery aviary

4.1 Quarantine pen

Apart from the aviaries, a management house has also been constructed.

Electricity and water supplies have been brought to the Centre.

Colony aviary- outside view 100 x 40 x 20'

Colony aviary- inside view

Holding aviaries

Office and staff accommodation

Objectives

1. To establish a founder population of 25 pairs of each of the two species, namely White-backed and Long-billed vultures.

2. To release 100 pairs of each of the two species in wild

Comments of the Coordinating Zoo

The Vulture Conservation Breeding Centre has made good progress and has been successful in creating the facility for housing the vulture for the Vulture Conservation Breeding Programme. The following are the main comments of the Coordinating Zoo :

1. All efforts should be made to get the founder stock for the Conservation Breeding Programme.

2. The husbandry protocols should be developed before the birds are brought in. Though cleaning every day in the small aviary is fine but in the colony aviary it should not be more than twice a month outside breeding season and once a month during breeding season. The water should however be topped up every day and the troughs should be emptied twice a week. Two trough should be kept empty every week.

3. The feeding protocols should also be developed. The birds need not be fed more than 4 kg of meat per week and should not be fed more than twice a week. Goat meat is preferred but if buffalo meat is offered it should be made sure that the buffalo has remained with the Centre for at least 7 days before slaughtering.

4. The health monitoring protocol should also be developed. The birds should be caught at least once a year after the breeding season for a thorough check up. The birds should be bled and the hematology and biochemistry should be carried out annually. The fecal samples should

be checked randomly for parasites. The birds should be examined visually by going near the aviary by the biologist or the veterinarian at least two times a day. At least four times a day they should be examined through CCTV monitors.

All the birds should be ringed and should also be micro-chipped for identification.

Colony aviary- outside view 100 x 4 0 x 20'

Vulture Conservation Breeding Centre,

Nehru Zoological Park, Hyderabad, Andhra Pradesh

Mallikarjun Rao, IFS, Project Leader
Vulture Conservation Breeding Programme,
Nehru Zoological Park, Hyderabad

Introduction

Status of vultures in Andhra Pradesh

Andhra Pradesh has 6 species of vultures, viz: White-backed vulture, Long-billed vulture, Eurasian Griffon vulture, Cinereous vulture, King vulture and Egyptian vulture.

An informal survey between 1990 & 1997 counted approximately 8,500 vultures across the state (Srinivasulu and Srinivasulu 1999).

A survey conducted by Lacones covering road transects of 4070 kms and foot transects 603 kms in 129 separate locations of Andhra Pradesh could sight only 20 individual vultures of 3 species.

This study clearly shows a catastrophic decline of vultures in Andhra Pradesh.

Other field studies on vultures in AP

In 2008 one carcass of vulture was received from Srisailam Tiger Reserve to Nehru Zoological Park, Hyderabad.

Samples were sent to Veterinary Biological Research Institute (VBRI), Hyderabad for further investigation.

Diclofenac residues were not observed in the carcass.

Recently, on 13.11.2010, Mr. Rajiv Mathew, a wildlife enthusiast sighted 13 vultures close to Shivaram village of Adilabad Dist. Out of 13 vultures, 7 were White –backed and 6 were Long- billed vultures. A couple of juvenile vultures were also sighted.

Vulture Conservation Breeding Centre, Nehru Zoological Park, Hyderabad

Objectives

1. To establish a founder population of 25 pairs of two species of vultures, White-backed vulture and Long-billed vulture.

2. To produce a population of at least 200 birds of both the species in 15 years to be reintroduced to the wild.

3. To rescue injured wild resident *Gyps* vultures and include them in the on going Conservation Breeding Programme after recovery.

Location of the Centre

The vulture Conservation Breeding Program was started at Nehru Zoological Park, Hyderabad in the year 2010-11.

Number of vultures

There are in all 5 White-backed vultures at the Centre which were shifted from "Birds of Prey" enclosure to newly built breeding aviary on 22nd November 2010. The DNA sexing of birds was carried out with the help of LaConES (Centre for Cell and Molecular Biology, Hyderabad). There are two males and three females.

Identification of Individuals

Both the male birds are marked with leg rings with numbers. The female birds are without any identification.

Infrastructure

Aviaries have been constructed for various purposes. There is one breeding or colony aviary, nursery aviary and quarantine aviary.

Quarantine aviary

There is one quarantine aviary at the Centre which is of 10'x12'x8'. It is open from all sides and is covered with chain link fence. The aviary is built on an about 3' raised platform. To provide shade in the aviary, half of the aviary is covered with asbestos sheets. There are a few stumps for perching. A water trough has been provided for drinking and bathing.

Nursery aviary

There is one nursery aviary of dimensions 10 x 12x 8'. It is located close to the quarantine aviary. It is similar in shape and size to the quarantine aviary. The flooring is of sand. To give double door protection there is a small chamber of wire mesh within the structure.

Colony aviary or breeding aviary

There is one colony aviary of 100x40x20'. It has aflooring of sand and is according to the design provided by the Central Zoo Authority. It has some natural trees for perching and nesting. There are 27 perches all wound with coconut rope to provide a rough surface for vultures. There are two kinds of nesting ledges, of which 18 are concrete ledges and 5 are wooden cots with coir netting. The concrete nesting ledges have windows behind each ledge, fitted with glass.

Breeding aviary- 100 x 40 x 20'

There are four water troughs and have the provision of cleaning from outside. There is double door protection as two doors are on each of the 40' wall and they open in a covered gallery. The food hatch also has a cover of wire mesh to prevent accidental escape of vultures. There is a feeding platform- round elevated platform made of cement and concrete, to facilitate feeding in vultures.

The aviary is fitted with 360° rotatable CCTV camera- to monitor the vultures in the aviary without disturbing the birds. The CCTV monitors are kept in the biologist room for monitoring. A long wooden ladder is kept inside the aviary for repairs.

The big windows in the 100 ft wall are lined with bamboo splits: for obstructing the vision of vultures, so that they do not get disturbed by human movement and they do not get hurt by hitting the wire mesh. The aviary is open to sky. It is covered by a layer of chain link mesh and a second layer of netlon to prevent injuries to vulture.

Feeding the vultures at the Centre

·Chopped beef was provided to the vultures when they were at "birds of prey enclosure" as display to the visitors at the zoo.

·Birds did not feed for a week after introduction into the new breeding aviary.

Initially, deskinned whole carcass of sheep/goat was introduced, but birds did not feed for few days.

Later, small pieces of meat from de-skinned whole carcass of sheep/goat were given, which the birds consumed within a day.

Size of the meat pieces was gradually increased from 50gms to 1 kg.

In future, whole deskinned body of sheep/goat will be given.

Breeding

No breeding attempts were recorded so far.

To distinguish the male birds, rings were attached to their legs.

To facilitate breeding activity nesting material was provided inside the breeding aviary.

It was observed, that during the month of December and January the female birds were sitting on coir cots for very long periods.

So far no progress in breeding has been noticed.

Recording vulture activities at the Centre

The breeding aviary is fitted with a 360o rotatable CCTV camera, which is used for monitoring the activities of captive vultures, without actually visiting the aviaries. The feed from the camera can be monitored and recorded in the biologist's monitoring room, where the biologist

monitors and documents the activities of vultures. Based on the observations, behavioral patterns of male and female vultures have been made.

Constraints and future plans

·The birds which are present at the zoo are aged about 30 years. They could be too old to breed.

·During 2004-05 LaConES scientists conducted few trials on these birds according to them both males and females are found to be sexually active.

·New birds are required to improve breeding activity at the Centre.

Staff

The Director of the Zoo is the project leader. There is a biologist dedicated to the Centre. The veterinary help is obtained from the main zoo. There are two dedicated vulture keepers.

Comments of the Coordinating Zoo

The Vulture Conservation Breeding Centre has made good progress and has been successful in creating the facility for housing the vulture for the Vulture Conservation Breeding Programme. The following are the main comments of the Coordinating Zoo:

1. The quarantine aviary should be away from the main breeding Centre and it should be a temporary facility. The existing quarantine aviary could be utilized as hospital aviary. It would be advisable to make at least one of the walls solid as it gives a feeling of isolation to the birds otherwise they feel exposed from all sides. It would be good to have a stand off barrier to the aviary.

2. The nursery aviary should also have at least one solid wall. It should open in a gallery. The nesting platform could be made before the nestlings are brought.

3. The breeding or colony aviary is good. There should not be any concrete feeding platform as it may cause bumble foot in vultures. It is fine to put the carcass on the sand.

6. The objectives of the Centre are not clearly defined. It should say the number and species of vultures the Centre wants to hold as founding stock.

7. The husbandry protocols are not clear. Though cleaning every day in the small aviary is fine but in the colony aviary it should not be more than twice a month outside breeding season and once a month during breeding season. The water should however be topped up every day and the troughs should be emptied twice a week. Two troughs should be kept empty every week.

8. The feeding protocols should be clearly defined. The birds need not be fed more than 4 kg of meat per week and should not be fed more than twice a week. Goat meat is preferred but if buffalo meat is offered it should be made sure that the buffalo has remained with the Centre for at least 7 days before slaughtering.

9. The health monitoring protocol should also be clearly defined. The birds should be caught at least once a year after the breeding season for a thorough check up. The birds should be bled and the hematology and biochemistry should be carried out annually. The fecal samples should be checked randomly for parasites. The birds should be examined visually by going near the aviary by the biologist or the veterinarian at least two times a day. At least four times a day they should be monitored through CCTV monitors.

11. As the Centre is within the Zoo premises it is imperative that high level of hygiene is maintained. The Vulture keepers, biologist and veterinarian should not go to the Zoo at all. All equipment should be kept separate from the Zoo and they should not be used in vulture Centre. If they have to visit the Zoo they must change clothes and footwear before coming to the Centre.

Vulture Conservation Breeding Centre,
Muta, Jharkhand

A T Mishra, IFS, Project Leader
Vulture Conservation Breeding Programme,
Muta Zoo, Ranchi

Introduction

The Central Zoo Authority sanctioned a Conservation Breeding Centre in Jharkhand.

The proposed site for the breeding center is Muta (35 km from Ranchi).

Due to some reasons the work could not be started. The construction work has recently started and is now in full swing.

Activities proposed at Conservation Breeding Centre, Muta

S. No	Item	Cost in Rs. Lakh
1.	Building of two quarantine pen	3.00
2.	Building of four nursery aviaries	2.50
3.	Building of four hospital aviaries	2.50
4.	Building of one colony aviary	12.00
5.	Building for project office	5.00
6.	Equipment	6.00
7.	Electricity and water supply	8.00
8.	Capture and transportation	2.00
	Total	41.00

Vulture Conservation Breeding Centre, Muta

Construction status

Colony aviary

It was proposed to construct one colony aviary of dimensions 100' x 40' x 20'. The construction has recently started. Foundation has been laid and 3 ft high brick walls have been erected in the super structure.

Nursery aviaries

4 Nursery aviaries are to be constructed, the dimensions of which are 10' x 12' x 8'. The work is in progress, wherein foundation and 3 ft brick work over the foundation in all 4 aviaries has been done.

Colony aviary under construction

Quarantine pen

It is proposed to construct two quarantine pens, the dimensions of which will be 20 x 20 x 16'. One quarantine pen at the proposed site is currently under construction.

Hospital Aviaries

Four hospital aviaries are proposed to be constructed, the dimensions which are 10 x 12 x 8'. The buildings are under construction and the foundation has been laid.

Nursery aviary under construction

Quarantine pen under construction

Office building

One office building is proposed to be constructed. Work is in progress, and the foundation for the building has been laid.

Comments of the Coordinating Zoo

The Vulture Conservation Breeding Centre has made little progress in construction. The work started only in 2010. The following are the main comments of the coordinating Zoo:

1. All efforts should be made to complete the construction before December 2011, so that the founder stock could be collected by March 2012.

2. All efforts should be made to get the permissions for catching the foundation stock.

3. The objectives of the Centre are not clearly defined. It should mention the number and species of vultures the Centre wants to hold as founding stock

4. The husbandry protocols should be developed before the birds are brought in. Though cleaning every day in the small aviary is fine but in the colony aviary it should not be more than twice a month outside breeding season and once a month during breeding season. The water should however be topped up every day and the troughs should be emptied twice a week. Two trough should be kept empty every week.

5. The feeding protocols should also be developed. The birds need not be fed more than 4 kg of meat per week and should not be fed more than twice a week. Goat meat is preferred but if buffalo meat is offered it should be made sure that the buffalo has remained with the Centre for at least 7 days before slaughtering.

6. The health monitoring protocol should also be developed. The birds should be caught at least once a year after the breeding season for a thorough check up. The birds should be bled and the hematology and biochemistry should be carried out annually. The fecal sample should be checked randomly for parasites. The birds should be examined

visually by going near the aviary by the biologist or the veterinarian at least two times a day. At least four times a day they should be monitor through CCTV monitors.

7. All the birds should be ringed and should also be micro-chipped for identification. All this equipment need to be obtained beforehand.

8. There should be a biologist or a veterinarian as Centre manager. He should be dedicated to the Centre only and no other responsibilities should be assigned to him. There should be at least four vulture keepers for the Centre.

Office building under construction

For further information, please contact

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Designed & Layout : CorePR