

**POPULATION STATUS, BREEDING SUCCESS AND CONSERVATION ISSUES OF WHITE-
RUMPED VULTURE (*Gyps bengalensis* Gmelin, 1788) IN NAWALPARASI FORESTS (IBA),
SOUTH-CENTRAL NEPAL**



A Dissertation

**Submitted for the Partial Fulfillment of the Requirements for the
Master's Degree of Science in
Zoology (Ecology)**

By

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DECLARATION

This study entitled “**POPULATION STATUS, BREEDING SUCCESS AND CONSERVATION ISSUES OF WHITE-RUMPED VULTURE (*Gyps bengalensis* Gmelin, 1788) IN THE NAWALPARASI FORESTS (IBA), SOUTH-CENTRAL NEPAL**” is original of its kind and has not been submitted anywhere. The findings and statements stated in this dissertation are based on my own field works.

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RECOMMENDATION

It is my pleasure to mention that **Mr. Narendra Kumar Upadhyay** has carried out the dissertation entitled "**POPULATION STATUS, BREEDING SUCCESS AND CONSERVATION ISSUES OF WHITE-RUMPED VULTURE (*Gyps bengalensis* Gmelin, 1788) IN THE NAWALPARASI FORESTS (IBA), SOUTH-CENTRAL NEPAL**" under my supervision and guidance. This is the candidate's original work, which brings out important findings regarding population status and breeding success essential for conservation of 'Critically Endangered' White-rumped Vultures in the Tarai region. To the best of my knowledge, this dissertation has not been submitted for any other degree in any institution. I recommend that the dissertation be accepted for the partial fulfillment of the requirements for the **Master's Degree of Science in Zoology** specializing in **Ecology**.

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ABBREVIATIONS AND ACRONYMS

BCN	=	Bird Conservation Nepal
BNHS	=	Bombay Natural History Society
CFUG	=	Community Forest User Group
CNP	=	Chitwan National Park
DNPWC	=	Department of National Parks and Wildlife Conservation
DS	=	Diclofenac Sodium
EG	=	Eurasian Griffon
ENS	=	Environmental News Service
EV	=	Egyptian Vulture
GoN	=	Government of Nepal
IBA	=	Important Bird Areas
IC	=	Indian Currency
IUCN	=	International Union for Conservation of Nature
JTA	=	Junior Technical Assistant
LBV	=	Long-billed Vulture
NGO	=	Non Governmental Organization
NRs	=	Nepali Rupees
NSAID	=	Non-Steroidal Anti-Inflammatory Drug
NSE	=	NewScientist Environment
NTNC	=	National Trust for Nature Conservation
OWBV	=	Oriental White-backed Vulture
PA	=	Protected Area
RSPB	=	Royal Society for Protection of Birds
SBV	=	Slender-billed Vulture
SWR	=	Suklaphanta Wildlife Reserve
VDC/s	=	Village Development Committee/s
WRV	=	White-rumped Vulture
WWF	=	World Wildlife Fund
ZSL	=	Zoological Society of London

ABSTRACT

The study of population status and breeding success of critically endangered White-rumped Vulture (*Gyps bengalensis*) was conducted in Nawalparasi Forests (IBA), Nepal from October 2006 to May 2007. The study was mainly focused to the North of Nawalparasi Forests, giving emphasis to the South as well. The study was concentrated in the villages of Makar, Panchanagar, Tilakpur, Ramnagar, Sunwal, Amarauda and Banjariya VDCs, though Daunne Devi, Swathi and Sukrauli VDCs, were also thoroughly surveyed regularly.

The estimated population size of WRVs using Jackknife technique was 101 individuals. The other Vulture species include Egyptian Vulture (*Neophron percnopterus*), Red-headed Vulture (*Sarcogyps calvus*) and Himalayan Griffons (*Gyps himalayensis*). Of the 34 nests recorded (20 occupied and 14 abandoned) only 9 reared the young. Based on active nests as the primary unit the calculated breeding success was 60%. A total of 30 trees of three species i.e. Saj (*Terminalia tomentosa*), Sal (*Shorea robusta*) and Karam (*Adina cordifolia*) were used by WRVs for nesting. Majority of nests (94.10%) were found in Saj and few in Sal (2.95%) and Karam trees (2.95%). Six carcasses of ox and buffalo along with 10 dead WRVs were also encountered during the study period. The largest flock size of WRVs was 43 recorded in January. No any significant difference in flock size of WRVs was found between nesting and post-nesting phases ($t_{cal} = 0.74 < t_{tab} = 2.1$).

Of the 72 villagers questionnairred from different VDCs of the study area only 5.60% of the people were known that certain kind of veterinary drugs were responsible for the decline in Vulture population. About 62.50% of the villagers think that loss of habitat is the main reason for the decline in Vulture population but 29.20% of people are in favor of decrease in carcass availability and 8.30% went for certain veterinary drugs and pesticides. Of the 10 veterinary professionals interviewed all of them were selling Meloxicam but among them 20% were selling both Meloxicam and Diclofenac.

Key words: White-rumped Vulture, Nawalparasi Forests (IBA), Population size, Breeding success, Diclofenac, Meloxicam

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CHAPTER 1: INTRODUCTION

1.1 Background

Nepal is exceptionally rich in biodiversity owing to its small size especially because of ecosystem diversity resulting from altitudinal gradients. Comprising more than one tenth of the world's bird species, bird life of Nepal is unrivalled in the world. New species are continually discovered as new areas are explored. To date 862 bird species have been recorded (BCN, 2006) of which 29 species are identified as 'Globally Threatened' (BirdLife International, 2000, 2001).

Vultures are the birds of prey of the order Falcones or Accipitres that habitually feed on carrion. This order comprising the eagles, hawks and their relatives, divided into several families, can be categorized into Vultures of Old World on one hand and those of New World on the other (Encyclopedia Americana, 1996). A particular characteristic of many Vultures is bald head i.e. devoid of feathers. This is because a feathered head would become spattered with blood and other fluids and thus will be difficult to keep clean. Physiologically the bare skin areas in Griffon Vultures play an important role in thermo-regulation (Ward *et al.*, 2008).

The New World Vultures of family Cathartidae contains seven species found in North and South America. It includes five Vultures and two condors. Now, American Vultures or New World Vultures are recognized as Ciconiformes in the family Cathartidae. New World Vultures are most probably not closely related to Old World Vultures or other diurnal raptors which themselves are often classified in different Orders. They resemble Old World Vulture because of convergent evolution and are usually considered to be more closely related to storks and ibises, as is reflected by their placement in the Ciconiformes (Gooders, 1975).

European and Asian Vultures are recognized as Old world Vultures (family Accipitridae, sub-family Aegypiinae). There are 15 species of Old world Vultures. Old world Vultures belong to the family Accipitridae which also includes eagles, kites buzzards and hawks. They range from Southern Europe and parts of America, India, Central Asia and China. They are not all closely related to the superficially similar New world Vultures and condors, and do not share that groups' good sense of smell. The

similarities between the two groups are due to convergent evolution rather than a close relationship (Gooders, 1975).

Vultures feed on carrion which they usually detect from aloft and rarely inhabit open regions but some feed on any sort of garbage. In eastern countries of the Old World and in parts of tropical America they are frequent in towns and villages, where they are tolerated as scavengers. These birds show no fear of man, perching as walking sedately about, in even the most crowded bazaar or market. In Tibet and India, they dispose of human dead exposed in certain sites when religious custom forbids burial or cremation. Vultures are repulsive in many ways but beautiful when aloft. Gliding on almost motionless wings and soaring in wide circles often to immense heights, the larger ones are among the most majestic of all birds (Encyclopedia Americana, 1996).

Vulture Species

Of the total nine Vulture species found in the Indian sub-continent all are known to be residents (Ali and Ripley, 1978; Grimmett *et al.*, 2000, Rasmussen and Parry, 2000). Eight species of Vultures are found in Nepal that includes four species of *Gyps* Vultures' i.e. White-rumped Vulture (*Gyps bengalensis*), Slender-billed Vulture (*Gyps tenuirostris*), Himalayan Griffon (*Gyps himalayensis*) and Eurasian Griffon (*Gyps fulvus*) (BCN, 2006). Other Vulture species include Lammergier (*Gypaetus barbatus*), Egyptian Vulture (*Neophron percnopterus*), Red-headed Vulture (*Sarcogyps calvus*) and Cinerous Vulture (*Aegypius monachus*). The Cinerous Vulture is winter visitor to Nepal. The Long-billed Vulture (*Gyps indicus*), also known as Cliff Vulture may occur in Nepal but there are no confined records yet (Giri and Baral, 2001). Long-billed Vulture is considered endemic to India and Pakistan (Rasmussen and Parry, 2000).

It is now well established that the Long-billed Vultures, now split taxonomically into two sub-species: Long-billed Vultures (*Gyps indicus*) and Slender-billed Vultures (*Gyps tenuirostris*) (Rasmussen and Parry, 2000), of which the later is thought to occur in Nepal. There have been studies on *Gyps* Vultures and other vulnerable Vultures in India, Pakistan and Nepal (Virani *et al.*, 2001; Gilbert *et al.*, 2002; Baral and Gautam, 2006; Cuthbert *et al.*, 2006).

White-rumped Vultures and Slender-billed Vultures are resident breeders of Lowland Nepal. The White-rumped Vulture has been the most common Vultures in Lowland Nepal (Fleming *et al.*, 1984; Inskipp and Inskipp, 1991). Though White-rumped Vultures are found in few isolated colonies at present, Nawalparasi Forests, Rampur valley and Dang forests are still stronghold habitats of this species. The largest density of remaining colonies of White-rumped Vultures in Nepal now occurs at Rampur valley, Palpa (Gautam *et al.*, 2003).

Among 27 Important Bird Areas (IBAs) in Nepal designed by Bird Conservation Nepal (BCN), Nawalparasi Forests is among the one which is not included in PA network. Nawalparasi Forests has been included in IBA because of a large number of nesting Vultures. It comes among 14 unprotected sites for bird and biodiversity conservation in Nepal. Important Bird Areas are places of international significances for the conservation of birds at the global level (Baral and Inskipp, 2005).

Since the early 90s *Gyps* Vulture populations have collapsed across the Indian sub-continent (Gilbert *et al.*, 2002; Prakash *et al.*, 2003). Populations of at least three species are known to have affected (Oriental-white backed, Long-billed and Slender-billed Vultures) and have declined by more than 97% since 1992 (Prakash *et al.*, 2003; Green *et al.*, 2004). All three species are now listed as 'Critically Endangered' (BirdLife International, 2000, 2001) despite the fact that White-rumped Vultures was in the previous decade, considered to be the commonest large raptor in the world (Houston, 1985). White-rumped Vultures and Slender-billed Vultures were formerly distributed in many lowland parts of Nepal (Inskipp and Inskipp 1991; Grimmett *et al.*, 2000). Recent research in India shows a sharp decline in the population of Egyptian Vultures and Red-headed Vultures (Cuthbert *et al.*, 2006).

1.1.2 Diclofenac Alternative

Considerable evidence now indicate that the catastrophic Vulture decline has been caused by the non-steroidal anti-inflammatory drug (NSAID) Diclofenac, which is widely used to treat livestock across the Indian sub-continent (Green *et al.*, 2004; Oaks *et al.*, 2004; Shultz *et al.*, 2004). Vultures are exposed to Diclofenac through consuming the carcasses of treated livestock. In experiments, captive WRVs died after feeding on tissues of domestic animals that had received a normal veterinary dose of the drug a few hours before death from renal diseases and all birds showed extensive visceral gout with deposits of uric acid on and within internal organs due to kidney failure. The same clinical signs were found in a high

proportion of dead or dying wild Vultures in Pakistan, India and Nepal; and all kidneys samples analyzed from birds with gout contained residue of Diclofenac, whereas none of the samples from birds without gout did so (Oaks *et al.*, 2004; Shultz *et al.*, 2004). More recently, Diclofenac was found to be lethal to *Gyps fulvus* and *Gyps africanus* and it seems likely that it is equally toxic to all *Gyps* species (Swan *et al.*, 2006).

However, other causes such as habitat destruction, food shortage, human persecution, poisoning and pesticide use may have caused a gradual decline in Vulture populations (Satheesan 1999; BirdLife International 2001; Baral and Gautam 2006, 2007a). Despite *Gyps* population decline across South-east Asia, until recently only one species of Africa, *Gyps coprotheres*, is considered globally threatened (Vulnerable; BirdLife International, 2000), largely because of the indiscriminate use of poisons in Southern Africa (Mundy *et al.*, 1992).

Ban on veterinary Diclofenac, establishment of captive breeding center, monitoring of Vulture colonies in the world and raising conservation awareness are some strategies to save the Critically Endangered Vultures from the brink of imminent extinction. The Government of Nepal has banned the manufacture and import of veterinary Diclofenac in June 2006. Meloxicam is a Vulture-safe alternative to Diclofenac. It has been manufactured by 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 Meloxicam to Diclofenac, it is expected that other Vulture range states will also ban veterinary Diclofenac soon.

1.1.3 Vulture Breeding

A captive breeding center established in Pinjore, Haryana of India successfully bred a chick of White-rumped Vulture in captivity under the supervision of scientist and breeder Vibhu Prakash who had been trying along with the Bombay Natural History Society (BNHS) and British Vulture Researchers since 2001 to ensure captive breeding (BBC, 2007).

A captive breeding center has also been established in Chitwan National Park (CNP) of Nepal to conserve and increase the number of declining Vulture species under the consideration from Department of National Parks and Wildlife Conservation (DNPWC). The breeding centre is managed by the Park itself with the aid from Zoological Society of London (ZSL), Bird Conservation Nepal and National

Trust for Nature Conservation (NTNC). The technical aspects for breeding are supported by Royal Society for Protection of Birds (RSPB).

In a drive to protect Vultures, ‘Vulture restaurants’ that were able to draw critically endangered Vulture species like White-rumped and Slender-billed Vultures in Cambodia (ENS, 2004) has also been established in different parts of Nawalparasi district. A Vulture restaurant has been started in Panchanagar VDC of Nawalparasi district by a community based organization with a technical and financial support from BCN. The ‘Vulture restaurant’ established in Pithauli of Nawalparasi district has increased the number of nesting pairs of Vultures from just 17 individuals in 2005 to 32 in 2007 (NSE, 2008).

A ‘Vulture restaurant’ is a place where carcasses and waste meat such as dead livestock, offal and waste meat products from butcheries and small abattoirs are regularly offered for Vultures. Such practice is important since they supplement the ever-decreasing food base of Vultures and provide a secure source of food for them which is free of poisons, agro-chemicals and veterinary drugs. They are places free from human disturbances where Vultures can feed. ‘Vulture restaurant’ serve to increase the survival rate of young Vultures, especially within their first year of leaving nest and they can be used to attract Vultures back to areas where they used to occur.

Though a ‘Vulture restaurant’ is operating, there is no way of preventing the birds feeding elsewhere on contaminated carcasses where the use of a toxic substance in treating livestock is pervasive. The best that can be hoped is to slow down the rate at which the local Vulture population approaches extinction, while efforts are made to take out the toxic substance of the environment (Gilbert *et al.*, 2007).

1.2 Status of *Gyps* Population in the Indian Sub-continent

White-rumped Vulture is classified as Critically Endangered on the IUCN Red list 2002 (4), and listed on appendix II of CITES (3). Three species of Vultures endemic to South-Asia, the Oriental white-backed Vulture (*Gyps bengalensis* Gmelin) along with Long-billed Vulture (*Gyps indicus* Scopoli) and Slender-billed Vulture (*Gyps tenuirostris* Gray) are at high risk of global extinction and are listed as ‘Critically Endangered’ because of rapid population decline within the last decade in the Indian sub-

continent (BirdLife International, 2000, 2001; Prakash *et al.*, 2003; Green *et al.*, 2004; IUCN 2004). Significant population declines of Vultures may have gone unnoticed for many years simply because they were so abundant.

WRVs occurs in Pakistan, India, Bangladesh, Nepal, Bhutan, Myanmar, Thailand, Laos, Cambodia and Southern Vietnam and extinct in Southern China and Malaysia. It has been recorded from South-east Afghanistan and Iran where its status is currently unknown. Previously widespread and abundant across its range, it disappeared from most of south-east Asia in the early 20th century and now occurs locally. Since 1996, WRVs has suffered a catastrophic decline over 95% in its remaining strongholds in Pakistan and India, although flocks are still present locally. It is described as 'Still common' in Shan state (Myanmar). It is very rare in Southern China (BirdLife International, 2006).

Surveys on the population status of Vultures have been carried out and reasons for their sudden decline studied by various avian experts. Decline of Vultures populations in India was first recorded at the Keoladeo Ghana National Park, Rajasthan during mid 1980's to mid 1990's, followed by Northern India road counts. Decline has been projected in excess of 97% over a 12 year period in India and 92% in a 3 year period in Pakistan (Virani, 2006). Nepal has also experienced similar reductions. A dramatic decline of two species, White-rumped Vultures and Slender-billed Vultures was noticed in Nepal since the mid 1990s, when an estimated >150,000 pairs of White-rumped Vulture were known to breed. There are now less than 1000 pairs of the Slender-billed Vultures in Nepal. The current rate of annual decline in Nepal is estimated to be 90% and the rate of decline within a decade is estimated at 90 to 95% (Nepal Country Report, 2006).

In Bangladesh, the WRV is threatened, and Long-billed Vultures and Eurasian Griffons are rare (Bangladesh Country Report, 2006). Population of WRV and SBV in South-east Asia (India, Nepal, Pakistan, Myanmar, Cambodia, Laos, PDR, and Vietnam) are low, but declines are thought to have been historical and slower, rather than recent and rapid. The world population size is not known for any of these species.

In India and Nepal, the White-rumped Vultures have declined from place as much as 95% (Prakash, 1999; Baral *et al.*, 2001). Studies in the Eastern Lowland have shown an alarming rate of Vulture

mortality (Baral *et al.*, 2001). Some preliminary observations in 2001 showed that West Nepal held bigger population of Vultures than the East and Central Nepal (Inskipp and Inskipp, 2001). The highest density of remaining colonies of White-rumped Vultures in Nepal now occurs at Rampur valley (Baral *et al.*, 2005). In the Thai-Malay Peninsula, where the White-rumped Vulture was previously 'resident and widespread' is now described as 'local and sparse' (Wells, 1999). The White-rumped Vulture was widely distributed in India, from the Himalayan west to Srinagar, east to Arunachal Pradesh, Assam and the northeast hill states, south to the southern Western Ghats in Kerala and Tamil Nadu (Ali and Ripley, 1978).

1.3 Ecology

1.3.1 External Morphology

Adult: The average length of adult White-rumped Vulture is 90cm (35inches). A specimen (♀) measured from Nepal by Bishwash (1960) gave wing 555mm, bill (from nostril) 62mm, tarsus 94mm, tail 238mm. A young non-breeding male from Nepal measured wing 590mm. The adult shows heavy brownish black with naked scrawny neck and head sunk into the shoulders while the bird is at nest. A white or whitish ruff of soft feathers is present round the base of neck, broken in front by a black crop-patch. The sexes are alike. When perched, as well as in flight below eye level or when banking high up in the air, white lower hank is diagnostic. In over head aspect a broad whitish band along underside of wings distinguishes this species (Ali and Ripley, 1978).

Young (Immature): Young are more brownish than black, without white back or underwing bands. Head and neck are more or less covered with dirty white fluffy down.

Chick: In chick down covers whole body except a track from base of neck broadening to vent. The down of head and neck is shorter than the rest. Mouse is gray in colour except darker patches to the uropygium and along ulnar border.

1.3.2 Status, Distribution and Habitat

Resident: Our commonest Vulture found more or less throughout the area from West Pakistan (Baluchistan) east through Assam and Manipur; South from Kashmir and along the Himalayas between 1500 and 2500m elevation (including Nepal), through the Peninsula to Kanyakumari. It is not found in

Ceylon. Where 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, 1978).

1.3.3 General Habits

White-rumped Vultures are usually seen in small groups, commonly in association with the Long-billed and other Vultures, perched hunched-up on tree-tops and palms on the countryside, on roofs or walls in the vicinity of slaughter houses, municipal refuse dumps and outskirts of villages and habitations. Favourite roosts and the ground underneath become besmirched and reeking with the birds acrid excreta, presenting a sepulchral while washed appearance, which kills off the tree if too long patronized.

Though a repulsive creature at close quarters, a Vulture gliding majestically in the sky on outspread motionless wings looks the embodiment of grace and buoyancy. 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 will soar for hours on end and circle aloft in the sky with no other apparent motive than fun. Their eyesight is remarkably keen get perhaps less phenomenal than popularly believed. That they are so quick to discover a carcass on the countryside, even though hidden under forest, and to gather at it from almost nowhere in such an incredible short time is usually due not so much to keenness of sight directly as to the low-flying birds being guided by the movement of crows, village dogs and jackals. When following one another down to a carcass some birds make a wide spiral descent while other hurtle down through space more or less perpendicularly, wings half palled in, legs dropped and dangling.

In order to take off from the ground, Vultures are obliged to run and hop along for some distance against the wind aided by powerful wing-flaps. When fully gorged they are sometime totally unable to get airborne, and often have to spend the night on the ground. Occasionally they feed throughout the night, whether moonlit or dark. It has been suggested that Vultures properly gorged can go without a meal for several days. Such a facility could be of distant survival value to birds which must frequently have to face feast-and-famine conditions. In spite of foul feeding habits which often entail the head, neck and other parts becoming besmeared with gore, the White-back like other large Vultures is a comparatively clean bird and misses no opportunity for a bath (Ali and Ripley, 1978).

1.3.4 Voice and Calls

They produce raucous, strident, creaky screeches or ‘laughter’ kakakaka while one bird is supplanting another at a carcass or roost. Long drawing grating noises, as of a hoe being scraped over a cement floor is uttered by female during copulation.

1.3.5 Breeding

Season: The breeding season is principally October to March.

Nest: A large untidy platform of sticks and twigs often with green leaves attached with a shallow central depression lined with green leaves represents the nest in White-rumped Vultures. Leafy things are collected from living tree by bird (♂?) tugging at it with bill, assisted by vigorous wing-flapping. Nests are built 10-18m up at or near the top of a large Banyan or Peepal (*Ficus bengalensis* or *Ficus religiosa*), Mango (*Mangifera indica*), Sheesham (*Dalbergia sissoo* or *D. latifolia*), Casuarina, or similar tree growing in or near a village, or lining a road or land bank. Sometime in scattered colonies of up to 25-40 nests in a grove or small patch of forest.

Egg: Eggs are normally a singleton, very rarely 2, thick-shelled, glossless white unmarked, or variably and faintly so with reddish brown, grey-brown, or lavender. The average size of 100 eggs is 85.8×64.2mm. The incubation period is about 45 days. Nest young fed on regurgitated gobbets of flesh. Copulation takes place close to the nest and often actually on it while the female is incubating, sometimes during moonlit nights. During the act, the female flatters herself on the perch with neck stiffly stretched forward, uttering the hard scraping screams. Male balance himself on her back with heavy flapping and performs with distinct jerks and pushes (Ali and Ripley, 1978).

1.4 Statement of the Problem

Though Nawalparasi Forests is an important IBA because of nesting White-rumped Vultures, there is still dearth of data regarding status and breeding in lack of regular monitoring. In the present context when there is rapid decline in *Gyps* population worldwide because of veterinary drug Diclofenac (a NSAID), Nawalparasi can't remain untouched. This catastrophic decline has listed WRVs as ‘Critically Endangered’ by BirdLife International (2000, 2001). Diclofenac might be the primary causes for the mortality of Vultures in the study area (Baral and Inskipp, 2005) other factors like habitat destruction,

disturbance, hunting, lack of people awareness, food shortage and predation can't be discarded (Baral and Gautam, 2007a). There is necessity to assess these factors in this area and make an address to them. The rapid decline in forest area and Vulture preferable tree species for nesting is resulting in the reduction of number of Vultures. Unless a comprehensive study of the population status and existing threats is conducted, no reasonable management recommendation and conservation action plan can be established. There is necessity of regular monitoring to save these majestic scavenging birds from extinction.

1.5 Aims of the Study

- To study the Population status of White-rumped Vultures in the Nawalparasi Forests (IBA).
- To study the breeding success of White-rumped Vultures in the area.
- To study the flock size, species diversity and carcass availability for available species.
- To assess the threats and recommend measures for Vulture conservation in the area.

1.6 Research Hypothesis

There is variation in the flock size of White-rumped Vultures between nesting and post-nesting phases

1.7 Importance of the Study

No regular study has been conducted in the Nawalparasi Forests (IBA) regarding the status and nesting of White-rumped Vultures. A total of 71 nests of WRVs were counted in the Nawalparasi Forests in the breeding season 2002/2003 (Baral *et al.*, 2003) which reduced to 48 *Gyps* Vultures nest in 2005 breeding season (Subedi, 2007). Lack of information regarding status and distribution of Vultures may lead to the local extinction of Vulture species. Action plan and its effective implementation are required for its protection by conserving natural habitats and allowing it to recover into viable population. This requires a sound and systematic database on the species by bridging the information gap. Hence, baseline survey of population and nests of Vultures in the Nawalparasi Forests will help to explore its distribution in the area and formulate proper conservation and management activities.

Further survey of *Gyps* Vulture to identify the breeding status, and effective conservation of Vulture habitat in the study area could be useful management initiation to ensure the combined existence of the lord of the sky. In the present context when there is catastrophic Vulture population decline in the Indian sub-continent, this study will provide useful data about the population and breeding success of Vulture in Nepal. Most of the researches were done in the protected area system; this research has been

conducted outside the protected area which adds the data and is important because of the nesting habit of White-rumped Vultures.

1.8 Limitation of the Study

- i. Dead White-rumped Vultures couldn't be examined medically for the probable cause of mortality.
- ii. Environmental complexity like presence of fog in early mornings of winter disturbed the clear visibility of Vultures and their nests through binoculars.

CHAPTER 2: LITERATURE REVIEW

Ward *et al.*, (2008) studied the bald heads and the role of postural adjustment and bare skin areas in thermoregulation in Griffon Vultures (Genus *Gyps*) using a mathematical model to estimate the amount of bare skin exposed in the postures adopted in cold and hot conditions. Postural change can cause the proportion of body surface composed of bare skin areas to change from 32 to 7% and in cold conditions these changes are sufficient to account for a 52% saving in heat loss from the body. The bare skin areas in Griffon Vultures may play an important role in thermoregulation.

Baral and Gautam (2007a) carried out field surveys from September 2006 to May 2007 to monitor the population status and breeding success of White-rumped Vulture in Rampur, Syanja and Tanahu. Repeated absolute counts at nesting and roosting sites as well as at carcass was done. The observed maximum WRV was 92 in Rampur, and 40 in Syanja and Tanahu. Based on active nest as primary units, the breeding success was 40% in Rampur, and 71% in Syanja and Tanahu.

Baral and Gautam (2007b) studied three Vulture species in Pokhara i.e. White-rumped, Slender-billed and Egyptian Vultures. In five colonies, a total of 36 WRVs, 15 SBVs and 86 EVs were recorded during 2006/2007 field season. Based on occupied nests as primary units, the breeding success of WRVs was 42.8% and that of Slender-billed Vulture was 57.1%. Seven chicks of Egyptian Vulture were on four nests.

Chalise (2007) described the presence of White-rumped Vulture, Slender-billed Vulture and Red-headed Vulture in the Suklaphanta and Kanchanpur area.

Gilbert *et al.*, (2007) studied the neck drooping posture in Oriental white-backed Vultures. The observations strongly suggested neck drooping posture having a role in thermo regulation. In contrast to the highly seasonal pattern of neck-drooping, mortality of Vulture occurred in all months of the year. These findings indicates that neck-drooping has low specificity and sensitivity as an indicator of poor health and impending death in Vultures.

Subedi (2007) conducted *Gyps* Vulture study in Western lowland of Nawalparasi district, South-central Nepal from 2 March to 6 June 2005 from six colonies of *Gyps* Vultures, once weekly. A total of 48 *Gyps*

Vulture nests were located at these colonies. Out of these nests, 18 were found to be active and 30 were found abandoned. Of the recorded, 18 active nests, six nests belonged to SBV and 12 nests belonged to WRV. A nesting success of 100% was observed in the study area.

Green *et al.*, (2006) measured the concentration of Diclofenac in the tissues of treated Indian humped and European cattle (*Bos indicus* and *Bos taurus*) in relation to the interval between dosing and death using a dose response model to assess the risk opposed to wild Vultures if they feed on carcasses of treated livestock. Diclofenac concentration in fat, intestine, kidney and liver were considerably higher than those in muscle. Diclofenac concentration, averaged across the carcass, was enough to cause reliable mortality (>10% of birds per meal) if Oriental White-backed Vulture were to take a large meal from the carcass of an animal that was given its last dose of the drug within a day or two before death.

Taggart *et al.*, (2006) studied the Diclofenac disposition in Indian cow and goat with reference to *Gyps* Vulture population decline. In the disposition experiment, animals were treated with a single intramuscular injection of Diclofenac at 1000 mg Kg⁻¹ bw. In Cow, Diclofenac was detectable in liver, kidney and intestine up to 71 hours post-treatment; in plasma, half-life was 1.2-2 hours. In Goat, tissue residues were undetected after 26 hours. Prevalence of Diclofenac in liver from 36 dead livestock collected in the field was 13.9%. Data suggested Diclofenac residues in Indian Cow and Goat to be short-lived; however Diclofenac prevalence in carcasses available to Vulture may still be very high.

Baral and Gautam (2005) monitored the population status and breeding success of critically endangered White-rumped Vultures in Rampur valley including Syanja and Tanahu in 2004/2005. The estimated population size using Jackknife technique was 100 birds. A total of 64 occupied nests were recorded from five colonies of which 42 were active and 30 were productive. Based on active nests as a primary unit, the breeding success was 71%. At the additional two sites, highest count of 25 Vultures was recorded in April. There were 14 occupied nests of which 12 were active and 9 were productive. The breeding success was 75%.

Baral *et al.*, (2005) conducted a survey of the critically endangered White-rumped Vultures in Lowland Nepal from October 2002 to May 2003 to assess the population size, breeding success and nest-tree availability. Six Vulture colonies were found, which supported 72-102 birds during the breeding season

and 123 birds following the breeding season. Breeding success at 70 occupied nests was 0.5 young per nest. Most nests were in Kapok (*Bombax ceiba*) tree. A total of 33 dead Vultures were found, of which 30 were adults.

Umapathy *et al.*, (2005) studied semen characteristics of the captive Indian White-backed Vulture over a period of 2 yrs using the manual massage method and evaluated semen P^H, sperm concentration, percentage normal/abnormal spermatozoa and percentage motile spermatozoa. The concentration of spermatozoa and percentage motile spermatozoa in the Indian White-backed Vulture was found low as compared to those in other birds.

Baral (2004) conducted study on the conservation status of White-rumped Vultures in Lumbini from October 2001 to June 2002 and found breeding success to be 0.33 chicks per nest. There was significant difference in flock size of White-rumped Vultures between nesting and post-nesting phases.

Green *et al.*, (2004) studied the Diclofenac poisoning as a cause of Vulture population decline across the Indian subcontinent. Surveys indicate animal decline of 22-50% for WRV, SBV and EV. In five colonies, a total of 36 White-rumped, 15 Slender-billed and 86 Egyptian Vultures were recorded during 2006/2007 field season. Based on occupied nests as primary units, the breeding success of White-rumped Vulture was 42.8% and that of Slender-billed Vulture was 57.1%. Seven chicks of Egyptian Vulture were on four nests.

Oaks *et al.*, (2004) studied Diclofenac residues as the cause of Vulture population decline in Pakistan. Between 2000 to 2003 high annual adult and sub-adult mortality (5-86%) and resulting population declines (34-95%) were associated with renal failure and visceral gout in 16 OWBV colonies in the Kasur, Khanewal and Muzaffargarh-Layyah districts of Pakistan. Diclofenac residues and renal disease reproduced experimentally in OWBVs by direct oral exposure and through feeding Vultures' proposed that residues of veterinary Diclofenac are responsible for the OWBV decline.

Pandey and Gupta (2003) conducted study in the status of White-rumped and Slender-billed Vultures in four selected sites of Chitwan from February 2002 to January 2003. Altogether 69 Vultures of different species were observed during one-year period in the four study sites. Overall study concluded parasitic

infections accompanied by reduced food availability, might be one of the major threats to them. Disease factor possibly a virus may be another cause of the Vulture population decline. Another presumed threat was the effect of helminthes parasites, which was confirmed by the prevalence of helminthes eggs (69.23%) in Vultures stool.

Prakash *et al.*, (2003) conducted a survey to quantify the decline in the populations of WRV and LBV across India since 1990-1993. Massive decline in the populations of both species were apparent from all parts of the country, and exceeded 92% overall. The extent of declines did not differ between protected areas and elsewhere. The pattern of decline and the presence of sick and dead birds indicate epidemic diseases as a possible cause.

Riley *et al.*, (2003) isolated *Raillietiella trachea* a sp., a Cephalobaenid pentastomid from the trachea of fledgling of an Oriental White-backed Vulture taken in Punjab province, Pakistan, with speculation about its life-cycle. This was the first record of a pentastomid from a fully terrestrial bird.

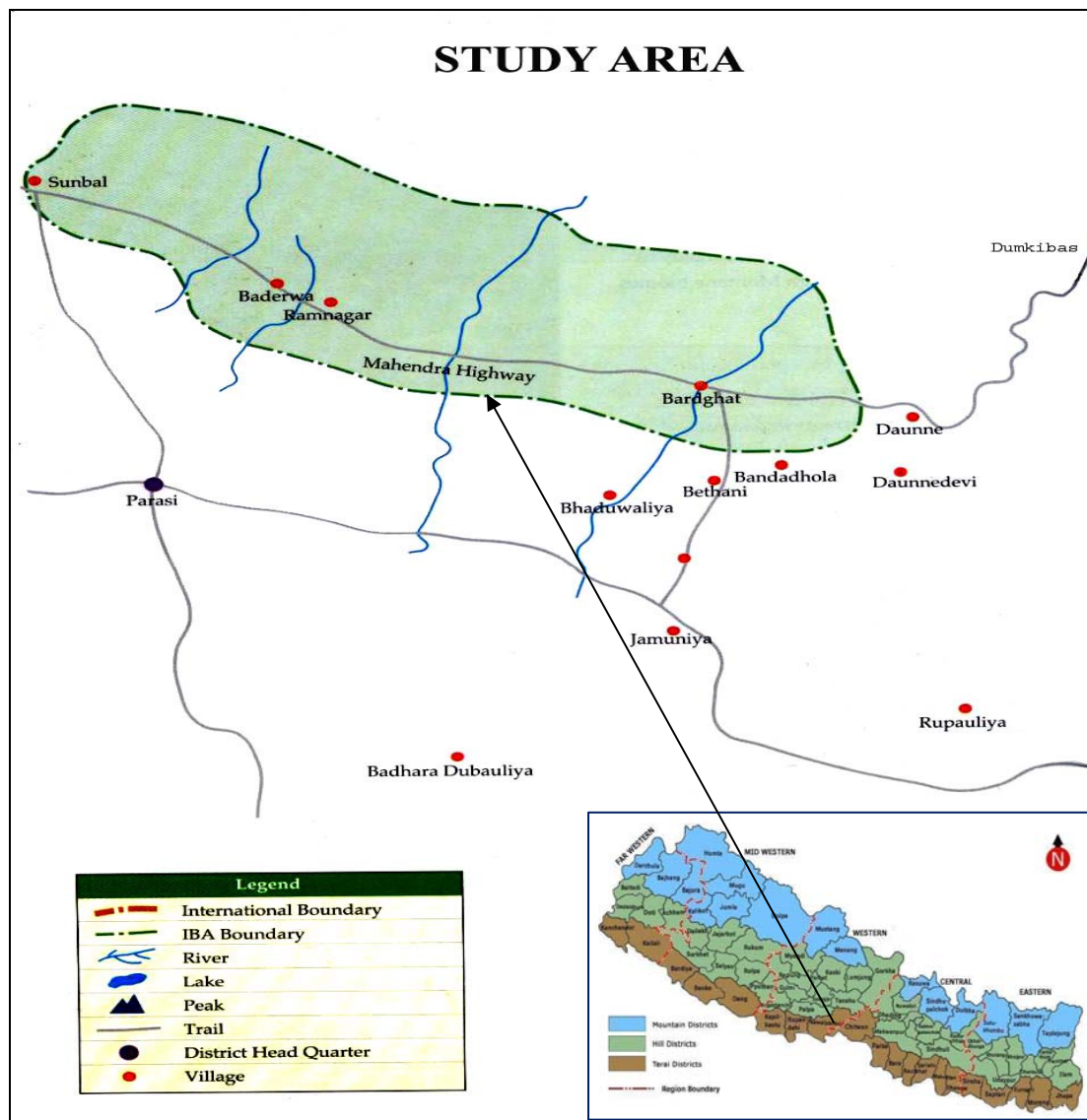
Chalise (1999) recorded two species of Vulture during a study of Churiya range of Ilam district with 5 Himalayan Griffons and 1 Egyptian Vulture.

CHAPTER 3: RESEARCH METHODS

3.1 Study Area

3.1.1 Physical Description

The proposed study was carried out in the Nawalparasi Forests, 27° 33' N and 83° 00' E in the Lumbini zone that lies in between Bardghat to Sunwal at the base of Churiya hills of Nawalparasi district in South-central Nepal. It is located at an altitude of 350 meters. The forest is unprotected covering an area of 4,000 hectares (Baral and Inskipp, 2005).



Map1. Map of Nepal showing Nawalparasi Forests (IBA)

3.1.2 Topography

Topographically Nawalparasi district can be divided into three regions as; Mahabharat and Churiya hills, Inner Tarai and Tarai plain. The elevation starts lowest from 91m above sea level to the mountains of 2,000m and more.

3.1.3 Geology and Soil

The geological formation of the district is Alluvial plain with characteristics similar to the Gangetic plain of India in the South while Siwalik in the North. The Siwalik hill is composed of coarsely bedded stone, crystalline rocks, clays and conglomerate in between the alluvial plains. Siwalik hill is the dry zone commonly known as Bhabar tract composed of boulder, gravels and sand. The soil of the Tarai flat plain is derived from the old as well as the new alluvial soil carried out by the rivers from the hills and mountains in the north. The soil ranges from loamy, sand loam, silty loam and clay loam.

3.1.4 Climate

Nawalparasi district has humid sub-tropical monsoon climate with three distinct seasons; winter, spring and monsoon. The summer days are quite hot with the mean maximum temperature of 31.99°C in 2005 and 31.85°C in 2006. The maximum mean temperature in May 2005 was 40.1°C and 37.8°C in April 2006. The winter is relatively not so cold. The minimum temperature recorded in 2005 was 19.33°C and in 2006 was 18.39°C. The mean minimum temperature recorded was 8.5°C in January 2005 and 8.5°C again in January 2006 (Fig. 1 and Fig. 2).

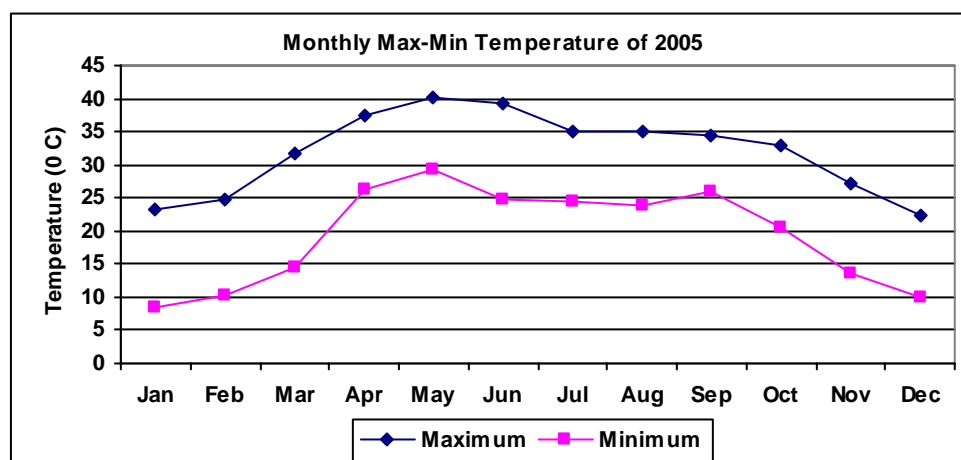


Fig. 1. Monthly maximum and minimum temperature of Simari, Nawalparasi in 2005 (Source: Department of Hydrology and Meteorology, NG, 2007).

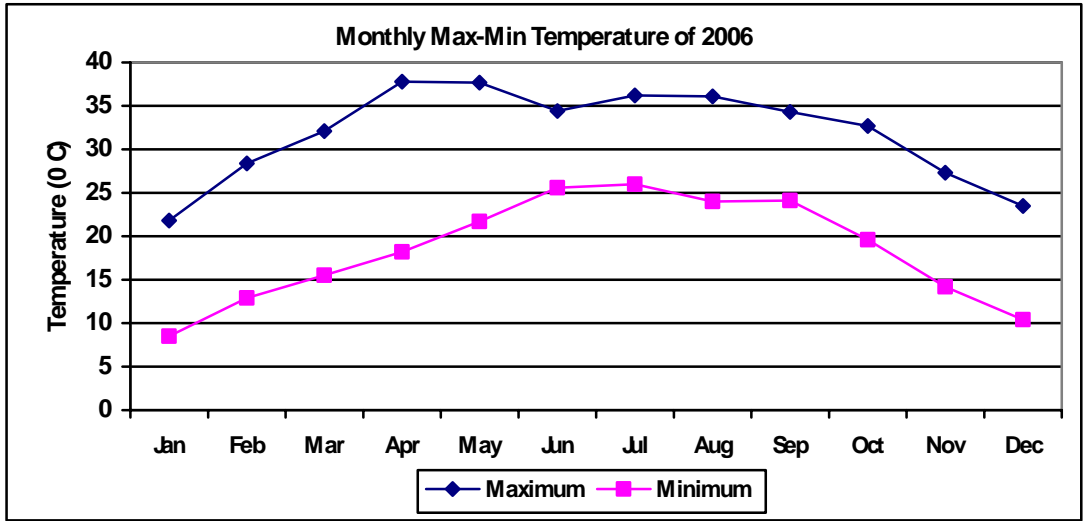


Fig. 2. Monthly maximum and minimum temperature of Simari, Nawalparasi in 2006 (Source: Department of Hydrology and Meteorology, NG, 2007).

The summer monsoon starts from mid June and reaches peak in August and continues to late September. The mean annual precipitation was estimated to be 235.7mm during 2005 and 231.61mm during 2006. The maximum rain fall was recorded to be 662.5mm in August during 2005 and 526.0mm in August during 2006 (Fig. 3).

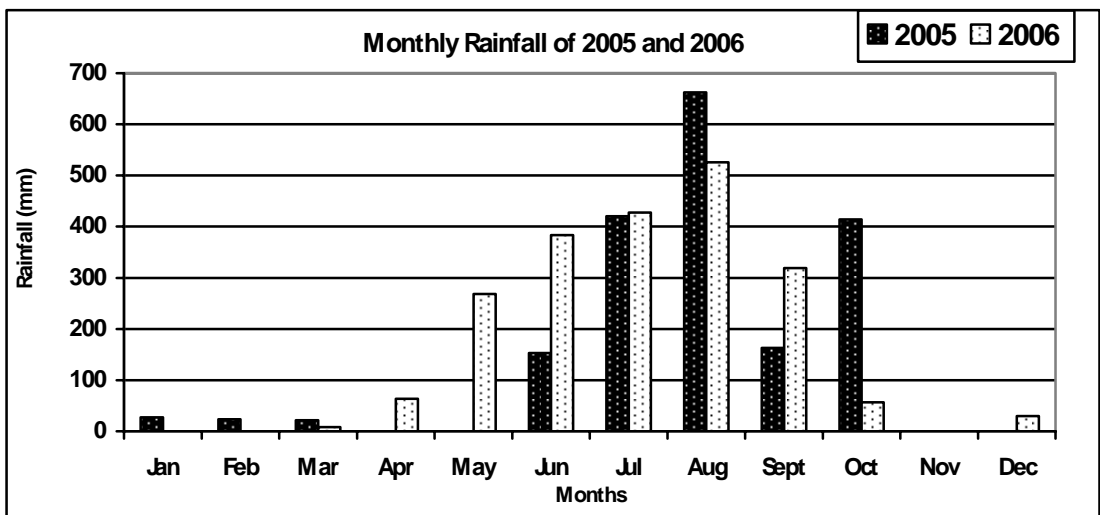


Fig. 3. Monthly rainfall of Simari, Nawalparasi in 2005 and 2006 (Source: Department of Hydrology and Meteorology, NG, 2007).

The relative humidity is relatively high. It varies from 45.4% to 92.2% in 2005 and 66.0 % to 95.2 % in 2006 (Fig. 4).

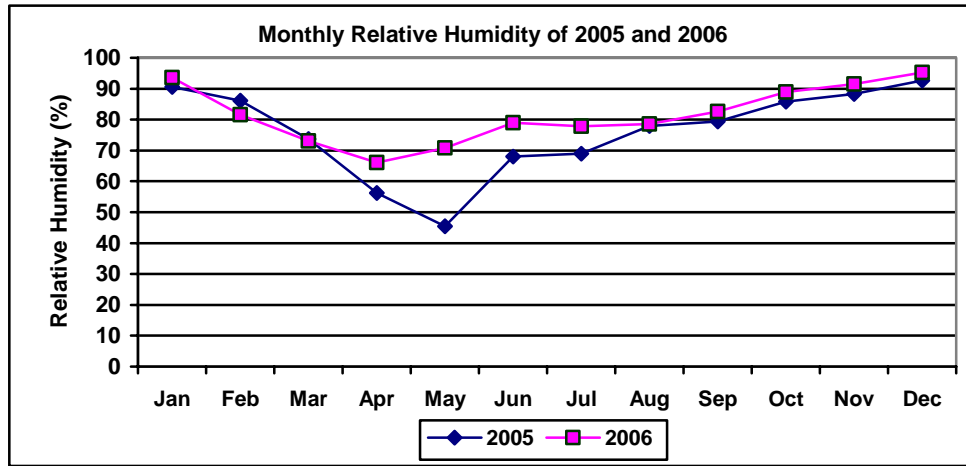


Fig. 4. Monthly relative humidity of Simari, Nawalparasi in 2005 and 2006 (Source: Department of Hydrology and Meteorology, NG, 2007).

3.1.5 Biodiversity

3.1.5.1 Flora

The Nawalparasi Forests encloses diverse vegetation types comprising tropical forest and sub-tropical forest to lower temperate forest. The forest consists mainly of Sal (*Shorea robusta*) with Saj (*Terminalia tomentosa*) as the co-dominant species. In degraded areas there is Sissoo (*Dalbergia sissoo*) plantation. Agriculture farms possess a significant part of the landscape in almost all of the southern part of forests. The Northern sloppy part of the area contains large mixed forest which is dominated by Sal, Kusum (*Carthamus tinctorius*), Karam (*Adina cardifolia*), Saj, Padari (*Stereospermum personatum*), Bhalayo (*Rhus javanica*), Dhaiyaro (*Woodfordia fruticosa*), Sigani (*Pterospermum lancefolium*), Tatari (*Dillennia pentagyna*) etc.

On the way of agricultural farms the study area is occupied by patches of Sissoo, Pipal (*Ficus religiosa*), Simali (*Vitex negundo*), Bar (*Ficus benghalensis*), Sami (*Ficus benjamina*), Simal (*Bombax ceiba*), Dabdabe (*Garuga pinnata*), Sajiwan (*Origanum vulgare*), Amp (*Magnifera indica*), Amba (*Psidium guajava*), Kera (*Musa paradisica*), Kimbu (*Morus rubra*), Katahar (*Artocarpus heterophyllus*), Lichi

(*Litchi chinensis*), Mewa (*Carica papaya*), Supari (*Areca catechu*) etc. The underground vegetation of the area is dominated by Dube banso (*Bothriochloa ischaemum*), Dubo (*Cynodon dactylon*), Mothe (*Cyperus cephalotus*), Banso (*Digitaria ciliaris*), Chitre banso (*Digitaria ciliaris*), Moto banso (*Echinochloa colonum*), Siru (*Imperata cylindrica*), Kaas (*Saccharum spontaneum*), Masino Dubo (*Sporobolus diander*), Kuro (*Anagallis arvensis*), Tapre (*Cassia sophera*), Tapre (*Cassia tora*), Pirrhe ghas (*Cymbopogon citrates*), Bayar (*Zizyphus mauritiana*), Dudhe jhar (*Euphorbia hirta*), Rudhilo jhar (*Hemigraphis hirta*), Chari amilo (*Medicago denticulre*), Amriso (*Thysanolaena maxima*), Babiyo (*Eulaliopsis binata*) etc. (Khanal, 2008).

3.1.5.2 Fauna

Nawalparasi Forests has been identified as an important IBA because of its important nesting colony of White-rumped Vultures (Baral and Inskipp, 2005). The forest is rich in bird diversity with 121 species belonging to 14 orders and 37 families. Out of 121 species, 98 (80.99%) species were resident, 13 (10.74%) species were winter visitors, 7 (5.78%) species were summer visitors and 3 (2.47%) species were local migratory (Khanal, 2008). The bird species of the forest consists of White-rumped Vulture, Slender-billed Vulture, Red-headed Vulture, Cinerous Vulture, Himalayan Griffon, Lesser-adjutant stork (*Leptoptilis javanicus*), Greater-spotted eagle (*Aquila clanga*) and Yellow-breasted bunting (*Emberiza aureola*) (Baral and Inskipp, 2005; BirdLife International, 2007). The other bird species include Indian grey hornbill (*Ocyrceros birostris*), Green bee-eater (*Merops orientalis*), Woolly necked stork (*Ciconia episcopus*), Greater raked-tailed drongo (*Dicrurus paradiseus*), and Peafowl (*Pavo cristatus*) (Khanal, 2008).

The area is also supported by different species of butterflies, fishes, amphibians, reptiles, birds and mammals. The mammalian species include Golden jackal (*Canis aureus*), Indian hare (*Lepus nigricollis*), Bengal fox (*Vulpes bengalensis*), Leopard (*Panthera pardus*), Rhesus monkey (*Macaca mullata*), Common langur (*Semmenopithecus entellus*), Hog deer (*Axis procinus*), Jungle cat (*Felis chaus*), Common mongoose (*Herpestes edwardsii*), bat and deer species (Baral *et. al.*, 2003).

Some important reptiles include Golden monitor lizard (*Varanus bengalensis*), Land tortoise (*Indotestudo elongate*), Common cobra (*Naja naja*), Indian python (*Python molurus*), Water snake (*Natrix piscator*) and Krait (*Bungarus*). Fishes like Labeo (*Labeo rohita*), Catla (*Catla catla*), Punti (*Barbus*), Clarias (*Clarias batrachus*) and Channa (*Ophipcephalus*) are also recorded in the study area.

3.2 Materials and Methods

Preliminary survey was carried out in the Nawalparasi Forests and around its vicinity to locate the nesting and roosting sites of Vultures along with the carcass dumping sites. The fieldwork was conducted from the dawn till dusk. The study was concentrated in different sites of Makar, Panchanagar, Tilakpur, Ramnagar, Sunwal, Amarauda and Banjariya VDCs from October 2006 to May 2007.

3.2.1 Absolute Count

Total count of White-rumped Vultures was done in their nesting and roosting sites. The nesting and roosting sites were identified by thorough survey of the forest area. All the roosting and nesting Vultures were monitored in the morning hours (06:00 AM to 10:30 AM) and in the evening hours (04:00 PM to 06:30 PM). Nesting and roosting sites of potential places were visited every month.

This gives the population size of White-rumped Vultures. Young and adults could not be clearly distinguished, so the age structure of the Vultures' population could not be assessed. The nesting and roosting sites were also thoroughly searched for dead Vultures and information gained was recorded. Binoculars, telescopes and digital cameras were used wherever necessary.

3.2.2 Nest Census

In order to study breeding success of White-rumped Vultures, nests were counted and nest occupancy was recorded. According to Postupalsky (1974) an active nest is the one in which eggs had been laid, an occupied nest is the one in which eggs have not been laid but some nest building activity must have taken place. Nesting trees were tagged for future reference. The name of the trees, geographic position and crude height of nests were also noted. The tree height and nest height was recorded with the help of Clinometer. Nest observations were made every month to assess the nest status and breeding success.

3.2.3 Count at Carcass

In order to assess the availability of food in the study area, the number of carcass found as well as the number of Vultures attending them were noted. Other scavengers associated with the carcass, its state and location were also recorded.

3.2.4 Questionnaire Survey

Questionnaire survey was done with the local people from different VDCs around the vicinity of study area to get general information about Vultures and their attitude towards Vulture conservation. A form designed by BCN and used elsewhere was used for surveying (Appendix 12). A general survey of the Agro-vet shops was done and veterinary professionals were questionnairred regarding the status of Diclofenac in the market and the effectiveness of Diclofenac replacement by Meloxicam (Appendix 11).

3.2.5 Community Outreach Education Programs

Community outreach and conversation education programs were launched for the local villagers, school children and veterinary professionals regarding the role of Vultures in nature. Pamphlets printed by BCN displaying the role of Vultures in nature were also distributed to the community people.

3.2.6 Secondary Data Collection

Various relevant literatures in journals, reports, books and internet were thoroughly studied to collect information on the status and breeding of Vultures.

3.2.7 Data Analysis

3.2.7.1 Population Size

The population size of White-rumped Vultures was determined using Jackknife technique (Cited in Rodgers, 1991). This method assumes that with repeated counts theoretically there is the probability of counting all the animals in the area at one time. This method requires at least five repeated absolute counts and uses the difference between the highest count ' n_{max} ' and the second highest count ' n_{max-1} ', to calculate population size (N).

The estimated total number,

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

(at no immigration or emigration)

3.2.7.2 Breeding Success

Breeding success of White-rumped Vultures was determined using following formula

$$\text{Breeding success} = \frac{\text{Productive nest}}{\text{Active or occupied nest}} \times 100\%$$

3.2.7.3 t-test

This test is used to compare the flock size between nesting and post-nesting phases. It is given by the formula

$$t = \frac{\bar{x} - \bar{y}}{\sqrt{S^2 \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}} \sim t_{n_1+n_2-2}$$

$$\text{Where, } \bar{x} = \frac{\sum X}{n_1},$$

$$\bar{y} = \frac{\sum Y}{n_2},$$

$$\text{and } S^2 = \frac{1}{n_1 + n_2 - 2} \left[\sum (x - \bar{x})^2 + \sum (y - \bar{y})^2 \right]$$

CHAPTER 4: RESULTS

A total of 62 days were spent in the Nawalparasi Forests (IBA) starting from October 2006 and ending in May 2007. On an average 7 hours were spent in the field per day for 62 days covering pre-nest to post-nest period (Table 1). During the fieldwork community forest guards, members of community forest user groups and the local villagers supported a great deal. On an average 7.75 days were spent in the study area every month.

Table1. Summary of fieldwork during three stages of breeding season

S.N.	Breeding Activities	Date	Days Spent	Time(hrs)
1.	Egg laying period	October	17	119
		November	10	70
		December	6	42
2.	Incubation period	January	9	63
		February	5	35
3.	Post-nesting period	March	5	35
		April	5	35
		May	5	35
	Total	October-May	62	434

4.1 Population Estimate

There were 6 colonies of White-rumped Vultures in the Nawalparasi Forests (IBA). Using Jackknife technique the estimated population size of WRV in Nawalparasi IBA was found to be 101 individuals for 2006/2007 breeding season. A minimum of 55 White-rumped Vultures were recorded in March while a maximum of 83 White-rumped Vultures were recorded in October and November (Table 2).

The average numbers of WRVs recorded were 66.6 individual. An average maximum of 20.9 individuals were recorded in Dharampur and an average minimum of 3.6 individuals were recorded in Gaidahakhal during entire study period.

Table 2. Population size of WRVs in six colonies of Nawalparasi Forests

Colonies	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Avg
Chisapani	25	28	24	20	19	14	12	10	19
Birta	12	14	9	13	9	8	9	11	10.6
Badera	15	13	2	3	1	3	3	13	6.6
Gaidahakhal	7	5	4	4	2	1	3	3	3.6
Srinagar	8	7	6	7	8	3	6	2	5.9
Dharampur	16	16	20	15	22	26	26	26	20.9
Total	83	83	65	62	61	55	59	65	66.6

4.2 Species Diversity of Vultures

During study all other Vulture species including White-rumped Vultures were recorded. In the study area Egyptian Vulture, Red-headed Vulture and Himalayan Griffons were also recorded. Red-headed Vulture and Himalayan Griffon were recorded only once in the month of April (Table 3).

Table 3. Species diversity of Vultures in Nawalparasi Forests

Vulture Species	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
White-rumped Vulture	83	83	65	62	61	55	59	65
Egyptian Vulture	4	5	2	-	4	-	-	3
Red-headed Vulture	-	-	-	-	-	-	2	-
Himalayan Griffon	-	-	-	-	-	-	4	-

4.3 Nest Census

In October 38 nests of White-rumped Vultures were recorded (20 occupied and 18 abandoned). A maximum of 45 nests (28 occupied and 17 abandoned) were recorded in November which got reduced to 39 nests (20 occupied and 19 abandoned) in December, 36 nests (20 occupied and 16 abandoned) in January and 34 nests (20 occupied and 14 abandoned) thereafter in February, March, April and May. Of the 45 nests, 11 nests (5 old and 6 new; 6 occupied and 5 abandoned) were destroyed. Of the 38 nests in October, 7 new nests were added in November to become 45. Of the total 45 nests, 6 nests were destroyed in December, 3 nests were destroyed in January and 2 nests were destroyed in February to

become a total of 34 nests. No any new nests were built after November. Of the 34 nests, 20 nests were occupied (15 active) and 14 were abandoned (Table 4). 9 nests were destroyed by the wind by dropping it down. An occupied nest in Sal tree in Birta was destroyed by children of nearby house by dropping the nest down while an old abandoned nest in Saj tree in Dharampur was destroyed when the tree branch was chopped off by the owner as it was in a private land. The nesting materials of White-rumped Vultures nests were found to be twigs of Sissoo and branches of Sal, Saj and Peepal trees.

Table 4. Distribution of occupied and abandoned nests of WRVs in different colonies

Year	2006										2007					
	Oct		Nov		Dec		Jan		Feb		Mar		Apr		May	
Colonies	O	A	O	A	O	A	O	A	O	A	O	A	O	A	O	A
Chisapani	7	3	11	3	7	3	8	3	8	1	8	1	8	1	8	1
Birta	4	2	5	2	5	2	5	2	5	2	5	2	5	2	5	2
Badera	2	2	4	2	1	3	1	3	1	3	1	3	1	3	1	3
Gaidaha-Khal	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Srinagar	2	0	3	0	2	1	1	1	1	1	1	1	1	1	1	1
Dharampur	4	10	4	9	4	9	4	6	4	6	4	6	4	6	4	6
Total	20	18	28	17	20	19	20	16	20	14	20	14	20	14	20	14
	38		45		39		36		34		34		34		34	

Note: **O**= Occupied nests and **A**= Abandoned nests

4.4 Breeding Success

In 2006/2007 breeding season a total of 20 occupied nests of White-rumped Vultures were recorded from all of the Vulture colonies, of which 9 nests were productive (fledged chicks). Based on active nests as primary unit the breeding success was 60% while based on occupied nest primary unit the breeding success was 45%. A total of 11 nests failed (6 in Chisapani, 3 in Birta and 2 in Dharampur). The breeding of White-rumped Vultures was found 100% successful in Badera, Gaidahakhal and Srinagar colonies (Table 5).

Table 5. Nest status and breeding success of WRV in Nawalparasi Forests

Colonies	Occupied Nests	Active Nests	Productive Nests	Unproductive Nests	Breeding Success (Active Nest as Primary Unit)	Breeding Success (Occupied Nest as Primary Unit)
Chisapani	8	5	2	6	40%	25%
Birta	5	4	2	3	50%	40%
Badera	1	1	1	0	100%	100%
Gaidahakhal	1	1	1	0	100%	100%
Srinagar	1	1	1	0	100%	100%
Dharampur	4	3	2	2	66.7%	50%
Total	20	15	9	11	60%	45%

4.5 Nesting Trees

A maximum of 39 trees of 3 species (37 Saj, 1 Karam and 1 Sal) were used by Vultures in the month of November 2006 which got reduced to 30 trees (28 Saj, 1 Karam and 1 Sal) in the month of February and remained constant thereafter till May 2007, due to destruction of nests (Table 6). The average height of nest location in the trees was 57.3ft and the average height of tree species was 80.5ft (Appendix 13). All the 20 occupied nests were observed in Saj trees. A maximum of 3 nests were built in two Saj trees. Remaining 28 trees (26 Saj, 1 Sal and 1 Karam) consisted of 1 nest each (Table 7). An average of 31 trees was used by WRVs during the entire study. An average maximum of 6.9 trees were used by Vultures in Birta and an average minimum of 2 nesting trees were used in Gaidahakhal.

Table 6. Number of nesting trees in different colonies of WRV

Colonies	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Avg
Chisapani	6	8	7	7	5	5	5	5	6
Birta	6	7	7	7	7	7	7	7	6.9
Badera	4	6	4	4	4	4	4	4	4.3
Gaidahakhal	2	2	2	2	2	2	2	2	2
Srinagar	2	3	3	2	2	2	2	2	2.3
Dharampur	11	13	3	10	10	10	10	10	9.6
Total	31	39	26	32	30	30	30	30	31

Table 7. Distribution of nesting tree species in Nawalparasi Forests

Colonies	Tree Species Harboring Nests			Total Nesting Trees
	Saj	Karam	Sal	
Chisapani	5(8)	-	-	5
Birta	7(5)	-	-	7
Badera	3(1)	1	-	4
Gaidahakhal	2(1)	-	-	2
Srinagar	2(1)	-	-	2
Dharampur	9(4)	-	1	10
Total	28(20)	1	1	30

Note: The numbers in parentheses indicate the occupied nests

4.6 Carcasses Availability

A total of 6 carcasses were recorded from Ox and Buffalo. Among them 5 were of Ox and 1 was of Buffalo. A maximum of 2 carcasses of Ox were recorded in the month of October 2006. The carcasses were found fed on by White-rumped Vultures, Egyptian Vultures, Red-headed Vultures and Himalayan Griffons along with kites, crows and domestic dogs (Table 8).

The largest number of White-rumped Vultures recorded in the carcass was 22 in April 2007, 4 Egyptian Vultures in October and February, and 2 Red-headed Vultures and 4 Himalayan Griffons in April. The maximum numbers of kites recorded were 6 in the month of November. 1 dog was recorded in October along with 10 crows.

Table 8. Carcass availability of various months in Nawalparasi Forests

Sites	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Gaidaha	Ox	-	-	-	-	-	-	-
Tulsinagar	Ox	-	-	-	-	-	-	-
Srinagar	-	Ox	-	Ox	-	-	-	-
Dharampur	-	-	-	-	-	-	-	-
Peepaldada	-	-	-	-	Buffalo	-	Ox	-
Total	2	1	-	1	1	-	1	0

4.7 Dead Vultures

A total of 10 White-rumped Vultures, 3 adults and 1 chick were found dead during my study period among them 1 was chick and others were adult. A maximum of 4 adult White-rumped Vultures were found dead in the Month of May 2007. The chick was found dead in April in Dhedari (Table 9). The probable cause might be Diclofenac poisoning.

Table 9. Dead Vultures of various months in Nawalparasi Forests

Sites	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Chisapani	2 WRV(A)	-	-	-	-	-	-	-
Dhedari	-	2 WRV(A)	-	1 WRV(A)	-	-	1 WRV(C)	-
Peepaldada	-	-	-	-	-	-	-	4 WRV (4)
Total	2	2	-	1	-	-	1	4

Note: WRV (A) = adult White-rumped Vultures

WRV (C) = chick White-rumped Vultures

4.8 Flock Size

The largest flock size of White-rumped Vultures recorded was 43 in Dharampur in January 2007. The largest flock size of Egyptian Vultures recorded was 4 in Tulsinagar in October 2006. The average flock size of WRV was 9.1 individuals in nesting phase and 11.6 individuals in post-nesting phase (Table 10).

Table.10. Flock size of WRVs in nesting and post-nesting phases

Sites	Nesting Phase						Post-nesting Phase				
	Oct	Nov	Dec	Jan	Feb	Avg	Mar	Apr	May	Avg	
Chisapani	3	3	7	-	-	5	6	4	7	5.7	
	7										
Birta	5	-	-	-	-	5	-	-	6	6	
Gaidaha	24	5	2	-	-	10.3	15	16	12	14.3	
Badera	5	3	-	-	-	4	3	6	-	5	
Patharayya	3	-	-	-	-	3	5	3	6	3.7	
Sunwal	8	-	-	-	-	8	-	9	3	9	
Srinagar	-	31	-	37	3	24	10	35	32	25.7	
				22							
				27							
Dharampur	-	-	9	43	8	20	26	-	-	23	
					20						
					20						
Gaidahakhal	-	-	-	-	2	2	15	-	-	15	
Dhedari	-	-	-	-	10	10	9	-	-	9	
	Total average						9.1	Total average			11.6

Calculation

Null hypothesis, $H_0: \mu_x = \mu_y$, i.e. there is no any significant difference in the flock size of White-rumped Vultures between nesting and post- nesting phases.

Alternative hypothesis, $H_1: \mu_x \neq \mu_y$ (two-tailed)

Calculated (t) = 0.74

Tabulated (t) = 2.10 at 5% level of significance for (10+10 – 2) degree of freedom (d.f.).

(i.e. $t_{cal} = 0.74 < t_{tab} = 2.10$)

Since, t_{cal} is smaller than t_{tab} , the null hypothesis is accepted at 5% level of significance and it is concluded that there is no significance difference in the flock size of White-rumped Vultures between nesting and post-nesting phases.

4.9 Vegetation

Vegetation composition study was carried out by quadrat sampling (Table 11). The quadrat size was 64 x 64 m² (0.4096 hectares) (Appendix 14).

Table 11. Vegetation recorded during survey period in Nawalparasi Forests

Forest Type	Name of Trees	Percentage (%)	Sample Area	Mean total no. of trees
Natural Forest (Sub-tropical)	Sal	54.05	0.4 hec.	37
	Kusum	10.81		
	Bajhi	10.81		
	Saj	8.10		
	Karam	2.70		
	Sigani	2.70		
	Kayamuno	2.70		
	Dhayaro	2.70		
	Padari	1.35		
	Bhalayo	1.35		
	Simal	1.35		
Tatari	1.35			
Semi-natural Forest	Sissoo	80.00	0.4 hec.	45
	Saj	13.33		
	Sal	6.66		

4.10 Questionnaire Survey

4.10.1 Questionnaire Survey with the Local People (Villagers)

4.10.1.1 Characteristics of Respondents

I conducted the questionnaire survey covering people from 8 VDCs i.e. Makar, Panchanagar, Tilakpur, Sunwal, Amarauda, Banjariya, Ramnagar and Daunne Devi. All the VDCs were colony sites except Daunne Devi. A total of 72 respondents close to Vulture colony were questionnairred (Fig. 5) of which 55 (76.4%) were male and 17(23.6%) were female respondents. The age of the respondents ranged from 15 to 71yrs. The mean age of respondents was 35yrs. Among the total respondents, 29 (40.3%) were educated while 43 (59.7%) were uneducated.

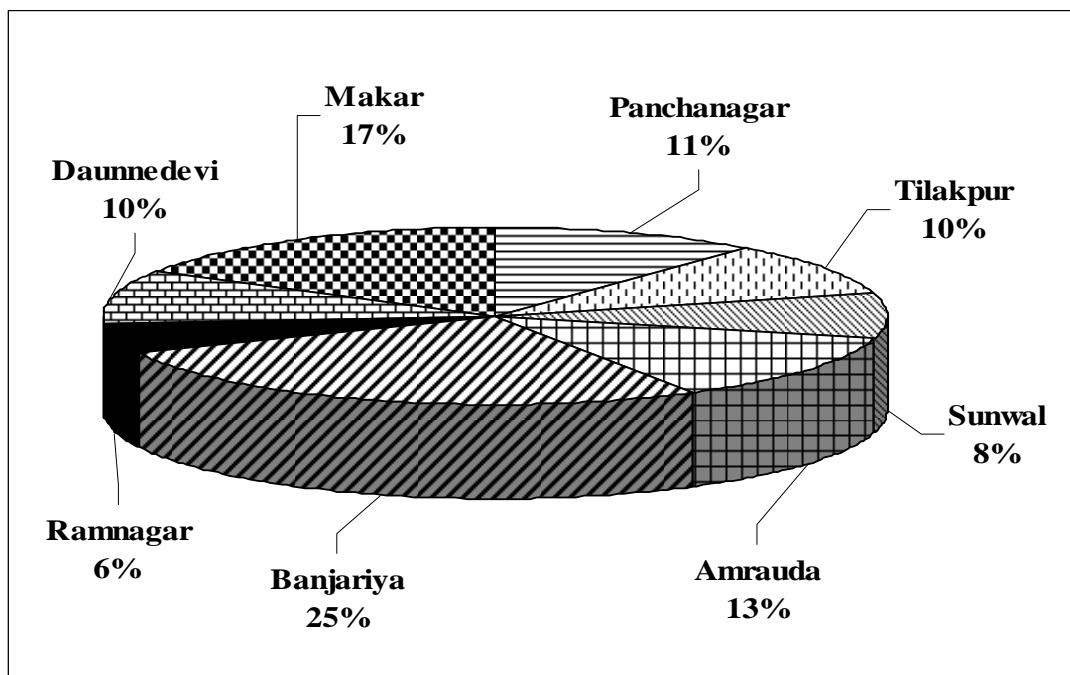


Fig. 5. Number and Percentage of respondents from different sites of study area

4.10.1.2 Livestock Holding

Of the total 72 respondents interviewed the number of livestock owned by the villagers ranged from 4 to 29, the average number of livestock being 7. According to the villagers, since the number of livestock rearing by the people is decreasing day by day, there is decrease in the number of carcasses available to the Vultures. Besides that, after the death of the livestock, 50% of the people bury their dead cattle, 16.7% people throw the dead animals randomly and about 33.3% people did not give any specific answer (Fig. 6).

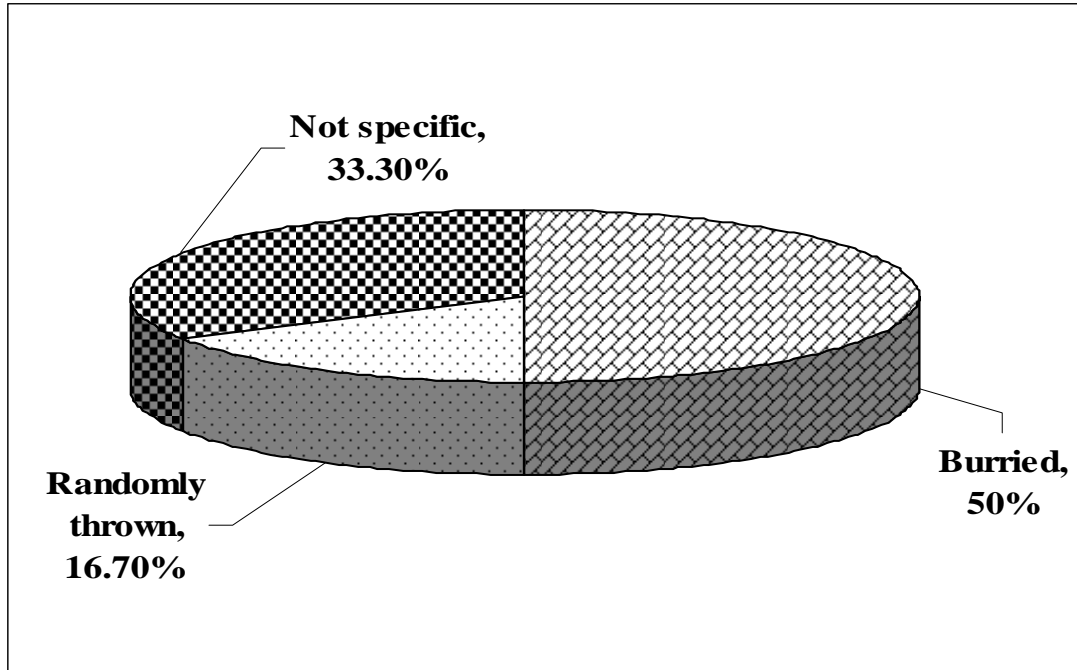


Fig. 6. Proportion of different methods for the disposal of dead cattle

66.7% of the people were of the view that the number of livestock carcasses have decreased than in the past, 16.7% of the people were of the view that the livestock carcasses were similar in number as before while 16.7% of the people were unknown of all these things (Fig. 7).

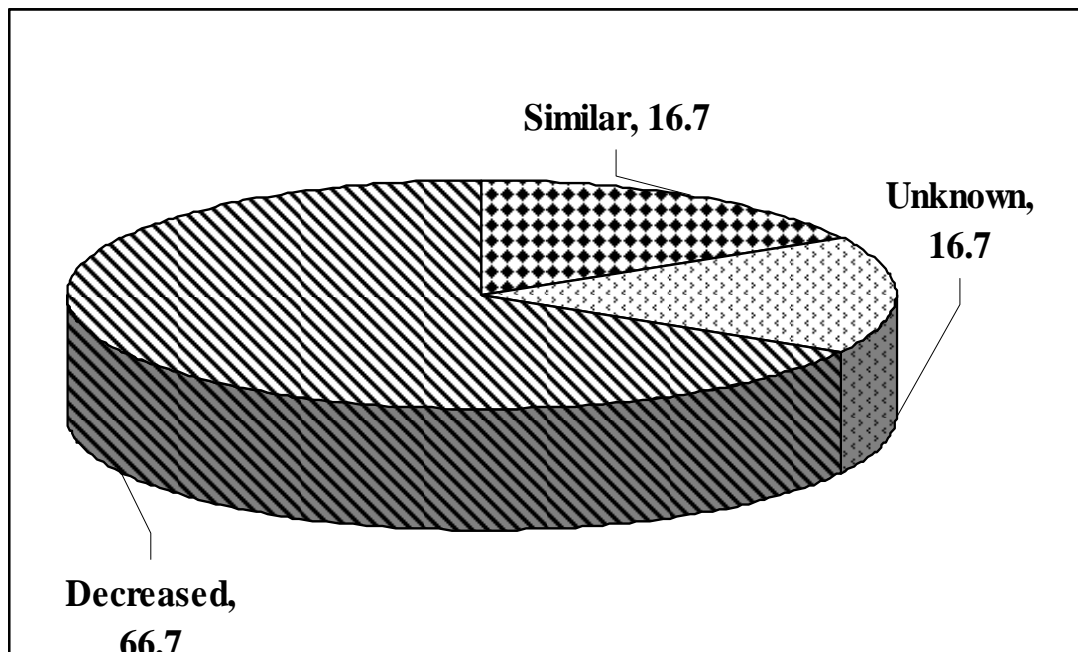


Fig. 7. Responses of the respondents about the state of the livestock carcasses

4.10.1.3 Response of Local Villagers with Attitude Measuring Statements

I measured the attitude of local villagers with 17 agree and disagree statements (Table 12). From the questionnaire survey, no villagers were found to be involved in killing of Vultures. Though 66.7% of the respondents were known that certain veterinary drugs are responsible for declining of the Vultures, none of them knew about Diclofenac and Meloxicam. The villagers were found very supportive to establish or incorporate activities relevant to the ‘Vulture Conservation’ by community level organizations and Conservation Non Governmental Organizations (NGOs).

Table 12. Percentage of local villagers agreeing, disagreeing or not responding with attitude measuring statements

S.N.	Statement	Don't Know	Agree	Disagree
1.	People kill Vultures?	-	-	100%
2.	Vultures are declining in your area.	-	83.3%	16.7%
3.	There are more livestock carcasses than before.	16.7%	-	83.3%
4.	Vultures are beneficial to human.	16.7%	50%	33.3%
5.	Vultures should be conserved.	16.7%	83.3%	-
6.	Chemical fertilities and Pesticides may cause Vulture decline.	33.3%	50%	16.7%
7.	Veterinary medicines may cause Vulture decline.	33.3%	66.7%	-
8.	You know Diclofenac? You know Meloxicam?	- -	- -	100% 100%
9.	Forests around your village have decreased.	-	83.3%	16.7%
10.	People have high regards for Vultures due to religious reason.	56.9%	15.3%	27.8%
11.	It is important to educate people about Vulture conservation.	15.3%	66.7%	18%
12.	You would like your local community to help protect Vultures?	-	100%	-
13.	You would like your conservation NGOs to help protect Vultures?	-	100%	-

4.10.2 Questionnaire Survey with the Agro-vet Professionals

A total of 10 Agro-vet Professionals were interviewed from 10 Agro-vets that are between Bardghat to Sunwal route (Table 13). The objective of the survey was to know the prevalence of Diclofenac in the area and effectiveness of its replacement by Meloxicam, and the attitude of Agro-vet professional towards Vultures' conservation. All the respondents were found Junior Technical Assistant (JTA) trained ranging in age from 28-35yrs with a mean age of 30.5yrs.

Table 13: Number and distribution of Agro-vets in and around the Nawalparasi Forests

S.N.	Place	No. of Agro-vets
1.	Bardghat	3
2.	Panchanagar	2
3.	Basa	2
4.	Bhumai (Ramnagar)	2
5.	Sunwal	1

4.10.2.1 Prevalence of Diclofenac and Meloxicam

Among the 10 veterinary professionals questionnairred no Diclofenac was recorded in 80% of the shops (8 shops) but Diclofenac was recorded in 20% (2 shops). 90% of the shop (9 shops) contained Meloxicam while 10% of the shop doesn't contained Meloxicam. 20% of the shop contained both Diclofenac and Meloxicam.

4.10.2.2 Selling Trend of Diclofenac and Meloxicam

Since Meloxicam is the new replacement for Diclofenac, the selling trend of it is also considered to be same as that of Diclofenac. In 70% of the Agro-vets, Meloxicam occupied 4th rank in the selling trend among the veterinary drugs while in 30% of the Agro-vets it occupied 3rd rank.

In most of the Agro-vets commonly sold drug consisted of Cypermethrin (an insecticide) followed by Calcium tonics (to increase milk of cattle and for growth), Liver-tonic (for indigestion and to increase appetite), anti-helminthics (de-worming) and antibiotic tablets.

4.10.2.3 Difficulties with Selling Meloxicam

Diclofenac was seen to be available in 2 forms i.e. oral tablets and injections. The oral tablets were available in 0.5gm and 1gm while the injections were usually available in 30ml vile. The price of one vile injection of Diclofenac ranged from Nepalese rupees (NRs) 35-60. The survey showed that injections were more preferable than the bolus. Many Agro-vet professionals were supporting the Diclofenac brand because of its low price, easy availability and effectiveness while promising to discard because of its effects to Vultures through carcasses (if the livestock are treated with Diclofenac before death).

Meloxicam was also seen available in both bolus and injection form. However, both bolus and injection form of Meloxicam were expensive than Diclofenac. Per vile of Meloxicam costs Indian rupees 40-48 (NRs 64-76.8) (Table 14). Meloxicam is also not easily available to them from whole-sellers of Butwal, which in-turn buy from whole-seller of India. The difficulties with Meloxicam in comparison to Diclofenac, on the basis of the information given by the Agro-vet professionals are:

Table 14. Comparison of Meloxicam with Diclofenac

S.N.	Characters	Meloxicam	Diclofenac
1.	Availability	Available with difficulty	Easily available
2.	Price	Expensive NRs 10-25/bolus NRs 64-76.8/injection	Not very expensive NRs 5-10/bolus NRs 35-60/injection
3.	Action	It is both anti-pyretic and anti-inflammatory	It is only anti-inflammatory but not antipyretic

4.10.2.4 Different types of NSAIDs and their Manufacturers

During my Agro-vet survey from Bardghat to Sunwal I came across different NSAIDs names and their manufactures. Among, the total Agro-vets surveyed, 30% of the shops contained other NSAIDs beside Diclofenac and Meloxicam. In 20% of the Agro-vets both Diclofenac and Meloxicam were present which they sell depending upon the nature of the customers, and NSAIDs the customers require (Table 15).

Table 15. Different types of NSAIDs and their manufacturers

S.N.	Name	Manufacturers	Available in
1.	Diclofenac	-	Bolus and injection
2.	Meloxicam	Alembic limited	Bolus and injection
3.	Nimesulide	Alembic limited	Injection
4.	Ketoprofen	Alembic limited	Injection

4.10.2.5 Attitude of Agro-vet Professionals

I measured the attitude of Agro-vet professionals with 7 agree and disagree statements (Table 16). The answers received were later converted into percentage of their total.

Table16. Attitude of Agro-vet professionals (percentage) on drugs

S.N.	Statements	Agree (%)	Disagree (%)
1.	Use of NSAIDs is increasing in the market	70	30
2.	You have been using Diclofenac for anti-inflammatory related problems in livestock	20	80
3.	You prescribe customers to use Meloxicam for anti-inflammatory related problems	100	-
4.	You sell both Diclofenac and Meloxicam depending upon the nature of the customers	20	80
5.	There are side effects of Diclofenac to livestock	-	100
6.	There should be continuity in the use of Diclofenac sodium	-	100
7.	Diclofenac play significant role in Vulture death.	100	-

CHAPTER 5: DISCUSSION

5.1 Population Status

Based on Jackknife technique the estimated population size of White-rumped Vulture in Nawalparasi Forests was 101 individuals. The minimum population size recorded by absolute count was 55 in March 2007 and a maximum of 83 in October and November 2006. The size cannot be considered large or small in lack of past survey results. The observed maximum number of White-rumped Vultures was 83 in October and November that may be because the Vultures that have migrated to farther places show back for nesting. However, the post-breeding count was as low as 55 that may be due to the fact that adults and juveniles may have dispersed to other habitats. The estimated population size of White-rumped Vultures in Nawalparasi Forests with 101 individuals is the highest population record in 2006/2007 breeding season in Nepal. The largest colony is represented by Chisapani and Dharampur with 10-28 WRVs and 15-26 WRVs respectively. The population cannot be considered large or small due to lack of past survey results.

A dramatic decline of two species, White-rumped Vulture and Slender-billed Vulture was noticed in Nepal since mid 1990s, when an estimated >150,000 pairs of White-rumped Vultures were known to breed. There are now less than 1000 pairs of the Slender-billed Vultures in Nepal. The current rate of annual decline in Nepal is estimated to be 40% and the rate of decline within a decade is estimated at 90-95% (Nepal Country Report, 2006). In Bangladesh, WRV is threatened and LBV and EG are rare (Bangladesh Country Report, 2006). Populations of WRV and SBV in south-east Asia (Cambodia, India, Laos, PDR, Myanmar, Nepal, Pakistan and Vietnam) are low but declines are thought to have been historical and slower, rather than recent and rapid. World population size is not known for any of these species.

Over five years, there has been a gradual decline in Vulture population in Rampur valley, Palpa. The estimated population size of WRVs based on the Jackknife technique was 145, 149, 100, 124, and 96 birds in 2002/2003, 2003/2004, 2004/2005, 2005/2006 and 2006/2007 breeding seasons respectively. The maximum no. of 123, 135, 97, 109 and 92 Vultures were recorded in 2002/2003, 2003/2004, 2004/2005, 2005/2006 and 2006/2007 breeding seasons respectively by absolute count method. In Syanja and Tanahu, the highest number of Vultures recorded was 25 in 2004/2005, 54 in 2005/2006 and

40 in 2006/2007. In Syanja and Tanahu, the highest number of Vultures recorded was 25 in 2004/2005, 54 in 2005/2006 and 40 in 2006/2007 (Baral *et al.*, 2005; Baral and Gautam, 2007a).

A comparison to the numbers of individuals of WRV and SBV counted in different years from 2001-2006 clearly shows decline in the population of both species in Bardia National Park. In total 41 (18 WRV and 23 SBV), 54 (30 WRV and 24 SBV), 35 (32 WRV and 3 SBV), 28 (20 WRV and 8 SBV) and only 8 WRVs were recorded in 2001, 2003, 2004 and 2006 respectively. A total of 206 Vultures comprising 150 WRV and 56 SBV were recorded in 2001-2006. The highest number of WRV (88) was recorded in Kailasi community forest followed by Khairapur (38) and Sanoshree Bhurigaun (12). The highest number of WRV was recorded in Khairapur (19) followed by Khaurahaphanta (18) and Kailasi Community Forest (11) (Giri, 2007). In five Vulture colonies in Pokhara valley, a total of 36 white-rumped, 15 slender-billed and 86 Egyptian Vultures were recorded in 2006/07 breeding season (Baral and Gautam, 2007b).

The most threatening results came from eastern Nepal where the decline has been more rapid than the western part. During the entire survey in 2001/2002, only a single White-rumped Vulture was repeated. Vultures have also declined in the west part of Nepal as evidenced by high mortality as well as increased rate of breeding failures. During the transect survey, compared to east, a very high number of Vultures were recorded in the west because west Nepal survey was carried in May and the east Nepal in April. In the west Nepal survey, the road transect passed through a nesting colony by the highway which has also made the counts look much higher (Baral *et al.*, 2002b).

Similarly, lower numbers of White-rumped Vultures were recorded at Koshi in 2002 as compared to the year 2001. Slender-billed Vultures' population has also declined and only two have been noted at the time of surveys carried out in Annapurna Conservation Area, Langtang and Sagarmatha National Parks to assess the population of Himalayan Griffon. Lower numbers of Himalayan Griffons were recorded in all these places compared to earlier studies. Himalayan Griffon number in Annapurna area seemed to have declined starting from late 90s. In view of this alarming situation much work is necessary to find out the status of Himalayan Griffon in other Himalayan valleys and continuous monitoring of population in Koshi area (Baral *et al.*, 2002a).

Surveys on the population status of Vultures have been carried out and reasons for their sudden decline have been studied by various avian experts. In India, there has been a 95% decline in the breeding population of White-rumped Vultures from 1987-88 to 1996-97. Likewise a 96% decline was observed in maximum population during the same decade (Prakash, 1999). Decline of Vulture populations in India was first recorded at the Keoladeo Ghana National Park, Rajasthan during mid 1980s to mid 1990s, followed by northern India road counts. Declines have been projected an excess of 97% over a 12 years period in India and 92% in a 3 years period in Pakistan (Virani, 2006).

Between 2001 and 2007 rates of decline across the three largest WRV colonies in Pakistan ranged from 11% to 61% per year (Gilbert *et al.*, 2006; Peregrine fund, unpubl. data). Two of these colonies, Changa Manga (approximately 80 km southwest of Lahore) and Dholewala (approximately 90 km north-west of Multan) were extinct by the 2003/2004 breeding season. The third colony Toawala (approximately 50 km northwest of Multan) during surveys by WWF-Pakistan in November and December 2006 showed only 152 Vultures. Following the loss of Changa Manga colony, Toawala colony was the largest known remaining colony of WRV in the world. The decline of this colony in 2007 highlights the reality of continued population decline for this species (Murn *et al.*, 2007).

An average of 30-40 White-rumped Vultures were regularly sited in Kathmandu valley in 1980 to 1982 (Inskipp, 1980, 1981, 1982). However in more recent years, only a few (3 in Feb. 1991 and 2 in Feb. 1993) WRVs were recorded (Baral, 1991, 1993). A bird survey in Gokarna Landfill site, Kathmandu in 1996 recorded no Vulture species (Giri, 1996; Panthi, 1996). Almost no sighting of these species came from the valley during last few years. Very small numbers of White-rumped and Slender-billed Vultures were recorded in Chitwan and Bardia National Parks in 2001, in comparison to 1982. These two species were almost entirely absent in eastern and central Nepal in 2001 (Inskipp and Inskipp, 2001). One flock of 38 White-rumped Vultures, 13 Slender-billed Vultures and 12 Eurasian Griffons were recorded at Suklaphanta. This flock size was far greater than any others found elsewhere in Nepal during their 2001 survey (Inskipp and Inskipp, 2001). Only a few individual flying Vultures and no Vulture nests have been recorded in the last five years from Chitwan National Park, once a major breeding stronghold of WRVs (Pandey and Gupta, 2003).

5.2 Species Diversity

Out of 6 species of Vultures found in Nawalparasi Forests (IBA) i.e. White-rumped Vultures, Slender-billed Vultures, Egyptian Vultures, Red-headed Vultures, Cinerous Vultures and Himalayan Griffons (Baral and Inskipp, 2005), only 4 species could be recorded i.e. White-rumped Vultures, Egyptian Vultures, Red-headed Vultures and Himalayan Griffons. Slender-billed Vultures could not be recorded, either in the roosting or carcass disposal sites, though it was recorded by Subedi (2007) in 2005 breeding season. Cinerous Vultures also could not be recorded as they are winter migratory. 2 Red-headed Vultures and 4 Himalayan Griffons were recorded only once in the month of April. A maximum of 5 Egyptian Vultures were recorded in November, although their population size is not large as compared to White-rumped Vultures.

In Rampur valley, Palpa, beside White-rumped Vultures, 4 other species were also found i.e. Egyptian Vultures, Slender-billed Vultures, Eurasian Griffons and Red-headed Vultures in 2004/2005 breeding season. A maximum of 22 Egyptian Vultures in October and 2 Red-headed Vultures in December were recorded in 2004 (Baral and Gautam, 2005). However, in 2006/2007 breeding season in Rampur valley, besides White-rumped Vultures, 6 other species were also recorded i.e. Egyptian Vultures, Slender-billed Vultures, Red-headed Vultures, Himalayan Griffons, Cinerous Vultures and Eurasian Griffons. A maximum of 54 EVs and 2 RHVs were recorded in January 2007 (Baral and Gautam, 2007a). In May and September 2006 five colonies of Vultures in Pokhara valley consisted of Egyptian Vultures (37), White-rumped Vultures (9) and Slender-billed Vultures (10) respectively (Gautam and Baral, 2007). In Pokhara valley three Vulture species i.e. White-rumped, Slender-billed and Egyptian Vultures were recorded in 2006/2007 field season. In five colonies, a total of 36 WRVs, 15 SBVs and 86 EVs were recorded (Baral and Gautam, 2007b). Study conducted in Bardia National Park from 2001-2006 showed only White-rumped Vultures and Slender-billed Vultures (Giri, 2007).

Road transect surveys of lowland Nepal in 2001/2002 showed 5 species of Vultures besides White-rumped Vultures (205). White-rumped Vultures were most numerous followed by Himalayan Griffons and Slender-billed Vultures. They include Slender-billed Vultures (5), Himalayan Griffons (9), Red-headed Vultures (10), Egyptian Vultures (11), Eurasian Griffons (1) and unidentified *Gyps* species (12). Sukila phanta survey showed two Vulture species i.e. White-rumped Vultures and Slender-billed Vultures (Baral *et al.*, 2002b). The species diversity of Vultures in Koshi includes an estimated of 150

Eurasian Griffons, 20 White-rumped Vultures, 15 Himalayan Griffons and 2 each of Cinerous and Slender-billed Vultures (Baral *et al.*, 2002a).

5.3 Nest Census and Breeding Success

38 nests of White-rumped Vultures were recorded in October (20 occupied and 18 abandoned). A maximum of 45 nests (28 occupied and 17 abandoned) were recorded in November which got reduced to 39 nests (20 occupied and 19 abandoned) in December, 36 nests (20 occupied and 16 abandoned) in January and 34 nests (20 occupied and 14 abandoned) thereafter in February, March, April and May. Of the 45 nests, 11 nests (5 old and 6 new; 6 occupied and 5 abandoned) were destroyed. Of the 38 nests in October, 7 new nests were added in November to become 45. Of the total 45 nests, 6 nests were destroyed in December, 3 nests were destroyed in January and 2 nests were destroyed in February to become a total of 34 nests. No any new nests were built after November. Of the 34 nests 20 nests were occupied (15 active) and 14 were abandoned.

The nesting material consists of twigs/branches of Sissoo, Sal, Saj, Peepal and Simal. Baral (2004) recorded the nesting materials to be green twigs/sticks and leaves plucked from the neighboring trees like Silk-cotton, Sissoo, Peepal etc. For the 2006/2007 breeding season, a total of 20 occupied nests were recorded of which 9 nests were productive (fledged chicks). Based on active nests as the primary unit the breeding success was 60% while based on occupied nest as the primary unit the breeding success was 45%. A total of 11 nests failed. The breeding success of WRVs was found to be lowered in comparison to previous studies done by Subedi (2007). The breeding success calculated based on 'active nests' as the primary unit is significantly higher than the breeding success calculated based on 'occupied nests' as the primary unit. In the light of published literature on raptor breeding ecology, the breeding success calculated based on 'occupied nests' is more accurate. Although Postupalsky (1974) recommends using occupied nests as primary unit to calculate breeding success, I used active nests as primary unit to compare my results with other studies conducted in the Indian sub-continent as they have also used active nests.

In Nawalparasi Forests, the breeding starts in October and lasts until May. The first chick was observed in March and the last nest building activities also took place in March. Breeding season is a considerably long period as nests with eggs and well developed nestlings have been noted in mid January and in late

February (Roberts, 1991). Vultures form pairs in November at Jodhpur, India (Sharma, 1970). In Pakistan, nest construction and repair starts from October or November (Roberts, 1991). There could be local variations at onset of breeding season however environmental factors such as temperature and humidity influence breeding at Jodhpur, India (Sharma, 1970).

The study by Subedi (2007) in western lowland of Nawalparasi, Nepal showed 48 *Gyps* Vulture nest in 6 colonies. Out of these nests, 18 were found to be active and 30 were found abandoned. Of the recorded 18 active nests, six nests belonged to SBV and 12 nests belonged to WRV. A nesting success of 100% was observed in the study area. Based on active nests as primary unit, breeding success for White-rumped Vultures was 69%, 59% and 71% for the 2002/2003, 2003/2004 and 2004/2005 breeding seasons in Rampur valley respectively. Taking occupied nests as primary unit then breeding success was 50%, 48% and 47% for 2002/2003, 2003/2004 and 2004/2005 breeding seasons respectively (Baral and Gautam, 2005).

Based on active nests as primary units, the breeding success was 40% for the 2006/2007 season in Rampur valley while 71% in Syanja and Tanahu while on the basis of occupied nests as primary units it was 23% in and 40% in Syanja and Tanahu. Of 40 unproductive nests in Rampur, 12.5%, 55% and 32.5% failed during the nest building, egg laying and nesting period respectively. Of 15 unproductive nests, 20% failed during egg laying, 73% failed during incubation and 7% failed during nestling period. The total numbers of occupied, active and productive nests have decreased over the past five years in Rampur. There had been 25.7% decrease in occupied nests, 41.2% decrease in active nests and 65.7% decreases in productive nests over five years (2002/2003 to 2006/2007). In Rampur valley the breeding success was comparable to the post-decline era until 2005/2006 but was lower than that in 2006/2007. Over the past three years, the breeding success of White-rumped Vultures has remained the same in Syanja and Tanahu. It was 75% in 2004/2005, 72% in 2005/2006 and 71% in 2006/2007 based on active nests as primary units. The number of occupied nests steadily increased from 14 in 2004/2005 to 25 in 2006/2007. Khairani 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 was deserted in 2006/2007 due to anthropogenic disturbances like village, local market, and rock and sand mining near the colony (Baral and Gautam, 2007a).

Baral and Gautam (2007b) in 2006/2007 breeding season in Pokhara valley based on occupied nests as primary unit found the breeding success of White-rumped Vultures to be 42.8% and that of Slender-billed Vultures to be 57.1%. Seven chicks of Egyptian Vultures were on four nests. Based on active nests as the primary unit for White-rumped Vultures, breeding success was 100% while based on occupied nests as primary unit breeding success was 42.85% for Slender-billed Vultures. Giri (2007) studied the number of nests and number of successfully fledged chicks in Bardia National Park. The survey resulted decline during the study period. A total of 2, 19, 11 and 4 chicks were successfully fledged in 2001, 2002, 2003 and 2004 respectively, however not a single nest was found in 2006. The highest breeding success was achieved in 2002 followed by 2003. A total of 36 chicks (32 WRV and 4 SBV) fledged successfully during the study period.

Giri and G.C. (2005) conducted study of nesting WRVs and SBVs in 2002-2004 breeding season at Suklaphanta wildlife reserve in the Lowland of far west Nepal. While total of 15 and 14 WRV nests were found in 2002 and 2003 respectively, not a single Vulture nest was recorded on the reserve in 2004. Three pairs successfully fledged chicks in 2002 and four pairs in 2003. Baral (2004) found breeding success of White-rumped Vultures to be 0.33 chick/nest in 2001/2002 study period in Lumbini. Giri and Baral (2001) reported 28% breeding success for 2000/2001 breeding season (n=67) that dropped to 23% in 2001/2002 breeding season (n=13) in Koshi Tappu Complex, eastern Nepal (Baral *et al.*, 2002a). They also reported 60% nest failure prior to egg laying and 30% during nestling. In all these studies they used active nest as the primary unit and defined breeding success as the number of birds raised to fledgling per active nest so our results are comparable to them.

The breeding success in the pre-decline era was reported to be 82-96% (Sharma, 1970; Prakash, 1999) but in the post-decline era it was 59-62% (Gilbert *et al.*, 2002). Prakash (1999) reported breeding success of 82% (n=244) in 1985/1986 but zero during 1997/1998 (n=25) and 1998/1999 (n=20) from a long-term research in Keoladeo, India. He indicated that 20%, 20% and 60% of nest failures occurred prior to egg laying, during incubation and during the nesting period, respectively in 1997/1998; and 60% prior to laying, 10% during incubation and 30% during the nestling period in 1998/1999. Gilbert *et al.*, (2007) found 59%-62% breeding success in Punjab province, Pakistan.

Gilbert *et al.*, (2006) reported Changa Manga and Dholewala in Pakistan to be extinct by 2003/2004 breeding season. They declined from 758 active nests and 412 active nests respectively in the 2002/2001 breeding season. Surveys by WWF-Pakistan during November and December 2006 showed that from the 2005/2006 breeding season, Toawala colony experienced the highest rate of decline, when the number of active nests fell from 84 to 33, a 61%, decrease in less than 1 year. By mid April 2007 only two active nests remained at Toawala. Following the loss of Changa Manga colony, Toawala colony was the largest known remaining colony of *Gyps bengalensis* in the world. The demise of this colony in 2007 highlights the reality of continued population decline for this species.

5.4 Nesting Trees

A maximum of 49 trees were used by White-rumped Vultures in the month of November which got reduced to 30 trees (28 Saj, 1 Karam and 1 Sal) in the month of February, March, April and May due to destruction of nests. Though vegetative sampling revealed 54.05% of trees to be Sal, 10.81% to be Kusum, 10.81% to be Bajhi and 3.10% to be Saj in Natural forest while 80% of trees to be Sissoo, 13.33% to be Saj and 6.66% to be Sal in semi-natural forest, 94.10% of nests were found in Saj trees (covering 8.10%), 2.95% of nests in Sal (covering 54.055) and 2.95% of nests Karam (covering 2.70%). All 20 occupied nests were located in Saj trees. The average height of trees were 80.5ft (n = 30) while of nest was 57.3ft. The nesting materials in White-rumped Vultures were found to be twigs of Sissoo and branches of Sal, Saj and Peepal trees. A maximum of 3 nests were built in two Saj trees. Remaining 28 trees (26 Saj, 1 Sal and 1 Karam) contained 1 nest each.

Not a single Silk-cotton tree (Simal *Bombax ceiba*) was used for nesting by White-rumped Vultures for nesting. Because of rapid cut down of Silk-cotton trees there might have been shifting of Vultures to similar kind of large trees of Saj and other tree species for security of their nests and chicks from anthropogenic disturbances. However, Vultures were found roosting in Silk-cotton trees. Similarly Subedi (2007) reported 96% of *Gyps* Vultures' nests in Saj trees and 4% on Sal trees in Western Lowland of Nawalparasi during winter survey in 2005. There is much diversity of tree species (14) used for nesting in Punjab province, Pakistan (Gilbert *et al.*, 2002).

Baral (2004) recorded the nesting materials to be green twigs/sticks and leaves plucked from the neighboring trees like Silk-cotton, Sissoo, Peepal etc. The nest holding trees were exclusively Silk-

cotton trees in the outskirts of village and flood plains of study area, where the human disturbances were insignificant. The average height of tall tree was found to be 62.23 ft (n = 16). Only five species of trees were used for nesting in 2002/2003 and 2003/2004 breeding seasons in Rampur valley. There has been further reduction in the diversity of nesting trees used in 2004/2005. Only three species of trees i.e. Kapok (*Bombax ceiba*), Kavro (*Ficus lacor*) and Tuni (*Cedrela toona*) were used by Vulture for roosting and nesting. A total of eight trees harbored 14 occupied nests. The highest number (10) of nests was in Kapok followed by Tuni (3) and Kavro (1). In Rampur, most nests are found in mature Kapok trees. There were 69%, 89% and 97% of occupied nests in Kapok trees in 2002/2003, 2003/2004 and 2004/2005 breeding seasons, respectively (Baral and Gautam, 2005).

Baral and Gautam (2007a) recorded a total of 42 trees of nine species in Rampur valley, Palpa while only 15 trees of 6 species were used in Syanja and Tanahu during 2006/2007 breeding season. There were 33 Kapok trees, 2 Khair and 1 each of the other seven trees species (Barro, Kavro, Ditabark (*Alstonia scholaris*), Tuni, Padke, Saj and Karma). Kapok trees harbored 81% of occupied nests. Ten trees had two nests on them and 32 trees had one nest. In Rampur valley, Palpa more than 85% of Vultures' nests were on Kapok trees (Gautam and Baral, 2007). Of three Vulture species, only WRVs and SBVs built nests on trees and they used a total of 13 trees in 2006/2007. White-rumped Vultures used six trees to build seven nests. They used three species of trees, Kapok, Tiju and Chilaune (*Schima wallichii*). One Kapok tree held two nests and all the other trees had one nest on them. Slender-billed Vultures built seven nests on seven Kapok trees (Baral and Gautam, 2007b). The high proportions of 98% of nests were built on Silk-cotton trees in Bardia National Park (Giri, 2007). In Sukila Phanta survey in 2001/2002 breeding season only 3 nests were found in Silk-cotton trees (Baral *et al.*, 2002 b).

5.5 Carcass Availability

A total of 6 carcasses of 2 livestock species i.e. Ox and Buffalo, were recorded during the study period. Five carcasses (83%) were of Ox and one (16.7%) of Buffalo. The carcasses were found to be fed by WRVs, EVs, RHVs and HGs along with kites and dogs. However 16, 17 and 14 carcasses of different livestock types in 2002/2003, 2003/2004 and 2004/2005 were encountered respectively by Baral and Gautam, 2005 in Palpa valley. In 2004/2005 breeding seasons, only one carcass of Buffalo was encountered. The carcass was attempted by two White-rumped Vultures and a single domestic dog. Baral *et al.*, (2005) found 16 carcasses during 2002/2003 field study in Rampur valley, Palpa. Most

(69%) were cattle, followed by Buffalos (25%). All carcasses were not attended by Vultures. On two occasions EVs and RHVs were seen feeding with WRVs. At six carcasses, 3-10 stray dogs were feeding.

18 carcasses of three different mammalian species; Buffaloes, Cattle (6 Oxen and 1 Cow) and domestic dogs were recorded by Baral and Gautam (2007a) in Rampur valley, Palpa. A maximum of 18 WRVs, 6 HGs, 12 house crows and 2 feral dogs were attempting the carcasses. Three carcasses of three mammalian species i.e. domestic dog, ox and water buffalo were recorded in Syanja and Tanahu (Baral and Gautam, 2007a). A total of 18 carcasses were met during Vulture survey in lowland Nepal in 2001/2002 (Baral *et al.*, 2002b). A total of 38 carcasses of 4 types i.e. Swamp deer (18), Spotted deer (5), cow (9) and buffalo (6) were recorded in Sukila Phanta by Baral *et al.*, (2002b) in 2001/2002 breeding season.

5.6 Dead Vultures

A total of 10 WRVs were found dead during my study period, of which 1 was chick. A maximum of 4 adults White-rumped Vultures were found dead in the month of May. The chick was found dead in April in Dhedari. Head drooping symptoms were observed in 2 dead white-rumped Vultures indicating the probable effects of Diclofenac that might have been transmitted to Vultures through carcass feeding. Subedi (2007) also reported head dropping behavior of *Gyps* Vultures during the study period of winter 2005 in western lowland of Nawalparasi. However, dead Vultures were found throughout the season at Bayana, Rajasthan, where a colony was being constantly monitored (*Prakash's unpublished observation*). The remains of 15 dead Vultures were found at Ranthambare in 2000. 28 freshly dead Vultures were collected from a range of area by the authors in 2000 and 2001 for post-mortem examination (Cunningham *et al.*, 2001). Other researchers monitoring colonies around India have also reported dead Vultures over the last few years.

In 2002/2003 in Rampur valley, Palpa, unexceptionally high number (30 adults and three sub-adults/juveniles) of dead Vultures were recorded. In 2003/2004 and 2004/2005 11 (4 adults) and 14 (half of them adults) dead Vultures were recorded respectively. A total of 16 dead Vultures (3 adults and 13 chicks) were recorded in Rampur and 2 dead Vultures (1 adult and 1 chick) in Syanja and Tanahu in 2006/2007 breeding season (Baral and Gautam, 2007a). However, two mature dead Egyptian Vultures

were recorded by Baral and Gautam (2007b) in the Pokhara valley in 2006/2007 breeding season. One dead Vulture was recorded in Kailasi Community Forest of Bardia National Park in 2003 (Giri, 2007). Seven dead Vultures were found in 2002, 2 in 2003 but none in 2004 in the 2002-2004 breeding seasons in SWR (Giri and GC, 2005).

5.7 Flock Size

There was no any significant difference in flock size of White-rumped Vultures between nesting and post-nesting phases ($t_{cal}=0.74 < t_{tab}=2.2$) in Nawalparasi Forests in contrast to the significant difference in flock size of White-rumped Vultures between nesting and post-nesting phases in Lumbini by Baral (2004). The largest flock size of White-rumped Vultures recorded was 43 in Dharampur in January during nesting period. There could be a local migration of non-breeding Vultures among colonies. However, the flock size was found to be highest (i.e. 64) in May in Lumbini in 2001/2002 breeding season (Baral, 2004).

The maximum numbers of Vultures recorded in flocks in 2003 were 28 WRVs and 21 SBVs dropping to 15 WRVs and 8 SBVs in 2004 in Suklaphanta Wildlife Reserve. There was decrease of nearly 50% for WRVs and an even greater decrease for SBVs in SWR (Giri and GC, 2005). The highest count of 47 Vultures in a flock was recorded soaring above the Khairani site in December 2004 (Baral and Gautam, 2005). Within one year, 84% decline was observed in the maximum population count of flock in the Koshi Tappu Complex in Eastern Nepal (Baral *et al.*, 2002a).

5.8 Conservation Approach to Vultures

During my study ban on Diclofenac was found to be applied very strictly except in 20% of Agro-vet shops. The major threat to the Vultures is contamination of carcasses by anti-inflammatory drugs and poisoning of carcasses by the villagers in some places to kill the leopards that were taking away their cattle. In Rampur valley, Palpa, about 3% of livestock carcasses are contaminated with veterinary Diclofenac (Baral and Gautam, 2007a).

The easiest and cost-effective method to protect Vultures will be to raise awareness among the stakeholders, Agro-vet professionals, CFUGs and the local villagers through various programs focusing on the role of Vultures in nature and the lethal effects of Diclofenac to Vultures and its replacement by Meloxicam.

CHAPTER 6: CONCLUSION

Present study focused in Nawalparasi Forests revealed important information regarding population status and breeding of White-rumped Vultures. The estimated population size of WRVs was found to be 101 individuals, larger than any other colonies in Nepal currently. The breeding success was 45% taking occupied nests as the primary unit while 60% taking active nests as the primary unit, showing decrease in the efficiency of breeding success. No any nests of SBVs were recorded in the study area in 2006/2007 breeding season.

Highly preferred nesting tree species were Saj (94.1%) followed by Sal (2.95%) and Karam (2.95%) showing probable shifting of nests from Silk-cotton trees to other larger trees. The average height of nesting trees was 80.4ft with average nest height of 57.3ft. Though the largest flock size of WRVs recorded was 43 in Dharampur in January, no any significant difference in flock size was found between nesting and post-nesting ($t_{cal}=0.74 < t_{tab}=2.1$) phases.

A total of 6 carcasses (5 of ox and 1 of buffalo) were recorded during the study period with the exception to many unnoticed carcasses. 10 dead WRVs (9 adults and 1 chick) were recorded during the study period which is not sufficient to explain the catastrophic decline in the *Gyps* population as many of dead Vultures might have gone unnoticed.

Questionnaire survey with Agro-vet professionals showed Diclofenac in 20% of the shops while 80% of the shops didn't show any presence. Though the prevalence of Diclofenac in the area indicates the probable death of Vultures by this NSAID, effects of other factors like habitat destruction, hunting, food contamination and shortage, and disturbance also can't be avoided. High mortality rate and low breeding success is leading White-rumped Vultures towards reduction. With the ban of veterinary drug Diclofenac, we are only in the half way to save Vultures. Still lack of information regarding nesting habitats and breeding success may hamper the conservation efforts of vultures. No Vulture conservation program succeeds without raising awareness among stakeholders. Some sort of incentives to private landowners to protect habitats and to local farmers to secure food should be instituted. At the end, conservationists should move beyond PAs and share hand with stakeholders to give a chance for the survival of critically endangered White-rumped Vultures.

CHAPTER 7: RECOMMENDATIONS

High mortality rate and low breeding success are the causes for the population decline of White-rumped Vultures. Though Diclofenac is said to be primary cause for the catastrophic decline of Vultures' population, multiple factors like disease, habitat destruction, disturbances, hunting and food shortage also adds on.

Following steps should be taken into consideration to conserve the Critically Endangered White-rumped Vultures from extinction.

1. There is an immediate need to establish Vulture restaurant in two Vulture colony sites, i.e. Chisapani and Dharampur, which holds the largest population of Vultures at present.
2. Cutting down of large trees with Vulture nests or acting as roosting trees, either in the private forest or community forest should be strictly prohibited.
3. The dead Vultures should be examined medically for the probable cause of their death and locals should be encouraged to inform Vultures' death to District Veterinary Office.
4. Awareness programs should be conducted to local villagers, CFUGs and Agro-vet professionals regarding the lethal effects of Diclofenac to Vultures and the role of vultures in the environment.

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APPENDIX 11: QUESTIONNAIRE FORMAT FOR SHOPKEEPERS

About Insecticides/Pesticides

- a. Name of the respondent: b. Address:
- c. Age: d. Occupation:
- e. Sex: f. Education:
- g. Name of the shop: h. Site name:
1. How is the selling trend of Insecticides/Pesticides nowadays?
a. Increasing: b. Decreasing: c. Same as before:
2. Which Insecticide do the farmers mostly demand from your shop?
.....
3. Where do you import the Insecticides from?
a. Nepal: b. India: c. Abroad:
4. In which season the Insecticides are demanded more?
a. Summer: b. Winter: c. Rainy:
5. For which crop do the farmers prefer to use the Insecticides?
a. Paddy/Wheat: b. Mustard: c. Vegetables:
6. Do you make the farmers aware of the use of the adverse effects of using Pesticides?
a. Yes: b. No:
7. How is the demand of banned Insecticides'?'
.....
8. Do you agree that the banned Insecticides are also in use?
a. Yes: b. No:
9. What suggestions do you give for the proper use of Insecticides in the country?
.....
10. What is your say regarding the current decline in vultures population?
.....

About Diclofenac Sodium

1. What medicines do you prescribe for anti-inflammatory and related problems in cattle?

2. What are the uses of Diclofenac Sodium?
.....

3. What are the administrations of 'Diclofenac Sodium'?
a. Bolus: b. Injection: c. Tablet:

4. What are the doses of DS for different animals?
a. Cows: b. Buffaloes: c. Goats:
d. Sheep: e. Dogs: f. Donkeys:
..... g. Horses:

5. Are there any side effects of DS?
a. Yes: b. No:

6. From which year the use of DS was maximum?
.....

7. In which month the use of DS is maximum?
.....

8. Do you think there should be continuity in the use of DS?
.....

9. Does it play the significant role in vulture death?
.....

9. What suggestions do you prefer for the conservation of vulture?
.....

APPENDIX 12: LOCAL COMMUNITY QUESTIONNAIRE

Your participation in this survey is voluntary. You will not get any direct monetary benefits for participating, nor will you be penalized for not answering some or all of the questions. Any information gathered in this survey will be only used for the purpose of the study. The

interview is completely confidential; your name will never be associated with your answers. The purpose of this study is to evaluate local community attitudes to the conservation of cultures.

Household questionnaire

- a. Name of interviewer:
- b. Date of interview:
- c. Village name:
- d. Name of VDC:
- e. Ward no.:

1. Respondents information

- a. Gender: Male/Female
- b. Age:
- c. Ethnicity (Caste):
- d. Education:
- e. Occupation:

2. Information about household members

S.N.	HOUSEHOLD MEMBERS	GENDER (M/F)	AGE (IN YRS.)	EDUCATION	OCCUPATION

3. Migration

- a. Have you migrated to this place from elsewhere? Yes/No
- b. What was the reason to migrate here?

- i. Landlessness:
- ii. Insufficient land:
- iii. Unemployment:
- iv. Under government's scheme:
- v. Others:

4. Landholding size

- a. Do you have plots for farming? Yes/No

- b. What is the status of land?
 - i. Private registered land:
 - ii. Public land without title:
 - iii. Feudal land:
 - iv. Others:

- c. What do you grow?
 - i. Rice:
 - ii. Wheat:
 - iii. Millet:
 - iv. Others:

- d. Do you get enough agricultural products to support your family for whole year?
..... Yes/No

- e. What are the alternate sources of income to fulfill your requirements?
 - i. Government employment:
 - ii. Pension:
 - iii. Business:
 - iv. Paid labor:
 - v. Remittances:
 - vi. Others:

- f. What type of manure do you use in your fields?
 - i. Organic fertilizers: kg
 - ii. Chemical fertilizers: kg
 - iii. Both: kg

- g. What type of chemicals have you used?
 - i. DDT:
 - ii. BHC:
 - iii. Aldrin:
 - iv. Malathion:
 - iv. Others:

- h. How much do you spend in Pesticides in a Year? NRs:

- i. Are you aware of organic farming? Yes/No

5. Livestock holding

a. Do you own any livestock? Yes/No

b. What livestock and how many of them do you have?

- i. Cattle: ii. Buffalo: iii. Calves (Cattle):
iii. Calves (Buffalo): iv. Goat: v. Sheep:
vi. Hens/Ducks: vii. Pigs: viii. Others:

c. What type of diseases the cattle suffer from?

- i. ii. iii. iv.

d. In the last five years how many animals died of old age, accident or diseases?

S.N.	ANIMAL SPECIES	ANIMAL DIED OF DISEASES	ANIMAL DIED OF OLD AGE	ANIMAL DIED OF ACCIDENT

e. What do you do when the cattle die?

- i. Bury: ii. Throw away: iii. Other:

f. If your livestock become sick do you call a Veterinarian for treatment or treat the animal yourself?

.....

g. What animals would you call a Veterinarian to treat?

.....

h. Do you know the name of the disease or illness that the Veterinarian treated?

.....

i. If the Veterinarian (or yourself) gave medicine to your animal do you know the name of the medicine?

.....

6. Conservation attitudes

Different people living in Nepal hold different opinions about vultures. Here are a few of the things that people say about them.

a. Do you know about vultures? Yes/No

b. Have you ever seen vultures? Yes/No

If yes, how many in number and when?

c. Have you ever seen dead vulture? Yes/No

If yes, how did it die?

i. Killed by man: ii. Died of diseases:

iii. Any other reason:

d. Have you ever killed the vulture? Yes/No

If yes, how many in number and why?

How did you kill it?

e. Do you think other people kill vultures? Yes/No

If yes, why?

How?

f. Are vultures declining in your area? Yes/No

Why, what is the reason?

.....

g. Do you think there are more livestock carcasses than before? Yes/No

Why?

h. Are vultures beneficial to humans? Yes/No

- i. Do you think vultures should be conserved? Yes/No
- i. If yes, why?
- ii. If no, why?
- j. Chemical Fertilizers and Pesticides may cause vulture decline? Yes/No
- k. Veterinary medicines may cause vulture decline? Yes/No
- l. Do you know about Diclofenac? Yes/No
- m. Forests around your village have decreased in recent years? Yes/No
- Why?
- n. People have high regards for vultures due to religious reason? Yes/No
- o. Is it important to educate people about vulture conservation? Yes/No
- p. You would like your local community to help protect vultures? Yes/No
- q. You would like your conservation NGOs to help protect vultures? ... Yes/No
- r. Do you want to give any suggestions for conservation of vultures?

APPENDIX 13: DISTRIBUTION OF NESTS, NEST HEIGHT AND TREE HEIGHT

Place	Nest Number	Tree Species	Nest Height (ft)	Tree Height (ft)
Chisapani	1	Saj 1	64	79
	2	Saj 2	31	72
	3	Saj 3	30	70
	4	Saj 4	60	87
	5		65	87
	6		70	87
	7	Saj 5	55	85
	8		56	85
	9		60	85
Birta	10	Saj 6	54	89
	11	Saj 7	62	82

	12	Saj 8	57	70
	13	Saj 9	54	71
	14	Saj 10	47	77
	15	Saj 11	55	90
	16	Saj 12	59	88
Badera	17	Saj 13	65	75
	18	Saj 14	59	79
	19	Saj 15	66	92
	20	Karam 1	52	83
Gaidahakhal	21	Saj 16	57	72
	22	Saj 17	44	67
Srinagar	23	Saj 18	60	81
	24	Saj 19	80	90
Dharampur	25	Saj 20	49	76
	26	Saj 21	50	70
	27	Saj 22	64	75
	28	Saj 23	60	89
	29	Saj 24	49	62
	30	Saj 25	65	88
	31	Saj 26	66	80
	32	Saj 27	78	90
	33	Saj 28	45	75
	34	Sal 1	59	76
Total	34	30	57.3	80.5

PHOTO PLATE 1



A. Roosting Egyptian vultures



B. Carcass feeding by White-rumped vultures, dog and crows



C. Collected bones of *Gyps bengalensis*



D. White-rumped vultures roosting in a Saj tree



E. A White-rumped vulture guarding its nest



F. Male and female White-rumped vultures copulating near its nest

PHOTO PLATE 2



A. Droppings of White-rumped vultures



B. A White-rumped vulture



C. White-rumped vultures in carcass feeding



D. White-rumped vultures and Himalayan Griffons in carcass feeding



E. A pair of Slender-billed vultures observed in Pithauli of Nawalparasi



F. A Himalayan Griffon

PHOTO PLATE 3



A. Himalayan Griffons in roosting site



B. Himalayan Griffons in carcass feeding



C. Remains of dead White-rumped vulture



D. A Saj tree with a vulture nest



E. A White-rumped vulture in the carcass dumping site



F. A Himalayan Griffon feeding on carcass