# Population Status and Breeding Success of White-rumped Vulture *Gyps bengalensis* in Rampur, Syanja and Tanahu, Nepal

With a Summary of Five-years' Monitoring Efforts


By

Nabin Baral
Ramji Gautam


Final Report Submitted to

The Peregrine Fund, USA

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2007

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Photos: Authors
Cover Photos: A White-rumped Vulture with a chick in a nest, school children reading a leaflet on vulture conservation, logging of a nesting Kapok tree and vultures on the fly.

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# ABSTRACT

We carried out field surveys from September 2006 to May 2007 to monitor the population status and breeding success of White-rumped Vulture *Gyps bengalensis* in Rampur, Syanja and Tanahu. We did repeated absolute counts at nesting and roosting sites as well as at carcasses. The estimated population size was 96 in Rampur, and 43 in Syanja and Tanahu. The observed maximum was 92 in Rampur, and 40 in Syanja and Tanahu. Based on active nests as primary units, the breeding success was 40% in Rampur, and 71% in Syanja and Tanahu. A total of 42 trees of nine species was used in Rampur while only 15 trees of six species were used in Syanja and Tanahu. We recorded 18 carcasses in Rampur, and only three in Syanja and Tanahu. There were only three dead adults recorded in Rampur, and two dead vultures in Syanja and Tanahu.

Since 2002, there had been gradual declines in vulture populations and breeding successes in Rampur. We discussed some potential reasons for the decline and suggested conservation strategies to avert threats to vultures. A diclofenac removal program was initiated in Rampur and Tanahu.

# INTRODUCTION

## Background

Of 22 vulture species in the world, eight are *Gyps* species (Mundy 1985). In the Indian sub-continent, the populations of three *Gyps* vultures (*G. bengalensis*, *G. tenuirostris* and *G. indicus*) have plummeted over the past decade; there has been up to 95% decline in wild populations of these species (Prakash 1999, Prakash et al. 2003, Gilbert et al. 2002, Sarrazin et al. 2004). The major cause of vultures' mass mortality is diclofenac contamination of livestock carcasses (Oaks et al. 2004, Green et al. 2006, Swan et al. 2006, Shultz et al. 2004); however, other causes such as habitat destruction, food shortage, human persecution, poisoning and pesticide use may have caused a gradual decline in vulture populations in the region (BirdLife International 2001). Aftermath of catastrophic population declines in their distribution ranges, the above three *Gyps* vultures were reclassified as "critically endangered" in the IUCN's Red Data Book. This has helped to highlight the vultures' plight and gather attention from concerned authorities to take conservation measures.

Ban on veterinary diclofenac, establishment of captive breeding centers, monitoring of vulture colonies in the wild, and raising conservation awareness are some strategies to save the critically endangered vultures from the brink of imminent extinction. The Government of Nepal has already banned the manufacture and import of veterinary diclofenac in June 2006 (Kantipur 2006). Meloxicam is a vulture-safe alternative to diclofenac, and it has been manufactured by a few pharmaceutical companies in Nepal. The Bird Conservation Nepal has been promoting a diclofenac swap program in the periphery of vulture colonies in Nepal. Since there has been an affordable alternative to diclofenac, it is expected that other vulture range states will also ban veterinary diclofenac soon. A captive breeding center has been established in India, and a vulture chick has been successfully hatched in the center (BBC 2007). A long-term monitoring of vulture colonies provides useful data on breeding success, population status and mortality rate in the wild. There have been studies on *Gyps* vultures and other vulnerable vultures in India, Pakistan and Nepal (Gautam and Baral 2006, Virani et al. 2001, Gilbert et al. 2002, Cuthbert et al. 2006).

For the past six years, we have been monitoring vulture colonies in the Rampur Valley, one of the Important Bird Areas in Nepal. We have also discovered a few breeding colonies in Syanja and Tanahu districts that surround the Rampur Valley. We have been monitoring these colonies for the past three years. Mainly White-rumped Vultures breed in these habitats; however, other vulture species are also recorded.

In this report, we estimate population size and compare the population status over the past five years. We document the breeding success of vultures and how it has changed over the years. The threats to vultures and some conservation strategies to avert these threats are also discussed. Finally, we list the publication accomplishments since the inception of vulture ecology project.

## Objectives

The project's goal was to monitor population status and breeding success of White-rumped Vultures in Rampur, Syanja and Tanahu. The specific objectives were:

- To estimate population size of different age classes
- To collect data on breeding ecology and measure the breeding success
- To assess food availability and vulture mortality
- To initiate veterinary diclofenac replacement with meloxicam

# THE STUDY AREAS

## *Rampur Valley*

Rampur Valley (27°51'80" N and 83°54'24" E) lies in the south-west of Nepal about 370 km road distance from Kathmandu. Its mean elevation is 442 m. The valley has the highest density of breeding White-rumped Vultures (Baral et al. 2005); therefore, it has been included in the list of Important Bird Areas of Nepal (Baral and Inskipp 2005). Since 2002, the old Islampur colony was deserted and a new breeding site, Keladi, was colonized. A short description of the extant vulture colonies is given below:

Sadawarta (Darcha VDC, 27°51'53"N and 83°54'38"E, Elevation: 425 m): There used to be two sites in Sadawarta: one near human settlement and the other on the bank of Kali Gandaki River. Local people logged two mango trees in the former site in 2005, so this year no nests were recorded there. The latter site lies in rice field adjoining a community forest. Most nests were on Kapok *Bombax ceiba* trees. The other trees in the area are Sal *Shorea robusta,* Mango *Mangifera indica* and Peepal *Ficus religiosa.* In community forests, hill Sal is regenerating along with Chilaune *Schima wallichii* and Budho-dhayar *Lagerstromia parviflora.*

Jyagdi (Rampur VDC, 27°53'13.4"N and 83°52'44.2"E, Elevation: 330 m): In the past, vultures used to nest on Kapok trees which lie inside the Jyagdi Community Forest. This year vultures did not built nests in this colony. The northern boundary of the community forest is the Kali Gandaki River while a village abuts the southern boundary. The community forest is divided into two blocks: a livestock grazing zone and a grazing restricted zone. Some dominant trees of the area were Bel *Aegle marmelos,* Budho-dhayar, Ashare *Murraya koenigii,* Chilaune and Sissoo *Dalbergia sissoo.*

Shera (Khaliban VDC, 27°52'43"N and 83°"51'51"E, Elevation: 356 m): The nesting site lies between a village and agriculture fields. The dominant nesting trees are Kapok and they are located in the downhill slope towards the Kali Gandaki River.

Khairini (Khaliban VDC, 27°52'45.5"N and 83°50'52.4"E, Elevation: 333m): In this site, there is less anthropogenic activities compared to other sites in Rampur. It lies by the side of Kali Gandaki River with a large number of matured Kapok trees in which vultures roost and build nests. The site consists of two blocks *viz.* western and eastern separated by a flood channel. Khairini is the most suitable site for vultures thus boasts the largest colony in the valley so far. Khair *Acacia catechu,* Veller *Trewia nudiflora* and Ashare are common tree species. Since 2003, about 40 matured Kapok and almost all Khair trees have been harvested by the forest user group to raise funds to run the public school. This has compromised nesting and roosting sites for vultures.

Shekham (Shekham VDC, 27°54'23"N and 83°51'28"E, Elevation: 406 m): The nesting sites in Shekham are Sim, Damachour and recently discovered Hilamarang. Sim lies on the slope

of the hill and consists of terraced agricultural fields. The nesting Kapok trees are located within a small village. Damachour is within a human settlement and it lies just opposite of Jyagdi. The dominant vegetation in the area is Kavro *Ficus lacor* scattered in agricultural fields. Hilamarang lies to the east of Damachour and south-east of Sim. Sim, Damachour and Hilamarang form a triangular complex just opposite of Jyagdi on the side of Kali Gandaki River.

Keladi (Sankhar VDC): It is a new nesting site about 1 km east of Sadawarta. Keladi and Sadawarta are separated by the Kali Gandaki River. Three nesting trees (Saj *Terminalia tomentosa*, Khair *Acacia catechu*, and Karma *Adina cordifolia*) are in private lands.

## *Syanja and Tanahu*

Syanja District (hereafter Syanja) lies (27° 52' to 28° 13'N and 83°27' to 84°46' E) to the north-east of Rampur Valley. It is about 60 km west from Pokhara and 260 km west from Kathmandu. The elevation ranges from 366 m to 2512 m. The total area of the district is 103,687 ha; of which 31% is forest (DDC 2002). About 342 forest parcels were handed over to local communities under the community forestry program. Common tree species are: Hill Sal, Chilaune, Katush *Castanopsis indica*, Tuni *Cedrela tuna* and Mango. The maximum and minimum temperatures recorded in the district are 28.3 °C and 9.5 °C, respectively. Vulture colonies were in two VDCs: the Chinnebash and Biruwa-Archale. None of the breeding colonies were within community forests. A short description of each colony is given below:

Kewa (Chinnebash VDC, 27°57'30"N & 83°53'44.6"E, Elevation 712 m): White-rumped Vultures used an old Kapok tree for nesting and roosting at this site. The tree was standing in the agricultural field and was about 100 m down slope of a Magar village called Kewa.

Mochabari (Biruwa-Archale VDC, 28°01'59.1"N & 83°53'4.8"E, Elevation 947 m): Mochabari is a small Magar village. Last year, vultures' nests were on two Tuni trees and a Barro *Terminalia bellirica* tree; however, this year only one Tuni tree is used. This site lies near a drinking water well, so villagers disturb vultures with the hope that vultures will ultimately desert the site.

Besharedanda (Biruwa-Archale VDC, 28°03'9.5" N & 83°52'19.2" E, Elevation 1190 m): The colony is 3 km road distance from Mochabari. Vultures used a single Kapok tree standing in the agricultural field for nesting and roosting.

Tanahu District (hereafter Tanahu) lies (27°36' to 28°05'N & 83°57' to 84°34'E) to the east of Rampur Valley. It is about 19 km east of Pokhara and 110 km west of Kahtmandu. The elevation ranges from 200 m to 2325 m. The total area of the district is 155,902 ha; of which half is covered with forests (DDC 2001). Common trees are Sal, Sissoo, Khair, Kavro, Kapok, Alder *Alnus nepalensis*, Saj, Bel, Chilaune, Katush. The following vulture colonies were located in three VDCs:

Hatiya Bazar (Ghiring-Sundhara VDC, 27°54'24.9"N & 84°2'15.3"E, Elevation 772 m): Vulture nests were in a Kavro and Kapok tree, which were standing just above the drinking water source for villagers.

Pokhari Chhap (Ghiring-Sundhara VDC, 27°54'51.1"N & 84°3'34"E, Elevation 763 m): A Kapok tree was used by vultures for nesting and roosting at this site. Other common trees of the area are hill Sal and Kavro.

Phalanthanti (Ghiring-Sundhara VDC, 27°54'5.2"N & 84°01'9.8"E, Elevation 895 m): There was a single Kapok tree standing at the top of a hill near by Chautara (a raised platform used by humans for resting). It is about 3 km far from Hatiyabazar.

Deurali (Ghiring- Sundhara VDC, 27°53'49.5"N & 84°00'24.3"E, Elevation 672 m): Vultures used Kapok, Barro *Terminalia bellirica*, and Saj trees for nesting and roosting in the area. The first tree was by the side of a road in public land while the other two were in private lands.

Newapani (Majhakot VDC, 27°55'30.6"N & 84°03'56.3"E, Elevation 854 m): It's a new place where a Sal tree was used by vultures for nesting. The southern slope of the ridge was covered with Sal forest.

Kathekot (Gajjarakot VDC, 27°53'12.6"N & 83°59'4.5"E, Elevation 700 m): A Barro tree was near an old Kapok tree in private field.

# METHODS

## Absolute counts

Because the intensive study areas in Rampur, Syanja and Tanahu are small, it is practical to regularly count all nesting and roosting sites, which will give accurate results. We monitored all the roosting and nesting sites early in the morning (0630-0930 hr) and late in the evening (1730-1930 hr). We recorded all the birds seen on nests and perched on roosts during the specified times. Counting roosting as well as nesting birds allows a count of non-breeders too. This approach is different from anything done in Pakistan or India. The estimate of population sizes is based on active nests and road transect counts in Pakistan and India, respectively. These approaches may seriously underestimate the non-breeding portion of the populations.

Since the data were of total counts we followed Jacknife Techniques (cited in Rodgers 1991) to estimate a population size. The underlying assumption of this method is that with repeated counts theoretically there is the probability of counting all the birds in the area at one time. The method requires at least five repeated absolute counts. The method uses the difference between the highest count $n_{max}$ and the second highest count $n_{max-1}$ to calculate N, the estimated total number;

$N = 2\, n_{max} - n_{max-1}$

We assumed fidelity of roosting and/or nesting sites, fixed time of roosting and geographic closure- no movement into (immigration) or out of (emigration) colonies – to estimate a population size, vulture mortality and natality rates. The nesting and roosting sites were thoroughly searched for dead vultures and when one was found the information was recorded and the vulture was buried.

## Nest census

In order to study breeding ecology, nests were counted and nest occupancy, breeding status, and general breeding behavior were recorded. Following Postupalsky (1974), an active nest is defined as a nest in which eggs had been laid, whereas an occupied nest is one in which an egg need not have been laid, but a minimum of nest building must have taken place. In other words, all active nests are occupied but all occupied nests are not active. Nesting trees were tagged for future reference. The name of the tree and geographic position of nests were noted. Nest observations were made from the ground, and an assessment of nest status was recorded. Regular monitoring of nests was carried out on each visit to assess the breeding success.

## Count at carcasses

In order to assess the food availability in the study area, we counted the number of carcasses found as well as the number vultures attending them whenever we had an opportunity.

Attendant raptor species and their number were noted. Other animals seen scavenging the carcass were also noted. The type of available carcass, its state and location were recorded.

# RESULTS

## *Rampur Valley*

### Field efforts

We spent a total of 30 days from September 2006 to May 2007, coinciding with the onset of breeding activities of White-rumped Vultures in Rampur (Table 1). During each visit, we spent on average 7 – 8 hours a day collecting ecological data. The vultures' breeding activities were categorized into three periods such as egg laying, incubation and nestling. We visited breeding colonies at least twice in each period. An assistant was hired throughout the year to monitor breeding colonies intensively. On some occasions, community forest guards, community forest user groups' chair and secretary, and public schools' head master also became a member of our research team.

Table 1: Summary of field efforts during the three stages of White-rumped Vultures' breeding cycle

| Breeding activities | Date | Days spent |
|---|---|---|
| Egg-laying period | September 24 – 28, 2006 | 5 |
| | October 20 – 24, 2006 | 5 |
| Incubation period | December 2 – 5, 2006 | 4 |
| | January 10 – 14, 2007 | 5 |
| Nestling period | February 16 – 19, 2007 | 4 |
| | March 24 – 27, 2007 | 4 |
| | April30 / May 1 – 2, 2007 | 3 |
| Total | | 30 |

### Population size estimate

A new colony, Keladi, was uncovered in 2006 near Sadawarta. Last year, the highest number of seven vultures and three occupied nests were recorded from Jyagdi, but this year there were no vultures and nests at this site. Therefore, there were five extant vulture colonies in Rampur (Table 2). Of five colonies, Khairini was the most important breeding colony in term of vulture population because it harbored the highest number of vultures. During the study period, we recorded a maximum and minimum of 92 and 51 White-rumped Vultures in October 2006 and March 2007, respectively. We also counted soaring vultures; the highest number of 41 birds was recorded on March 17, 2007 around 1.15 PM over the Khairini site. We visited each colony seven times and counted all vultures, so we followed the Jacknife Technique to estimate the total population size. The population size of White-rumped Vulture was 96 in Rampur during the study season on the basis of Jacknife Technique. In October, we recorded the highest count of 92 vultures. It could be due to immigration of both breeding and non-breeding vultures in the area and increase in breeding activities. Towards the end of breeding season, we recorded comparatively a few vultures, which suggested that unsuccessful vultures may have dispersed to other places.

Table 2: The number of White-rumped Vultures recorded among six colonies in Rampur Valley during the 2006-07 breeding season

| Colonies | September | October | December | January | February | March | April/May |
|---|---|---|---|---|---|---|---|
| Sadawarta | 12 | 9 | 21 | 16 | 12 | 12 | 1 |
| Jyagdi | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Shera | 2 | 4 | 5 | 14 | 12 | 1 | 9 |
| Khairini | 43 | 47 | 44 | 45 | 41 | 20 | 29 |
| Shekham | 26 | 26 | 8 | 9 | 15 | 14 | 15 |
| Keladi # | 2 | 6 | 4 | 4 | 4 | 4 | 1 |
| Total | 85 | 92 | 82 | 88 | 84 | 51 | 55 |

# A new colony discovered in 2006

## Population age structure

The birds were classified into adults (more than three years old), subadults (one to three years old), juveniles (four months to one year old) and nestlings (less than four months old) on the basis of plumages (Alstrom 1997). The highest number of adults (81) was recorded during the egg laying and incubation periods in October and January, respectively. The lowest number of adults (36) was recorded during the nestling period. During the incubation period (December), we recorded 78 adults, 1 subadult and 3 juveniles. Towards the end of the breeding season, 46 adults, 7 subadults and 2 juveniles were recorded. Please refer to Appendix 1 for detail.

## Nest census and status

We recorded a total of 52 occupied nests in Rampur Valley during the study period (Table 3). The Khairini site held the highest number of nests (23) followed by Shekham (10), Sadawarta (8), Shera (7) and Keladi (4). This year, the Jyagdi site was deserted. Of 52 occupied nests, 30 were active and 12 were productive.

Table 3: Occupied, active and productive nests among six colonies in Rampur

| Vulture colonies | Occupied nests | Active nests | Productive nests |
|---|---|---|---|
| Sadawarta | 8 | 3 | 1 |
| Jyagdi | 0 | 0 | 0 |
| Shera | 7 | 4 | 3 |
| Khairini | 23 | 15 | 4 |
| Shekham | 10 | 5 | 3 |
| Keladi | 4 | 3 | 1 |
| Total | 52 | 30 | 12 |

In Rampur, the breeding season started in September; we saw vultures forming pairs, heard mating calls frequently, observed mating and recorded nest building activities. While mating, a female produces sound when a male mounts on her, balances itself by spreading its wings, and lowers its tail so as to fit cloacal aperture to hers. Mating was short, lasting from 35 to 65 seconds, and took place in nests or branches of the nesting trees. To our surprise, we saw a few vultures mating in May in Shekham; this should be a futile attempt of unsuccessful pairs.

There were only 11 occupied nests in September, 16 new nests were built by October and another 16 new nests were built by December. In January, only 9 nests were built, but none after January, suggesting the end of nest building and egg laying, and the commencement of incubation.

### Breeding success

Based on active nests as primary units, the breeding success was 40% for the 2006-07 season, while on the basis of occupied nests as primary units, it was 23%. The breeding success was unequal among six colonies. The highest breeding success was in Shera followed by Shekham, Keladi, Khairini and Sadawarta. Last year, three occupied nests were in Jyagdi but none this year. The breeding success in Khairini sharply decreased this year. On February 14, 2007 the unexpected rain and hailstones killed 12 vulture chicks, 10 in Khairini and one each in Sadawarta and Shera. A dead chick was found in Keladi in March 2007.

Of 40 unproductive nests, 12.5%, 55% and 32.5% failed during the nest building, egg laying and nestling periods, respectively.

### Nesting trees

A total of 42 nesting trees of nine different species was recorded during this study period. There were 33 Kapok trees, 2 Khair and 1 each of the other seven tree species (Barro, Kavro, Ditabark *Alstonia scholaris*, Tuni, Padke, Saj and Karma). Ten trees had two nests on them and 32 trees had one nest. Kapok trees harbored 81% of occupied nests. Please refer to Appendix 2 for detail.

### Carcasses availability

We recorded 18 carcasses of three different mammalian species: water buffaloes (9), cattle (7, 6 oxen and 1 cow) and domestic dogs (2). All the carcasses were exposed in the following habitats: 7 carcasses were in river or on the bank, 5 were in crop field, 5 were in open field and 1 was in forest. We recorded skeletons of 10 carcasses and asked villagers about when they died and whether they died naturally. Vultures and other scavengers partially consumed two carcasses but three carcasses were untouched. We saw vultures consuming three carcasses. We recorded a maximum number of 18 White-rumped Vultures, 6 Himalayan Griffons, 12 house crows and 2 feral dogs attending the carcasses. Please refer to Appendix 3 for detail.

### Observation of dead vulture

Only three dead adults were recorded during the study period: two from Shekham and one from Khairini. Unlike the previous years, 13 chicks were dead in this season.

### Records of other vulture species

We recorded other six species of vultures during the study in Rampur (Table 4). The maximum number of 54 Egyptian Vultures was recorded in January 2007. They used to perch on trees, but with the commencement of the breeding season, they dispersed to nesting

sites on cliffs. Two each of Slender-billed Vulture, Red-headed Vulture and Himalayan Griffon were also recorded. There were four Eurasian Griffons in April/May 2007, and one Cinereous Vulture was recorded in December 2006.

Table 4: Records of other vulture species in Rampur

| Vulture species | Sept. 2006 | Oct. 2006 | Dec. 2006 | Jan. 2007 | Feb. 2007 | Mar. 2007 | Apr./May 2007 |
|---|---|---|---|---|---|---|---|
| Egyptian | 1 | 4 | 28 | 54 | 36 | 2 | 0 |
| Slender-billed | 1 | 0 | 0 | 2 | 1 | 1 | 0 |
| Red-headed | 0 | 0 | 1 | 2 | 1 | 0 | 0 |
| Himalayan | 0 | 0 | 1 | 1 | 2 | 0 | 0 |
| Cinereous | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Eurasian | 0 | 0 | 0 | 0 | 0 | 0 | 4 |

### Diclofenac replacement

In Rampur, six agro-vet shops used to sell diclofenac. Of six, one vet shop was recently established. We administered questionnaire surveys to vet professionals in 2005. During interviews we talked with them about various aspects of vulture conservation and made them aware of the vultures' plight. When we requested them to swap diclofenac with vulture-safe melaxicom, they readily accepted our request. Meloxicam tablets are manufactured in Nepal but injections should be imported from India which increases costs. The price of meloxicam tablet is NRs 29 per strip but of diclofenac ranges from NRs 7 to 13. One vial injection of meloxicam costs NRs 64 but diclofenac costs NRs 30-53. Meloxicam is more expensive than diclofenac. The price could be a hindrance to a large scale diclofenac removal.

A total of 37 vials of injection (30 ml) and 2100 tablets of diclofenac were swapped with meloxicam.

## *Syanja and Tanahu*

### Field efforts

We spent a total of 16 days in the field during the 2006-07 breeding season (Table 5). We started the fieldwork in October and ended in May, and made six repeated visits in each breeding colony. Two research assistants (one each in Syanja and Tanahu) were hired throughout the breeding season to monitor vulture nests and populations.

Table 5: A summary of fieldwork during the three stages of a breeding cycle in Syanja and Tanahu

| Breeding activities | Dates | Days spent |
|---|---|---|
| Egg laying period | October 8 and 10 | 2 |
| | November 9-10 and 25 | 3 |
| Incubation period | December 7 and 30 | 2 |
| | January 9, 15 and 25 | 3 |
| Nestling period | March 10, 23 and 26 | 3 |
| | May 5-7 | 3 |
| Total | | 16 |

## Population size estimate

All nine colonies recorded in the last year were monitored this year too. Of nine colonies, only eight colonies (three in Syanja and five in Tanahu) were active (Table 6). The estimated population size was 43 based on the Jacknife Technique. The highest number of vulture (40) was recorded during January 2007 and the lowest number (16) was recorded in March 2007. The highest number of adult vultures was recorded in January 2007. The detail of population age structure was given in Appendix 4.

Table 6: Estimate of population size in Syanja and Tanahu

| Vulture Colonies | October 2006 | November 2006 | December 2006 | January 2007 | March 2007 | May 2007 |
|---|---|---|---|---|---|---|
| Syanja | | | | | | |
| Kewa | 7 | 8 | 4 | 2 | 7 | 3 |
| Mochabari | 0 | 2 | 1 | 1 | 0 | 1 |
| Besharedanda | 4 | 4 | 3 | 2 | 2 | 4 |
| Tanahu | | | | | | |
| Hatiya Bazar | 0 | 0 | 5 | 5 | 0 | 0 |
| Pokharichhap | 12 | 12 | 12 | 13 | 4 | 6 |
| Phalanthanti | 0 | 0 | 2 | 1 | 1 | 0 |
| Deurali | 6 | 6 | 7 | 7 | 0 | 0 |
| Newapani | 0 | 2 | 3 | 9 | 2 | 3 |
| Kathekot | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 29 | 34 | 37 | 40 | 16 | 17 |

## Breeding success

A total of 25 occupied nests was recorded in Syanja and Tanahu, of which 14 were active and 10 were productive (Table 7). On the basis of active nest as a primary unit, the breeding success was 71% for the year 2006-07. Based on occupied nest as a primary unit, the breeding success was 40%. Of 15 unproductive nests, 20% failed during egg laying, 73% failed during incubation and 7% failed during nestling periods.

Table 7: Occupied, active, productive and unproductive nests among nine colonies in Syanja and Tanahu

| Vulture colonies | Occupied | Active | Productive | Unproductive |
|---|---|---|---|---|
| Syanja | | | | |
| Kewa | 4 | 3 | 3 | 1 |
| Mochabari | 1 | 1 | 1 | 0 |
| Besharedanda | 2 | 2 | 2 | 0 |
| Tanahu | | | | |
| Hatiya Bazar | 2 | 0 | 0 | 2 |
| Pokharichhap | 7 | 4 | 3 | 4 |
| Phalanthanti | 1 | 1 | 0 | 1 |
| Deurali | 4 | 1 | 0 | 4 |
| Newapani | 4 | 2 | 1 | 3 |
| Kathekot | 0 | 0 | 0 | 0 |
| Total | 25 | 14 | 10 | 15 |

## Nesting trees

In Syanja and Tanahu, 25 occupied nests were on 15 trees of six species (Table 8). A total of seven occupied nests was on three trees in Syanja and 18 nests were on 12 trees in Tanahu. There were 3 nesting trees in Syanja and 12 nesting trees in Tanahu. Kapok trees held the maximum number of occupied nests (16) followed by Sal (5) and the other tree species had one nest on them. The maximum number of four nests was built on two Kapok trees, one each in Syanja and Tanahu.

Table 8: Nesting trees and occupied nests in Syanja and Tanahu

| Vulture colonies | Tree species harboring nests | | | | | | Total nesting trees and nests |
|---|---|---|---|---|---|---|---|
| | Kapok | Tuni | Sal | Saj | Peepal | Katush | |
| Syanja | | | | | | | |
| Kewa | 1 (4)* | 0 | 0 | 0 | 0 | 0 | 1 (4) |
| Mochabari | 0 | 1 (1) | 0 | 0 | 0 | 0 | 1 (1) |
| Besharedanda | 1 (2) | 0 | 0 | 0 | 0 | 0 | 1 (2) |
| Tanahu | | | | | | | |
| Hatiya Bazar | 2 (2) | 0 | 0 | 0 | 0 | 0 | 2 (2) |
| Pokharichhap | 1 (4) | 0 | 1(2) | 0 | 0 | 1(1) | 3 (7) |
| Phalanthanti | 1 (1) | 0 | 0 | 0 | 0 | 0 | 1 (1) |
| Deurali | 1 (2) | 0 | 0 | 1(1) | 1(1) | 0 | 3 (4) |
| Newapani | 1 (1) | 0 | 2(3) | 0 | 0 | 0 | 3 (4) |
| Kathekot | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 8 (16) | 1 (1) | 3(5) | 1 (1) | 1 (1) | 1 (1) | 15 (25) |

* Numeral in parentheses is occupied nest.

### Carcass availability

Three carcasses of three mammalian species were recorded. An untouched carcass of domestic dog and a fully consumed carcass of ox were in Mochabari, Syanja. We observed vultures consuming a carcass of water buffalo in Pokharichhap, Tanahu.

### Observation of dead vulture

We recorded two dead vultures: an adult and a chick. According to the field assistant, the adult had died in a nest in Kewa, Syanja while the chick was killed by an avian predator in Pokharichhap, Tanahu.

### Diclofenac replacement

Only two vet shops were close to vulture colonies in Tanahu. We knew the shop owners since 2005 when we conducted questionnaire surveys regarding diclofenac use. As they were aware of vulture conservation efforts and we had good relationships, they agreed to swap diclofenac with meloxicam. A total of 13 vials (30 ml) and 460 tablets of diclofenac were replaced with vulture-safe meloxicam.

## *Vulture Awareness Programs*

We distributed 100 posters and 500 pamphlets on vulture conservation to local people, farmers, vet professionals, students, teachers, members of community forests and local leaders. The color poster was 60 cm X 45 cm in size and read, "Please Conserve Nepal's Endangered Vultures." An A4 size black and white pamphlet read, "Let's Conserve Vultures – the Nature's Scavengers!" Both the poster and pamphlet were in Nepali language and easy to read and understand. They highlighted the vultures' plights and suggested simple things people can do to conserve vultures. The Bird Conservation Nepal published the posters and pamphlets and gave us to distribute free of costs.

Ramji Gautam was interviewed for the Kantipur Telivision's 8 PM national news regarding vulture conservation works in Nepal. It was broadcasted on March 6, 2007 and he highlighted conservation strategies such as diclofenac replacement, habitat protection, captive breeding and wholesome food supply to prevent the imminent extinction of vultures.

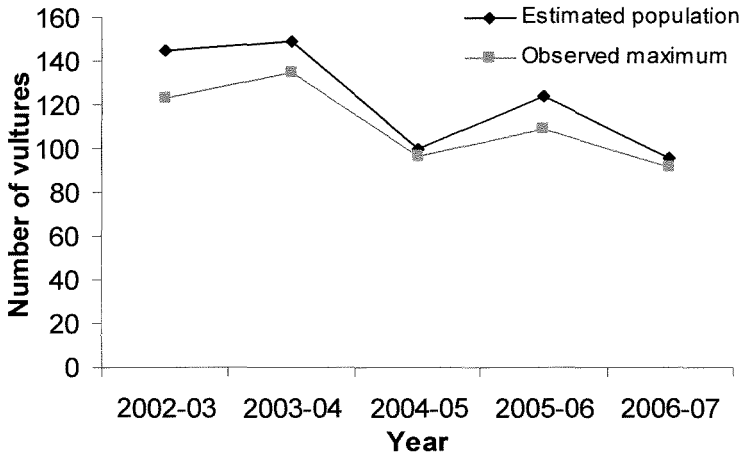
In Rampur, we have conducted socioeconomic surveys regarding vulture conservation in 2003. We also did surveys of vet professionals in four districts (Syanja, Tanahu, Kaski and Palpa) to collect data on diclofenac dynamics. These surveys have raised awareness to some extent about vultures' plights and how people can contribute to their conservation.

# DISCUSSION

## Population status

Over the five years, there had been a gradual decline in vulture populations in Rampur (Figure 1). The estimated population sizes based on the Jacknife Technique were 145, 149, 100, 124 and 96 birds in 2002-03, 2003-04, 2004-05, 2005-06 and 2006-07 breeding seasons, respectively. We recorded the maximum number of 123, 135, 97,109 and 92 vultures in 2002-03, 2003-04, 2004-05, 2005-06 and 2006-07 breeding seasons, respectively by the absolute count method.

Figure 1: Number of vultures based on the Jacknife Technique and absolute counts from 2002-03 to 2006-07 in Rampur



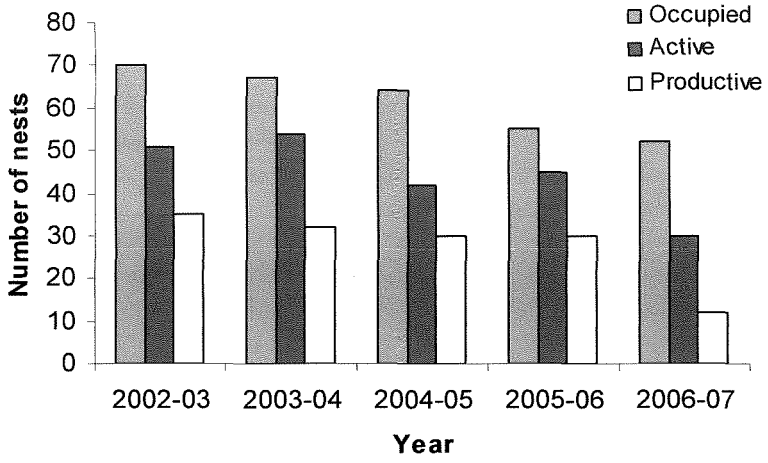

We calculated the proportions of adults, subadults and juveniles in vulture colonies based on three years data. On average, there were 83.9 ± 7.5% adults, 7.3 ± 4.9% subadults, and 8.8 ± 4.6% juveniles (mean ± 1 standard deviation). The proportions of adults (86%) and juveniles (8%) remained more or less the same over the three years, but the proportion of subadults decreased from 11.3% in 2004-05 to 5.2% in 2006-07.

In Syanja and Tanahu, the highest number of vultures recorded was 25 in 2004-05, 54 in 2005-06 and 40 in 2006-07.

## Breeding success

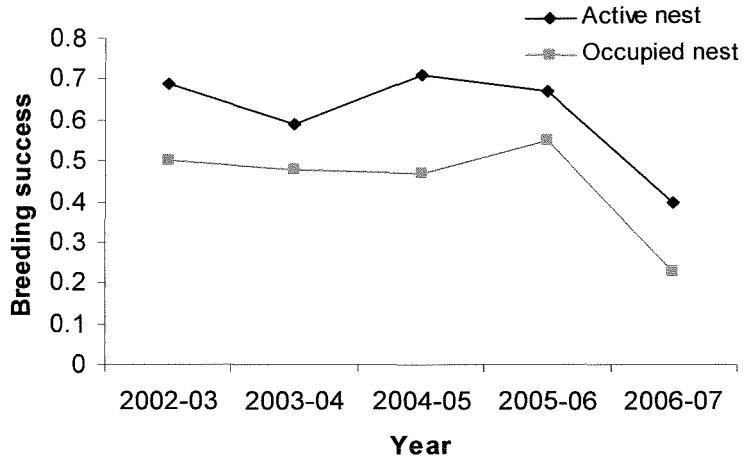
The total number of occupied, active and productive nests decreased over the past five years in Rampur (Figure 2). There had been 25.7% decrease in occupied nests, 41.2% decrease in active nests and 65.7% decrease in productive nests over the five years (2002-03 to 2006-07).

Figure 2: Occupied, active and productive nests from 2002-03 to 2006-07 in Rampur




The breeding success calculated based on 'active nests' as the primary unit was significantly higher than the breeding success calculated based on 'occupied nests' as the primary unit ($P < 0.01$; Figure 3). In the light of published literature on raptor breeding ecology, the breeding success calculated based on 'occupied nests' was more accurate. However, we also calculated breeding success based on 'active nests' because other researchers had done so in South Asia, so that we could compare our results.

Figure 3: Breeding success of White-rumped Vultures from 2002-03 to 2006-07 in Rampur, calculated based on active and occupied nests as primary units




Khairini is an important colony in terms of vulture population, number of nests and breeding success. It used to be the most successful colony (70% success rate) in the past, but only 26.6% nests were successful this year. This has lowered the breeding success in Rampur. The Jyagdi site is deserted this year and anthropogenic disturbances could be the reason for this.

The colony is near by a village and the local market so it suffers from more anthropogenic disturbance than other colonies. In addition, rock and sand mining near the colony could have caused adverse impacts on vultures.

The breeding success in the pre-decline era is reported to be 82-96% (Sharma 1970, Prakash 1999), but in the post-decline era, it is 59-62% (Gilbert et al. 2003). In Rampur, the breeding success was comparable to the post-decline era until 2005-06, but was lower than this in 2006-07.

Over the past three years, the breeding success of White-rumped Vultures has remained the same in Syanja and Tanahu. It was 75% in 2004-05, 72% in 2005-06 and 71% in 2006-07 based on active nests as primary units. The number of occupied nests steadily increased from 14 in 2004-05 to 25 in 2006-07.

# THREATS TO VULTURES AND THEIR MITIGATION

## Threats to vultures

Over the years, we have noticed the following serious or potential threats to vultures. The compilation of the list was based on a case study in Rampur; however, these threats are also common in other colonies.

Diclofenac contamination: In Rampur, about 3% of livestock carcasses are contaminated with veterinary diclofenac (Baral and Gautam 2007). The Government of Nepal banned veterinary diclofenac in June 2006; yet there are still many doses of diclofenac on the shelves of vet shops. Replacement of diclofenac with vulture-safe meloxicam has been started only in the vicinity of vulture colonies in Rampur. However, vultures travel far away to feed, so the threat of diclofenac has not been removed completely.

Habitat destruction: As per the community forestry regulation, trees that are included in the operational plan can only be cut. The law protects Kapok tree and it cannot be harvested from community forests and public forests. However, many Kapok trees are cut in Rampur. In 2003, about 40 matured Kapok trees were harvested from the Khairini site of which 50% were either nesting or roosting trees (Gautam and Baral 2004). In the same year, local people felled down three nesting and roosting trees in Islamapur and following the incident vultures deserted the colony permanently. Those trees were in private lands. In 2005, the school management committee decided to sell two nesting and roosting mango trees that were inside the school premises. A land owner from the Sadawarta colony cut a Kapok tree, which has holding two nests, to make a boat in 2006. Landowners can cut Kapok trees in their private lands even though they're protected. The revenue generated by selling trees from community forests is used in community development programs. The government officials who are in-charge of monitoring community forests do not intervene in community's decision unless the decision becomes controversial and attracts media attention. In all colonies, vultures exclusively build nests on Kapok trees and these trees are removed for various purposes, which has limited nesting habitats for vultures.

Disturbance: The present wildlife protection rules do not have a provision to punish people who disturb or kill vultures outside a network of protected areas. In Syanja, a homeowner disturbed a breeding pair by burning a nest, dismantling it with a long stick or pelting stones on vultures. Vultures had built a nest for two years in a row in his home garden but deserted the site after disturbance. Likewise, local people destroyed vulture nests in Shekham, Rampur and killed a vulture by putting a poison-bait in Hatiya, Tanahu because vultures built nests right above a drinking water spring and their droppings polluted the water. Development activities such as rock and sand mining near vulture colonies (for example in Jyagdi and Khairini, Rampur) also have disturbed vultures.

Hunting: During the socioeconomic surveys in Rampur, local people said that they had not seen other people hunting vultures (Baral and Gautam 2007). However, we have recorded a few instances in which children killed vultures with a catapult. An indirect form of hunting is

egg collection. It is not a serious problem at present, but could be in the future. In 2003, we recorded an instance of local people collecting a vulture egg. This year an egg was collected from Shekham. The collector ate the egg because the local people believed that vulture eggs make human bones stronger. Both nests were on the trees that were easy to climb.

In June 2007, Nabin Baral recorded a case of Himalayan Griffon hunting in Manang. Local children put a homemade rope snare targeting vultures near a horse carcass. A Himalayan Griffon was caught in the snare and the children killed it for quills. The vulture's quills were used to make a tail of arrows. After removing the required number of quills, the vulture was stuffed and put on a wall of a hotel for decoration (see a photograph below). The hotel owner said that he gave some money to the children. Archery is a famous sport among men in Manang and Mustang districts. Hunting for quills would have an adverse impact on the population dynamics of Himalayan Griffons, if done in a large scale. This case suggests that vultures are also hunted for a purpose.

In Rampur, local people told us that vultures' bones are used to plaster and mend broken bones of livestock and humans. In addition, villagers believe that vulture bones mixed with other local ingredients can cure arthritis. The perceived medicinal use of vultures could increase the probability of their hunting.

Lack of awareness: Children kill vultures for fun. In rural areas, many children do not go to school or drop out of school to look after livestock or support a family. While grazing livestock, if they come across vulture colonies some of them practice pelting stones on vultures with a catapult for fun and kill vultures sometimes. These children should be motivated not to play with catapults. Adults are not appreciative of important ecological roles played by vultures. They try to chase vultures off their lands when they build nests there.

Food shortage: Food shortage is likely to be a challenge for vulture conservation in the offing. Slaughtering of cattle was forbidden by the law in the past, but the Maoists rebels started killing cattle for beef during a decade long Maoist insurgency. After the People's Movement in April 2006, Nepal is declared as a secular state. Now, people have started consuming beef in many rural areas of Nepal. Many carcasses that are available to vultures are of cattle. The consumption of beef may seriously undermine the food supply to vultures. The chronic shortage of food can alter vulture behaviors. After the mad cow disease incident, the Government of Spain made it mandatory to bury all carcasses. In the past, farmers used to leave carcasses in open fields for vulture to feed on them. Due to the present regulation, vultures suffered from the chronic shortage of food and in a desperate attempt to feed around 100 vultures killed a cow and a calf in (Sage 2007). So far, no case of vulture predation has been recorded; they used to feed on dead animals. Such thing can happen in Nepal too.

In Nepal, many important vulture colonies are in fast growing villages. As a consequence of urbanization, the carcasses that are left in open fields now will be safely dumped in the offing for sanitary reasons. Furthermore, we expect decrease in livestock holdings in those villages because villagers will engage in the market economy. Social, political and economic changes are likely to work synergistically to limit the food availability to vultures.

Predation: Avian predators such as owls and crows kill vulture chicks or eat eggs. Last year, a Spot-bellied Eagle Owl *Bubo nepalensis* was observed in a vulture nest. It displaced the vulture pair and used the nest for sometime. We observed crows attacking vulture chicks in nests. If incubating adults leave the nest for a while, crows can eat eggs. According to the field assistant, an unidentified eagle killed a chick in Pokharichhap, Tanahu this year.

Natural calamities can take a heavy toll on vulture populations. This year 12 chicks were dead due to hail stones and heavy rainfall.

## Conservation strategies

To mitigate the above mentioned threats, we have listed the following strategies that could be helpful to safeguard vulture populations:

Diclofenac replacement: The replacement of veterinary diclofenac should be done with urgency in and around all breeding colonies throughout the country. The Bird Conservation Nepal is taking a lead on it and has already initiated the program around some colonies. The current pace of diclofenac replacement is inadequate to make the environment safe for vultures.

Local debt-for-nature swap: To save nesting trees in Rampur, we have proposed this program. All the nesting trees should be bought at a reduced cost with the financial help from donors. In return, the community forest user groups should take responsibility of protecting the nesting trees and implement vulture conservation programs. The user groups are cutting trees to collect funds. If we propose this program in which they get funds without cutting trees, they will heartily accept the proposal. Without saving nesting trees, the prospect for vulture conservation in Rampur is bleak.

Captive breeding: To boost the remaining wild populations, the captive breeding program is required. The National Trust for Nature Conservation (NTNC) has already signed the memorandum of understanding with foreign donors for the establishment of a captive breeding center in Chitwan. However, the project has not been materialized yet. The recent political changes in Nepal have also changed the organizational structure of NTNC. This could be one reason for the delay of breeding center's establishment.

Some seed birds for captive breeding can be taken from Rampur as the colonies have a higher proportion of adult vultures. Captive-bred vultures could be released into deserted colonies or in those sites where vulture populations are decreasing.

Awareness campaigns: Massive conservation awareness programs are required to make other vulture conservation programs successful. We recommend the publication of vulture conservation booklet in Nepali language. The booklet should be distributed free of costs to the target groups such as farmers, members of forest user groups, vet professionals, students and teachers. Awareness camps targeting children who look after livestock may help to prevent fun hunting. Replacement of catapults with other playing gears such as football or volleyball can motivate the children to protect vultures. All target groups should be educated about the full range of vulture's values such as utilitarian, existence, ecological and aesthetic.

Vulture restaurant: A proactive measure to establish a vulture restaurant will avert the imminent threat of food shortage. It should be done with local community involvement. Local farmers should be provided with some sort of incentives to leave livestock carcasses in open fields where vultures can feed on them. Alternatively, old or unproductive livestock can be purchased and fed to vultures.

Legal protection: Although three species of vultures are on the IUCN's Red Data Book, the Nepal Government's law does not protect them. Only nine avian species are protected by the National Park and Wildlife Conservation Act 1973. The Act should be amended and at least *G. bengalensis* and *G. tenuirostris* should be included in the protected species list. Harmful activities such as hunting, and rock or sand mining can be handled with legal procedures if vultures are included in the protected species list.

Ecological research: Many aspects of vultures' biology are still unknown. For example, the proportion of subadults is low in Rampur, but we don't know the reason why this is so. What are the mortality rates of juveniles and subadults is an interesting and useful question for vulture conservation. To make ecological research more comprehensive and useful, sharing of information is crucial, but the problem is that it is hard to find technical reports and not many vulture researchers publish their works in journals. Vulture scientists should be encouraged to publish their results in peer-reviewed journals. The BCN can organize vulture workshops in every two years so that all scientists can share valuable information in one platform and tailor their ecological research in order to save critically endangered vultures.

# CONCLUSION

The estimated population size of 96 vultures is lower than the sizes recorded during the past four years in Rampur. The breeding success of 40% was also lower than the so far recorded breeding success in Rampur. There had been 25.7% decrease in occupied nests, 41.2% decrease in active nests and 65.7% decrease in productive nests over the past five years. Khairini is an important colony but many trees have been harvested from this site. This could be the major reason why the breeding success at this site has decreased sharply so are occupied and active nests.

There has been not much change in the population size and breeding success of White-rumped Vultures in Syanja and Tahanu over the past three years.

We initiated diclofenac replacement in Rampur and Tanahu. So far, 43 vials and 2560 tablets of diclofenac were removed from there. The replacement of diclofenac should be done with urgency in the periphery of all vulture colonies.

Currently, diclofenac contamination, habitat destruction, disturbance, hunting, food shortage and lack of awareness are serious or potential threats to vultures. To avert these threats, diclofenac replacement, local debt-for-nature swap, captive breeding, vulture restaurant, legal protection and awareness campaigns are some of the conservation strategies.

Except Lammergeier, all other vultures found in Nepal are recorded in Rampur. The Rampur valley still has a good number of vultures. Over the past five years, there was no change in carcass availability in Rampur. The adult mortality rate is low. In light of these facts and vultures' critical status, we recommend to develop the Rampur valley as a 'vulture sanctuary.'

# PUBLICATIONS

We have submitted five technical reports to donors and conservation organizations that are working enthusiastically to save critically endangered south Asian *Gyps* vultures. These reports contain rich information on population biology and ecology of vultures along with socioeconomic data and diclofenac dynamics in and around important vulture colonies. Since the inception of vulture ecology project in Rampur, the following papers were published in peer-reviewed journals and newsletters:

Baral, N., R. Gautam, N. Timilsina and M.G. Bhat (2007). Conservation Implications of Contingent Valuation of Critically Endangered White-rumped Vulture *Gyps bengalensis* in South Asia. *The International Journal of Biodiversity Science and Management* 3: 145-156.

Baral, N. and R. Gautam (2007). Socioeconomic perspectives on the conservation of critically endangered vultures in South Asia: an empirical study from Nepal. *Bird Conservation International* 17: 131-139.

Baral, N. and R. Gautam (2007). Why should conservationists go beyond protected areas to safeguard critically endangered vultures? *Danphe* 16(1): 30-31.

Gautam, R. and N. Baral (2007). Endangered vultures in the Pokhara valley: will they thrive? *Danphe* 16(1): 32-33.

Baral, N., R. Gautam and B. Tamang (2005). Population status and breeding ecology of White-rumped Vulture *Gyps bengalensis* in Rampur Valley, Nepal. *Forktail* 21: 87-91.

We believe that the above publications have disseminated information to a large audience about the vulture status and conservation efforts in Nepal. The publications also contain relevant data required to make public policies to save critically endangered vultures. We intend to publish a couple of papers in peer-reviewed journals in the coming years.

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