Panthera uncia (Snow leopard)

The **snow leopard** *(Panthera uncia syn. Uncia uncia)* is a large cat native to the mountain ranges of Central and South Asia including Nepal. It is listed as endangered on the IUCN Red List of Threatened Species because as of 2003, the size of the global population was estimated between 4,080 and 6,590 adults. Snow leopards inhabit alpine and subalpine zones at elevations from 3,000 to 4,500 m.

Biodiversity Conservation Efforts in Nepal

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Government of Nepal
Ministry of Forests and Soil Conservation
Department of National Parks and Wildlife Conservation

Biodiversity Conservation Efforts in Nepal

Special issue published on the occasion of

20th Wildlife Week 2072

Let us discover and conserve Prehistoric fossil mammals of Nepal

Extinct Primate, Ramapithecus sivalensis *(also called Sivapithecus punjabiensis)*, was a kind of a primate found in Nepal Siwalik hills between 8.5 and 12.5 million years ago.
Extinct Elephant, *Archidiskidon planifrons*, was a prehistoric elephant found in Nepal between 1 and 3 million years before.
Extinct Giraffe, *Giraffa punjabiensis*, was found in Nepal some 2.5 million years ago.
Extinct Hippopotamus, *Hexaprotodon sivalensis*, was a kind of hippopotamus species found in Nepal between 0.11 and 5.33 million years ago.

Let us conserve moths of Nepal

Acherontia lachesis Fabr. is a large moth measuring up to 13 cm in its wing span and with head and thorax blackish with white or yellow suffusion
Argina argus Koll. is a beautiful moth with head, thorax and abdomen scarlet red. Besides Nepal, this moth is distributed in Myanmar, Sri Lanka and India.
Asota producta belongs to the family Noctuidae and it is a medium sized moth with using span of 60-71 mm. This is a rare species of moth and occurs both in low and upper mountain forest.
Biston contectaria Walker is an uncommon Geometridae moth with wing span of 27 to 28 mm. This is a large winged moth and is widely distributed in Holoarctic, Oriental and Ethiopian regions.

Let us conserve moths of Nepal

Brahmaea wallichii Gray is a large moth species of the family Brahmaeidae and the species found in Nepal is little different in colour from those of Western Himalayan and Taiwanese species.
Campylotes histrionicus Westw. Is a beautiful brilliant moth that has head, thorax and abdomen blue black. Abdomen has yellow bands below.
Dermaleipa (Lagoptera) juno belongs to the family Noctuidae with its wing span of 90-100 mm. This is a rare moth generally found in upper mountain forest.
Episteme adulatrix Koll. moth belongs to the family Agaristidae has series of white spots on both the wings.

Let us conserve moths of Nepal

Erasmia putchella Hope is a beautiful moth species of the family Zygaenidae and it is a very rare moth and has the wing span of 70-80 mm.
Eterusia aedea edocla is a medium sized moth with wing span of 65–75mm.
Eudocima salminia Fabr.: Head plum coloured, thorax green and abdomen orange, forewing golden green with a broad cream coloured costal fascia from near base of inner margin to apex.
Gynautocera papilionaria: This is beautiful moth species which looks like Papilio butterfly.

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20th

Wildlife Week 2072 BS

Chief Advisor:
Mr. Tika Ram Adhikary, Director General, Department of National Parks & Wildlife Conservation.

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Prof. Ramesh Shrestha, PhD., Chief, Natural History Museum, Swayambhu, Kathmandu.

Front cover photo: Calf of Rhinoceros unicornis at Kasara, Chitwan National Park (Courtesy: Prof. Ramesh Shrestha, PhD.)

Backside cover photo: Panthera uncia (Snow leopard) (Website: www.dnpwc.gov.np)

Inside front cover: Postage stamps of 4 Prehistoric mammalian fossils of Nepal and 4 moths of Nepal issued by Postal Service Department from the collection of Natural History Museum.

Inside back cover: Postage stamps of 8 different moths of Nepal issued by Postal Service Department from the collection of Natural History Museum.

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२०औं वन्यजन्तु सप्ताह

वैशाख १-७, २०७२ को अवसरमा

माननीय मन्त्री श्री महेश आचार्यज्यूले दिनुभएको रेडियो सन्देश

आदरणीय दाजु भाइ तथा दिदी बहिनीहरु,

सर्व-प्रथम नव बर्ष २०७२ को शुभ अवसरमा सम्पूर्ण नेपाली दाजु भाइ तथा दिदी बहिनीहरु प्रति सुख, शान्ति र सम्वृद्धिको लागि हार्दिक मंगलमय शुभ कामना व्यक्त गर्दछु। यस पावन अवसरमा राष्ट्रिय निकुन्ज तथा वन्यजन्तु संरक्षण विभागले "हाम्रो भविष्यका लागि वन्यजन्तु" भन्ने उद्घोषका साथ मनाउन लागि रहेको २० औ वन्यजन्तु सप्ताह-२०७२ को समेत पूर्ण सफलताको कामना गर्दछु।

नेपाल सरकार, वन तथा भू-संरक्षण मन्त्रालय, राष्ट्रिय निकुन्ज तथा वन्यजन्तु संरक्षण विभागले विगत ४० वर्षदेखि जैविक-विविधता संरक्षण गर्दै आएको व्यहोरा सर्व-विदितै छ। जैविक-विविधता संरक्षणमा स्थानीय समुदायको अहम भूमिका हुने हुदाँ उनीहरुको चेतना र क्षमता अभिवृद्धि गर्नु सरकारको प्रमुख दायित्व हुन आउद्छ। यसका लागि राष्ट्रिय निकुन्ज तथा वन्यजन्तु संरक्षण विभागले बिगत १९ बर्षदेखि वन्यजन्तु र जैविक-विविधता संरक्षणमा जन-चेतना जगाउने खालका विविध कार्यक्रमहरुको आयोजना गरी वन्यजन्तु सप्ताह मनाउदै आएको छ। संरक्षणको क्षेत्रमा भएका विविध प्रयासहरुको परिणाम स्वरूप बाघ र गैंडा जस्ता लोपोन्मुख तथा दुर्लभ वन्यजन्तुको संख्या बढेको सुन्न पाउदा, संरक्षणमा स्थानीय जनताको सहभागितामा बृद्धि भै उनीहरुको जीवनयापनमा समेत सकारात्मक प्रभाव परेको देख्न पाउँदा तथा दुई-दुई पटक गैडाको शुन्य चोरी शिकार वर्ष मनाउन पाउँदा खुशीको अनुभूति हुन्छ। वन्यजन्तु र जैविक-विविधता संरक्षणको क्षेत्रमा यस्ता सकारात्मक परिवर्तन ल्याउन प्रत्यक्ष र परोक्ष रुपमा सहयोग गर्नु हुने सम्पूर्ण सरकारी कर्मचारी, नेपाली सेना, नेपाल प्रहरी, स्थानीय समुदाय र संरक्षणका साझेदार संस्थाहरु लगायत सम्पूर्ण महानुभावहरुलाई विशेष धन्यवाद दिन चाहन्छु।

हाल नेपालमा १० वटा राष्ट्रिय निकुन्ज, ३ वटा वन्यजन्तु आरक्ष, १ वटा शिकार आरक्ष र ६ वटा संरक्षण क्षेत्र स्थापना भै देशको कुल भू-भागको २३.२३ प्रतिशत क्षेत्र संरक्षित क्षेत्रले ढाकेको अवस्था छ। साथै १२ वटा संरक्षित क्षेत्रको वरीपरी मध्यवर्ती क्षेत्र घोषणा गरी, ती संरक्षित क्षेत्रहरुले बार्षिक आम्दानीको ३०(५०५ रकम वन, वन्यजन्तु र जैविक(विविधता

संरक्षण, सामुदायिक विकास निर्माण, आयमुलक र रोजगारी सिर्जना गर्ने कार्यक्रमहरुमा खर्च गरी एक साथ जैविक-विविधता संरक्षण र स्थानीय समुदायको जीविकोपार्जन सुधार गर्ने कामहरु हुदै आएका छन् । मध्यवर्ती क्षेत्रमा संचालन भएका संरक्षण कार्यक्रमहरु स्थानीय समुदायहरुलाई संरक्षण कार्यमा सहभागी गराउन निकै सफल भएको मैले महशुस गरेको छु । तथापि संरक्षणको कार्य गर्दा हामीसँग थुप्रै चुनौती र जटिलताहरु पनि छन् । मानव-वन्यजन्तु द्वन्द बढ्दो छ, चोरी शिकार र वन्यजन्तुको अबैध ब्यापार एउटा समस्याको रुपमा रहेको छ भने कानुन कार्यान्वयन एउटा चुनौतीको रुपमा देखिन्छ । आगामी दिनमा यस्ता समस्या र चुनौतीहरुलाई क्रमश न्यूनीकरण र निराकरण गर्दै जानु हामी सबैको दायित्व हुन आउँदछ । त्यसका लागि हाल हुदै आएका जैविक-विविधता संरक्षण कार्यक्रमहरुलाई अझै परिस्कृत र परिमार्जन गर्नु पर्ने हुन्छ । यसका लागि वन दशक २०७१-८० तथा वन नीति २०७१ ले मार्गदर्शन गर्ने नै छन् भन्ने मैले आशा एवं विश्वाश लिएको छु . हामीले गर्दै आएका राम्रा कामहरुलाई सस्थागत गर्न तथा स्थानीय समुदायलाई प्रत्यक्ष लाभ पुग्ने कार्यक्रमहरु मार्फत थप उत्साहका साथ् काम गर्नका लागि म सबै सरकारी एवं गैर सरकारी निकाय तथा संरक्षणका साझेदार सस्थाहरुलाई हार्दिक अनुरोध गर्न चाहन्छु .

अन्त्यमा, वन, वन्यजन्तु र जैविक-विविधताको संरक्षण कार्य अनन्त सम्म चल्ने एउटा नियमित प्रक्रिया भएको स्मरण गर्न चाहन्छु । यस पवित्र कार्यमा अनवरत रुपमा सहयोग र समन्वय गर्नु हुने सम्पूर्ण नेपाली दाजु भाइ तथा दिदी बहिनीहरुलाई हार्दिक धन्यबाद पनि दिन चाहान्छु । भविष्यमा पनि यस प्रकारको सहयोग र समन्वयको आशा गर्दै पुन-एकपटक वन्यजन्तु सप्ताह २०७२ को सफलताको शुभ-कामना ब्यक्त गर्न चाहन्छु ।

जय नेपाल

२०७२/१/१

Government of Nepal
Ministry of Forests & Soil Conservation
Department of National Parks & Wildlife Conservation

Foreword

The Department of National Parks and Wildlife Conservation is a leading institution in managing protected areas of Nepal. The main aim of protected areas is to maintain viable population of wildlife species, healthy ecosystem for ecosystem services, and to conserve genetic resources. The Government has given more emphasis on collaboration, correlation and coordination with national and international conservation institutions in the protection of wildlife. A wide range of conservation partners have been supported to Nepal on researches, anti-poaching operations, habitat management, infrastructure development, capacity building and implementation of international convention and treaty is recommendable. Declining poaching incident of wildlife and increasing trend of their populations causes a conflict between local people and wildlife is the most important part of management that remains to be resolved. Poaching and retaliatory killing of some wildlife species is still continued. As a result government is committed to minimize the problem.

Since 1970s, protected areas have been establishing in various parts of Nepal focusing on flagship species for conservation, protection of important landscape, monuments and historical places. All conservation areas and buffer zone forests are managed through people participation. Up-to fifty percent of protected areas revenue is shared with the buffer zone and conservation areas communities is the best example in the world for conservation. The local people are also benefited from eco-tourism in the protected areas that encourage people to protect wildlife. However, understanding at individual level is different and some of the knowledge on forests/wildlife conservation is still unknown to scientists as well as researchers who have been devoting their life to discover new knowledge and skill. In addition, natural resources are common property to all and therefore it is essential to let know their importance for all and forever.

The Department of National Parks and Wildlife Conservation has been celebrating wildlife week since 1997. This year, the theme of the wildlife week was ‘wildlife

for our future'. On the occasion, the department is established a trend to publish a journal with advance academic research articles.

I am highly delighted to let you know that ten peer review articles, written by researchers are included in this journal. I hope all articles are very innovative and useful to policy makers, law makers, field biologists, protected areas managers as well as communities' leaders. I would like to share my sincere thanks to all authors and co-authors. I am equally indebted to Professor Dr. Ramesh Shrestha for his innovation in reviewing and providing inputs to improve the quality of the journal. Finally, I do hope that the findings of the articles will be very much helpful to design the policy and revise the planning system on biodiversity conservation in Nepal. At last, but not the least, my sincere thank goes to Dr. Maheshwar Dhakal for his strong coordinated effort to publish this journal.

Tika Ram Adhikari
Director General

EDITORIAL

In the first week of this year 2072 BS (2015 AD), we are celebrating the 20th Wildlife Week as before every year with many programs related to the conservation and management of our precious wildlife and their habitats. The publication of this journal is also one of the parts of these pious efforts of Department of National Parks & Wildlife Conservation.

In 1972, works on national parks and wildlife conservation began with the establishment of Conservation Section under Department of Forest. However, keeping in view the accelerating trend of importance of the national parks and wildlife reserves and their management, the Department of National Parks and Wildlife Conservation (DNPWC) (Website: http://www.dnpwc.gov.np) was set up as a separate entity under the Ministry of Forest and Soil Conservation in 1980. The DNPWC is the administrative authority in Nepal of the Ramsar Convention; management authority of the fauna in partnership with Natural History Museum as the scientific authority (NHM) since 1990 under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES); and focal institution of the World Heritage Convention (UNESCO), Global Tiger Forum (GTF) and Convention on Biodiversity (CBD).

The Department of National Parks and Wildlife Conservation is committed to the conservation, management and regulation of the protected areas and biodiversity in Nepal. It has a network of protected areas that include Ten National Parks, Three Wildlife Reserves, Six Conservation Areas, One Hunting Reserve, and Twelve Buffer Zones areas. These protected areas cover 34,185.62 Km^2 (23.23%) of the total geographical area of the country.

In the past also we have published the similar journal **Biodiversity Conservation Efforts in Nepal**. In the due course of time we have received several inputs regarding our former issues and we gained more knowledge on how to bring out the contemporary journals better than past issues. We are so much excited that we promise to continue such encouraging tasks in the future also.

This issue of Journal of **Biodiversity Conservation Efforts in Nepal 2072** includes many significant articles, which can be applicable to the future researchers. Articles

on conservation issues have also been entertained in this issue. As usual the views expressed in the papers are those of the respective authors themselves and not necessarily epitomize that of the editors.

The editorial board of this journal wishes to thank to all paper contributors to this issue of **Biodiversity Conservation Efforts in Nepal 2072**. Finally, we would like to express our sincere thanks to all our valued reviewers, particularly Prof. Dr. Bhaiya Khanal and Prof. Dr. Dharma Raj Dangol of the Natural History Museum, who despite their busy schedules accepted to review papers of this issue.

Editors

Dr. Maheshwar Dhakal, Conservation Education Officer, Under Secretary, DNPWC

Prof. Ramesh Shrestha, PhD., Chief, Natural History Museum, Swayambhu, Kathmandu

2072 Baisakh 01

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Amphibian Survey in Kathmandu Valley, Nepal

Prakash Chandra Aryal[1], Subash Chandra Kharel[2], Bed Prasad Bhurtel[3], Eva Nath Paudel[4], Man Kumar Dhamala[5], Bishal Rijal[6] & Arjun Thapa[7]

ABSTRACT

The study was carried out as an opportunity to understand the amphibian diversity, populations and habitat conditions of Kathmandu valley. The overall objective of the study was to enumerate the amphibian species of Kathmandu Valley, evaluate the habitat conditions of amphibian along with capacity building of graduate students. A sampling design covering three distinct parts: city core, fringe and rural parts, was adopted. Random points, 503 suitable random points were auto generated inside water bodies (5 m buffer in river and natural and manmade ponds) with minimum of 200 m distance between two points in ArcGIS 10, located with a help of GPS. A total of 60 belt transects (50 m x 10 m, n=20 in each parts), were set and surveyed. To carry out amphibian survey, 34 graduate students in biological sciences were trained in 3 days of training program. Visual Encounter Survey (VES) was adopted in each transect during September-October. Amphibian micro-habitats such as boulders, fallen logs, leaf litter and other debris were surveyed to capture most of aquatic and riparian species. The presence-absence and individual occurrence data was used to measure the species richness and abundance. Through the field surveys we recorded 569 individuals of seven amphibian species in Kathmandu valley from 89 sites surveyed. Of the three regions categorized as urban, suburban and rural were not significantly difference ($p>0.05$) in frog species occurrence.

KEY WORDS: Shivapuri-Nagarjun National Park, Visual Encounter Survey, Snout-Vent-Length

1 Companions for Amphibians and Reptiles of Nepal (CARON) & Golden Gate International College.
2 Companions for Amphibians and Reptiles of Nepal (CARON) & Wildlife Conservation Nepal (WCN).
3 Companions for Amphibians and Reptiles of Nepal (CARON).
4 Companions for Amphibians and Reptiles of Nepal (CARON).
5 Companions for Amphibians and Reptiles of Nepal (CARON) & Golden Gate International College.
6 Companions for Amphibians and Reptiles of Nepal (CARON).
7 Companions for Amphibians and Reptiles of Nepal (CARON).

INTRODUCTION

As herpetofauna is a poorly studied group in Nepal, their present status is also poorly known (CEPF, 2005). Few studies have been carried out in (e.g. Arun Valley in eastern Nepal, Chitwan National Park in central Nepal and the Annapurna-Dhaulagiri region in western Nepal) (HMGN/MFSC, 2002), so there is a critical gap in information about species richness and population status. Due to lax information and studies, conflicting records exist about amphibians of Nepal. For example, Shah and Tiwari (2004) reported 59 amphibian species of which 15 are listed as globally threatened whereas *Amphibia web* (www.amphibiaweb.org) lists only 42 amphibian (41 anurans) species in Nepal. Altogether, 10 endemics and 46 total species have been reported from Nepal (Molur, 2008).

Conservation efforts have been limited (Shah and Tiwari, 2004), exemplified by the exclusion of amphibian species from protected status. Globally, the total number of recognized species has increased by over 60% since 1985 (www.amphibiaweb.org). On the other hand, owing to taxonomic rearrangements and revalidations, Nepal has a reduced species composition compared with the 2001 checklists (Molur, 2008). With nine amphibian species threatened with local extinction (HMGN/MFSC, 2002), a quick response is required in terms of scientific information about species occurrence and population status as well as relevant policy response.

Furthermore, the problem of urbanization being the worst among factors of habitat modifications and destruction has recently attracted the attention of conservation biologists regarding conservation in urbanizing areas. In this context, the proposed study is taken as an opportunity to understand the amphibian diversity, populations and habitat conditions in Kathmandu valley.

OBJECTIVES

Overall objective of the study was to enumerate the amphibian species of Kathmandu Valley, evaluate the habitat conditions of amphibian along with capacity building of graduate students.

The specific objectives were:

- To examine the amphibian species composition, evaluate habitat conditions, influence of habitat type and quality on populations.
- To build capacity of graduate students in herpetology.

STUDY AREA

Kathmandu, a valley covering an area of 665 KM^2 of three districts, Kathmandu, Lalitpur, and Bhaktapur, lies at 1,300 masl and is located between latitudes 27°32'13" and 27°49'10" north and longitudes 85°11'31" and 85°31'38" east. The valley is surrounded by the Mahabharata mountain range on all sides with the highest altitude being 2,831 m. The climate is subtropical, temperate and cool-temperate, with four distinct seasons: spring from March to May; summer from June to August; autumn from September to November; and winter from December to February (ICIMOD *et al*., 2007).

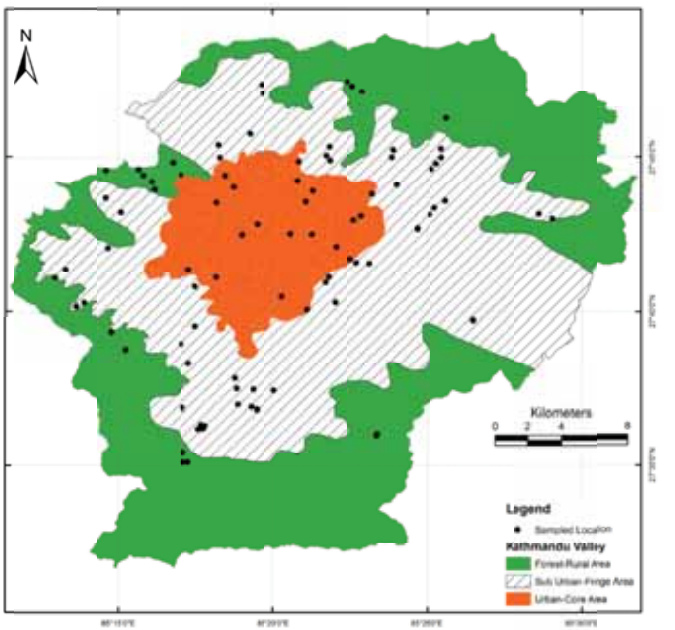

Figure 1. Kathmandu Valley with sampled location

METHODOLOGY

i. Sampling Design

A sampling design covering three distinct parts: city core, fringe and rural parts, was adopted. Random points, 503 suitable random points were auto generated inside water bodies (5 m buffer in river and natural and manmade ponds) with minimum of 200 m distance between two points in ArcGIS 10, located with a help of GPS. A total of 60 belt transects (50 m x 10 m, n=20 in each parts), were set and surveyed. Fifty percent of the transects were located along the water bodies or riparian areas (within 20 m from water bodies). The point was considered as a starting of transect. The transects were rotated around 360 degrees as per the field condition. Within this dimension, a thorough exploration was made in each transect searching amphibian species. Out of the four members in a survey team,

one member recorded site features, habitat conditions while the three searched for amphibians. We also carried out opportunistic sampling during field visit.

ii. Study Arrangements

To carry out amphibian survey, 34 graduate students in biological sciences were trained in a 3 day training program coordinated by Companions for Amphibians and Reptiles of Nepal (CARON) and Wildlife Conservation Nepal (WCN) with support from Golden Gate International College using instructors from CARON, Natural History Museum, Tribhuvan University, Kathmandu and Department of National Parks and Wildlife Conservation (DNPWC). Techniques of sampling, searching, species identification and measurements, habitat survey and animal handling were delivered in the training. Additionally, they were trained about GPS navigation, habitat characteristics and variable measurements. Six team leaders lead the field surveys, each accompanied by four graduate student volunteers. Members from CARON also carried out cross check surveys and covered several sites during day and nights. Cautionary principles in field, emergencies and ethics were dealt in details.

iii. Field Methods

A. Species, Population and Habitat Survey

Visual Encounter Survey (VES) was adopted in each transect during September-October. Amphibian micro-habitats such as boulders, fallen logs, leaf litter and other debris were surveyed to capture most of the species of aquatic and riparian species. Species were identified in the field using Shah and Tiwari, 2004, individuals recorded in area constrained survey were counted and Snout-Vent-Length (SVL) was measured and released *in situ*. Whenever not possible to get the measurements of the individuals, we recorded the number of individuals of particular species and in some cases we recorded only presence or absence. Specimens were caught by hand during VES using surgical gloves free of powder.

We recorded temperature at surface level, at 10 cm above surface and air temperature at 1 m. we categorized a survey site as per habitat features in to agriculture, settlement, forest, aquatic & pond. We estimated canopy cover and tree diameter at breast height (DBH) in forested areas. The data were recorded using check lists.

DATA ANALYSIS

The presence-absence and individual occurrence data was used to measure the species richness and abundance. We calculated average for abundance and SVL of frog species. We examined frogs' presence, total number of frog species records in sites and the abundance between different habitat types and three urbanization regions using chi-square test of independence using R (R Core Team, 2013).

RESTULTS

i. Species records

We visited a total of 89 sample sites (designed and opportunistic) and conducted opportunistic surveys on the ways to &/ or from the sites. Through the field surveys we recorded 569 individuals of seven amphibian species in Kathmandu valley (Table 1). Of the three regions categorized as urban, suburban and rural were not significantly different ($p>0.05$) in frog species occurrence. However, the populations of *Xenophrysparva* and *Amolopsformosus* were recorded from forested sites only; namely from Nagarjuna and Shivapuri National Park area. The species records are from site specific surveys and opportunistic surveys.

Table 1. Species records from Kathmandu valley

Family	Species	IUCN Red List Status
Bufonidae	*Duttaphrynus melanostictus* (Schneider, 1799)	Least Concern
Ranidae	*Euphlyctis cyanophlyctis* (Schneider, 1799)	Least Concern
Ranidae	*Hoplobatrachus tigerinus* (Daudin, 1802)	Least Concern
Ranidae	*Limnonectes syhadrensis* (Annandale, 1919)	Least concern
Ranidae	*Amolops formosus* (Günther, 1876)	Least Concern
Megophrydae	*Xenophrys parva* (Boulenger, 1893)	Least Concern
Microhylidae	*Microhyla ornata* (Duméril and Bibron, 1841)	Least Concern

We observed a total of 569 individuals of seven frog species from the study area divided into six blocks (Table 2).The species occurrences varied between different blocks. Of the 89 sites surveyed, we did not record any frog species from 31 sites. Among the blocks, *Euphlyctis cyanophlyctis* was the most frequent species in abundance (n=410) followed by *Limnonectes syhadrensis* recorded (n=113) in all blocks and regions. Three species of the frogs *Amolops formosus,* recorded (n=2)

from a single site, *Xenophrys parva* (n= 25) recorded from two blocks and *Microhyla ornata* recorded (n=3) from only two sites from SE and NW blocks of study area.

Table 2. Observed number of individuals and size (SVL cm) distribution of frog species

Block	*Duttaphrynus melanostictus*	*Euphlyctiscyano-phlyctis*	*Limnonect-essyhadren-sis*	*Hoploba-trachustige-rinus*	*Micro-hylaornata*	*Amolops-formosus*	*Xenophrys-parva*	Absent (Sites)
SE	1(6.9)	71(3.07±0.57)	33(2.38±0.3)	2(7.25±0.35)	1(1.7)	ABSENT	ABSENT	6
C	ABSENT	8(1.81± 0.81)	4(2.24±0.21)	3(6.25+ 3.9)	ABSENT	ABSENT	ABSENT	4
E	ABSENT	**290***(1.81±0.82)	ABSENT	3(6+1.32)	ABSENT	ABSENT	ABSENT	4
NW	2(3.5±0.84)	16(3.05±1.06)	31(2.47±0.8)	1 (5.6)	2(1.64±0.2)	ABSENT	16(3.6±0.8)	4
NE	ABSENT	7(2.07±0.26)	44(1.69±0.5)	1 (3.5)	ABSENT	2(3.8+0.8)	9(3.26+0.4)	6
S	1(6.5)	18(4.00)	1(3.2)	2(6.5)	ABSENT	ABSENT	ABSENT	7
Total	4	410	113	12	3	2	25	31

Note: Number of individuals & SVL cm. (average ±standard deviation)

* all the individuals were not measured for SVL

Species abundance remained similar for all blocks for two of the most dominant species *Limnonectes syhadrensis* (for example in South-East block, Figure 2). In many sites all the individuals were not recorded for SVL and sometimes counting of all individuals was not practically feasible in areas like some pools and river banks.

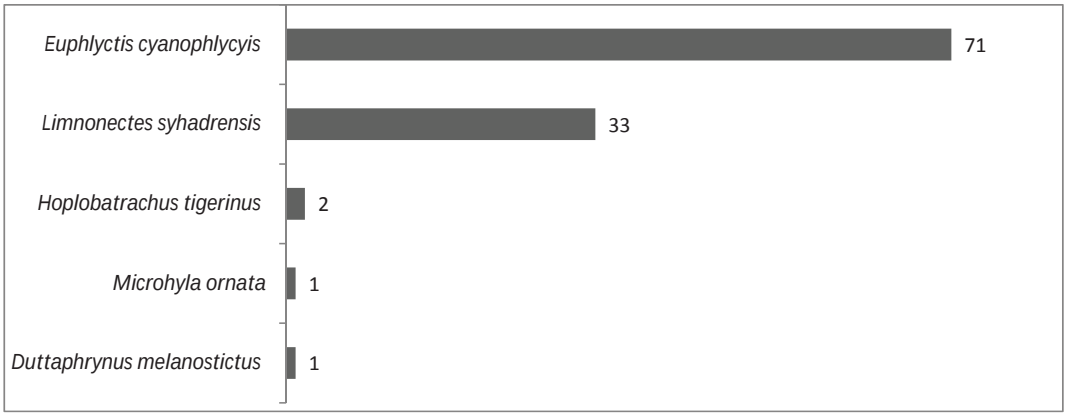

Figure 2. Abundance of frog species in South-East block (Lalitpur area)

i. Urbanization, habitat type and frog occurrences

The frogs' response to urbanization intensity is reflected through increased dominance and reduced occurrences. The dominance of two species *Limnonectes syhadrensis* and *Euphlyctis cyanophlyctis* in most of the sites was prevalent (Table 2). The urbanization intensity was not found to have significant (χ^2=3.39, df=2, p-value=0.18) influence in the occurrence and distributions of frogs (without considering particular species) in the study area (Table 3).

Table 3. Survey sites with Presence or absence of frogs in relation to urbanization

	Rural Region	Suburban Region	Urban Region
Absence	5	13	11
Presence	5	37	12

Exact habitat conditions of frog occurrence during field survey showed that the habitat type did not influence the presence or absence of the frogs. There was no significant difference (χ^2=8.15, df=4, p = 0.08) in occurrence (presence or absence) of the frogs between different categories of habitats (Table 4).

Table 4. Presence and absence of frogs in relation to habitat types

Habitat	Agriculture	Aquatic	Forest	Pond	Settlement
Absence	5	3	3	3	5
Presence	13	11	3	4	1

Table 5. Distribution of survey sites (n=51) in terms of habitat type and urbanization

Habitat	Rural Region	Suburban Region	Urban Region	Total
Agriculture	0	14	4	18
Aquatic	1	7	6	14
Forest	2	2	2	6
Pond	1	3	3	7
Settlement	1	2	3	6
Total	5	28	18	**51**

DISCUSSION

We recorded seven frog species in Kathmandu valley. This has been the first field based list of frogs of Kathmandu valley. However, we did not record previously reported (Pokhrel *et al.*, 2011) two species namely Liebig's Paa Frog(*Paa lebigii*) and Marbled Toad (*Duttaphrynus stomaticus*). Although the common frog species were recorded from different sites, *Amolops formosus* and *Xenophrys parva* were recorded from very few sites and forest areas only. Furthermore, the low encounter of *Haplobatrachustigrinus* is sought to be due to some sampling problem otherwise it is a common frog species of the region (Shah and Tiwari, 2004).

Despite earlier expectations that the urbanization should have impact on presence of the frogs mostly in the urban areas, we found no association of urbanization intensity with frog occurrences. This might have been due to our treatment of presence of frogs as factor instead of particular species for analysis. Moreover, the higher intensity of sampling in suburban area could have nullified the reflections of impacts of urbanization on frogs. Also, the association of habitat types with presence or absence of species ($p>0.05$) might be due to varied sampling efforts in categorically different habitat types. Our sampling strategies to capture most of the species in valley using sites near water bodies may have been important to record aquatic species rather than those inhabiting distant areas from water bodies. For example, the widespread common toad (*Duttaphrynus melanostictus*) of the region should have been recorded from more sites than we observed. Our study does not support the impact of urbanization on amphibian species occurrence in Kathmandu. This follows Scheffers and Paszkowski (2012) who found amphibians as a whole responded negatively to urbanization in North America.

However, the record of *Amolops formosus* and *Xenophrys parva* from forested sites only directs us to have insights in the ecological response of these species with urbanization intensity. The rarity of *Microhyla ornata* (n=3) can be expected to be due to sampling design, probable variation in sampling efforts in specific habitat areas. The level of pollution, disturbance and associated habitat features can only be expected in lack of species specific ecological and population data. The absence of frog species in many sites should be the combined response of our survey timing, survey efforts and sample site characteristics.

CONCLUSION

This was the first time amphibian survey in Kathmandu valley with involvement of graduate student researchers and herpetologists of Nepal. The record of seven frog species in Kathmandu valley in a short span of time using visual encounter method has been considered significant step in recording amphibian fauna in the valley. Since there are no past data for amphibian status and trends, this study has set the baseline of the future amphibian studies.

Moreover, the overall dominance of *Limnonectes syhadrensis* and *Euphlyctis cyanophlyctis* in urban and suburban regions and rarity of *Amolops formosus, Microhyla ornate* and *Xenophrys parva* from the study can be used for further analysis of amphibian response in terms of urbanization intensity at population levels. The lack of sufficient records hindered statistical analysis of later three species to relate the abundance and presence comparing different habitat types and urbanization intensity.

Missing of previously recorded species from the study area due to timing of the study, (September- October which is not the best time of the year) should be compensated through another quick survey in the months from June- August. The recording of habitat features and environmental variables should be continued so that we can provide statistically reliable and valid reasons on the amphibian occurrences and populations with habitat characteristics and the impacts therein from urbanization.

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Climate Change Adaptation Planning for Rhino population in Chitwan National Park, Nepal

Ganesh Pant[1]

ABSTRACT

Chitwan National Park, a natural world heritage site, is the flagship for biodiversity conservation in Nepal and One-horned Rhino (Rhinoceros unicornis) is the iconic species of the park. Rhino population in Chitwan National Park is highly vulnerable to climate change as its survival has already been challenged by serious decline in both quality and quantity of the habitat. Rhino population in Nepal is likely to be affected from temporal and spatial shift in suitable habitat as a result of regional climate shift and the adverse impact of extreme weather events such as excessive drought and flood. This report has identified key areas of interventions needed to facilitate this mega herbivore in Nepal to withstand likely adverse impacts in the face of climate change. Further, it has emphasized the need of further research and stakeholders' engagement for ensuring the effectiveness of climate change adaptation planning for rhino population in Nepal.

KEY WORDS: Rhino, Chitwan, population, climate change, adaptation, relocation, stakeholders.

INTRODUCTION

Climate change has been one of the most serious challenges for biodiversity conservation over the last decades. Species assemblage and ecosystem dynamics has started responding to the recent climate shift globally. Shifts in species distributions particularly along elevation gradients, changes in the timing of life-history events or phenology, effects on demography such as survival and fecundity, reductions in population size, increased fire frequency, pest and disease outbreaks, increased spread of wildlife diseases, parasites, and zoonotic, increased spread of invasive or non-native species, including plants, animals, and pathogens, direct loss of habitat and species extinction are some of the identified biodiversity related impact of climate change (Mawdsley *et al.*, 2009, Olson *et al.*, 2009, CBD, 2013).

1 Banke National Park, Banke, Nepal

One of the most likely impacts of climate change is shift in spatial and temporal pattern in availability of suitable habitats for terrestrial species. Some species can simply move to suitable habitats, while other animals try to adapt in new habitat conditions or shift gradually over generations. As climate change is occurring rapidly, most species may not be able to respond through local adaptation or migration across landscapes (Olson *et al.*, 2009). One-horned Rhino *(Rhinocerous unicornis)* is a definitive example of such type of species which is neither capable to adapt rapid change nor can migrate to other areas. Rhino is a specialist species, which is confined to the riverine grasslands in the foothills of the Himalayas. As a result of habitat destruction and climatic changes, its range has gradually been reduced. At present, remnant population of rhino thrive in the grasslands of southern Nepal and in the Brahmaputra Valley of Assam, India (Talukdar *et al.,* 2008, DNPWC, 2006).

CLIMATE CHANGE ADAPTATION

Climate change adaptation as defined by The Intergovernmental Panel on Climate Change (IPCC) is "adjustment in natural or human systems to actual or expected climate stimuli or their effects, which moderates harm or exploits beneficial opportunities" (IPCC, 2007). Adaptation involves the planning and implementation of measures that intends to increase the resilience, or the ability of natural or human system to withstand shocks resulted from direct or indirect effects of a changing climate. The following framework illustrates the difference between mitigation and adaptation.

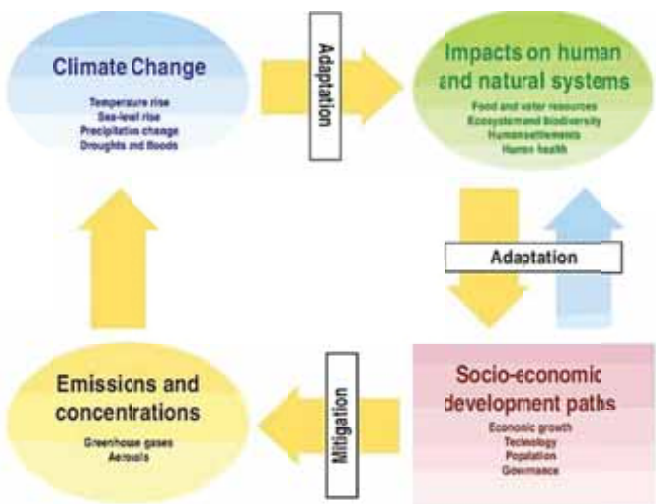

Figure 1. Conceptual Framework for Climate Change Adaptation and Mitigation adopted from IPCC, 2001

Source: http://www.intechopen.com

Adaptation is any measures intended to minimize impact of climate change on human and natural systems whereas mitigation refers to any strategy or action to reduce the amount of green house gases in atmosphere. It is claimed that human and natural systems are capable to adapt autonomously to some extent, while planned adaptation is supposed to supplement autonomous adaptation. The following diagram depicts the interrelationship between climate change impact, adaptation and mitigation.

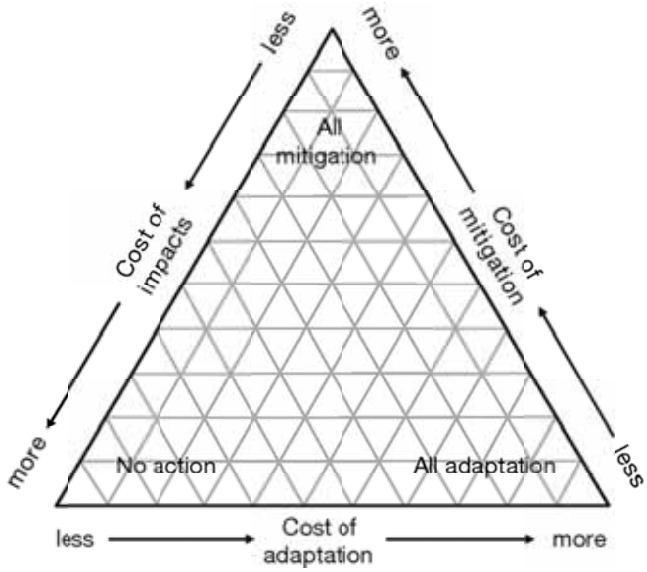

Figure 2. A schematic overview of inter-relationships between adaptation, mitigation and impacts adopted from Holdridge, 1947

Source: http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter18.pdf

In other words, climate change adaptation is those activities intended to minimize the adverse effects of climate change on human infrastructure and natural environment. The adaptation strategies for biodiversity in the face of climate change are broadly grouped into four categories viz. land and water protection and management, direct species management, monitoring and planning and law and policy (Mawdsley *et al*., 2009).

Adaptation consists of measures that are taken in response to the actual or expected changes in climate to minimize their impact. Such measures help in reducing vulnerability of natural or human systems to the likely adverse effects of climate change by increasing the system's resilience. Loss prevention, loss sharing, behaviour modification and relocation are the broad categories of adaptation

measures in the face of climate change. Thus, effectiveness of climate change adaptation heavily relies on rigorous planning which can adequately combine these types of measures in relation to most significant and eminent vulnerabilities of the concerned system taking into account of available resources, skill and institutional roles and capacities (DoCC, 2009). Loss prevention refers to the actions taken for reducing vulnerability to climate change whereas loss sharing is spreading the risk of loss among wider population such as insurance. Likewise, behaviour modification intends to eliminate the activity or behaviour that is likely to cause hazard. Last but not least, relocation involves moving vulnerable population or systems away from areas prone to hazards.

CLIMATE CHANGE ADAPTATION PLANNING FOR RHINO POPULATION IN NEPAL

Nepal, a landlocked country in South Asia is highly vulnerable to the impacts of climate change. The factors that make Nepal highly sensitive to climate change includes higher rate of temperature increase than global average, exposure to diversity of climatic conditions, high dependency on natural resources, steep topography, fragile geology and inadequate financial and human resources (Gurung and Bhandari, 2009). Chitwan district, which encompasses more than 70% of Chitwan National Park (CNP, 2012) has been ranked as high-risk category district of Nepal in the face of likely impact of climate change (MoE, 2010). Chitwan National Park is second home to one-horned rhino in the world, which supports about 20 % of global population of one-horned rhino and more than 90% of the rhino population in Nepal (DNPWC, 2012).

Rhino, which inhabits flood plain grasslands, is a true specialist in terms of food and habitat requirement. It also requires plenty of water holes in its habitat to wallow for keeping its body cool in extreme temperatures (DNPWC, 2006, Talukdar et al., 2008). Poaching of rhino for illegal trade of its horn and inadequacy of suitable rhino habitat are the major challenges of rhino conservation in Nepal (DNPWC, 2012). Chitwan National Park has already experienced serious decline in both quantity and quality of rhino habitat due to encroachment of woodland in grasslands, invasion by alien plants into grasslands and riverine forests, and silting up of wetlands (Talukdar et al., 2008). The extent of grassland in Chitwan National Park has dropped from about 20 % of the park area during 1970s to about 5 % of the park area in 2008 (Kafley et al., 2009). Grassland comprises the major portion of suitable rhino habitat

and the drastic decline in rhino habitat, which is attributed to climate change, has serious implication for long-term survival of rhino population in Nepal.

There exists very limited information on impact of climate change on rhino population and adaption measures needed for its long-term conservation. Based on available information, the rhino population in Nepal seems to be highly vulnerable to climate change as its exposure to climate change related risk is high and adaptive capability to moderate the associated risk is low. In this context, immediate management intervention is required to assist this mega herbivore to adapt under predicted impact of climate change. However, there could be multiple impacts of climate change on rhino population; drastic decline of suitable rhino habitat from severe drought has been identified as the most serious risk resulted from climate change.

The ultimate goal of adaptation planning for rhino population is to complement the ongoing rhino conservation initiatives for maintaining viable rhino population in Nepal. The expected outcome of this adaptation planning is to ensure adequate suitable habitat for the rhino population in Nepal in the context of likely adverse impact of climate change. In order to achieve this outcome, at least 10 % of the park area will be restored and maintained as suitable rhino habitat by 2020.

Figure 3. Diagrammatic representation of current and desired condition related to rhino habitat in Chitwan National Park Nepal

The adaptation strategies to climate change demand integrated approaches, both within and between the natural ecosystem and the socio-economic system (Gurung and Bhandari, 2009). In order to enhance resilience of rhino population in Chitwan National Park, combinations of adaptation measures should be applied. Among four broad categories of adaptation measures, loss prevention and relocation seems to be applicable for adaptation planning of rhino population based on the available information so far. In addition, loss sharing and behaviour modification strategies could be developed to moderate harm to local community especially through diversification of livelihood options apart from rhino-based tourism.

LOSS PREVENTION

Loss prevention refers to the actions taken for reducing vulnerability to climate change. The system which is less sensitive to climate and able to adapt the changes is likely to be less vulnerable to impacts of climate change. Thus, increase in sensitivity and exposure increases the vulnerability whereas an increase in adaptive capacity will reduce the vulnerability of the system (Nair and Bharat, 2011). The following management actions for active habitat management are proposed, as rhino population is vulnerable mainly due to habitat shrinkage.

- ✓ Restoration of at least 5 km^2 of grassland annually by removing woody species selecting most suitable sites
- ✓ Develop and maintain fire lines in prime rhino habitats in order to avoid accidental fire especially in grasslands
- ✓ Management of wetlands and maintaining at least one waterhole within 2kmX2km grid in suitable rhino habitat
- ✓ Removal of invasive species *(Mikania mikarantha)* from at least 5 km^2 of grassland and riverine habitat
- ✓ Regular monitoring of habitat dynamics and habitat use pattern by rhino especially in the newly restored habitats

RELOCATION

Relocation involves moving vulnerable population or systems away from areas prone to hazards. Numbers of rhinos have been translocated to Bardia National Park to establish new viable breeding population especially to protect this species from likely catastrophic events such as natural calamities and epidemics (DNPWC, 2012). However, there are less than 30 rhinos in Bardia, which is not a viable population. Thus, supplementation and management of this new population would be one of the adaptation measures to minimize vulnerability to rhino population likely to arise from climate change.

INVOLVEMENT OF STAKEHOLDERS

Stakeholders' involvement is vital in climate change adaptation planning as it is the stakeholders who will be most affected from the adverse impact of climate change and they may need to adapt (IPCC, 2007). Identification and engagement of relevant

community of interests in adaptation planning is key to success as stakeholders contribute in the process through the skills and knowledge they have. Meaningful involvement of stakeholders ensures better understanding of nature and extent of risk and vulnerabilities through the amalgam of scientific, technical and factual information with local traditional knowledge and experience. Thus, stakeholders can develop adaptation strategies and measures through shared knowledge and experience, which is likely to be socially, economically, environmentally as well as culturally appropriate (CIP, 2013).

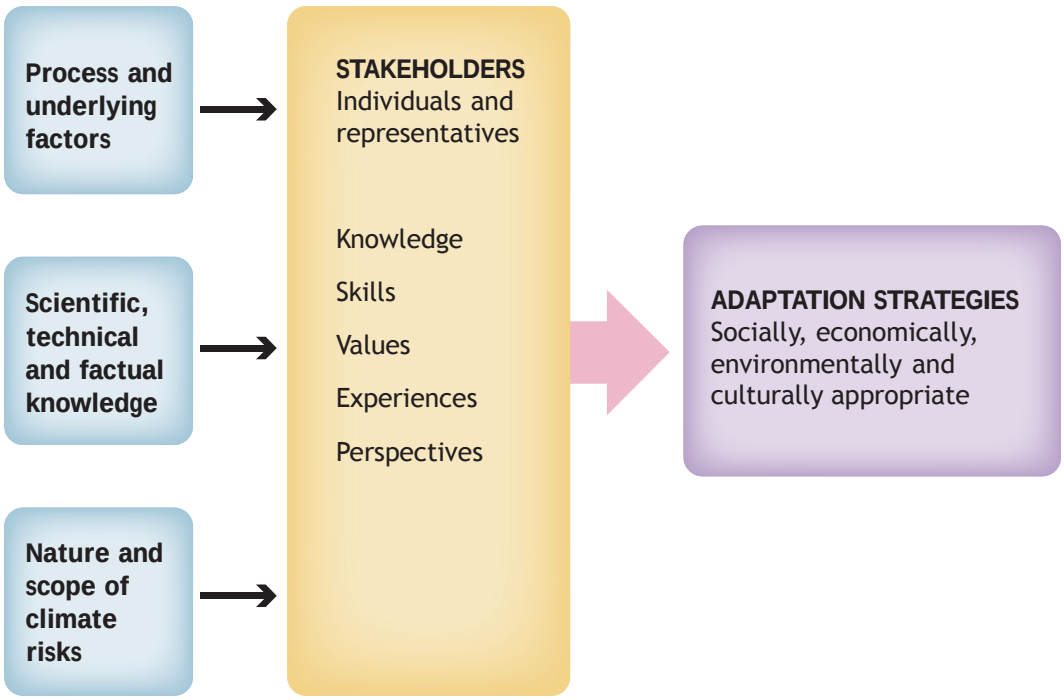

Figure 4. Involvement of stakeholders in the adaptation process

Source: http://www.ukcip.org.uk/wordpress/wp-content/PDFs/ID_Adapt_options.pdf

In the context of climate change, stakeholders refers to individuals or groups of people who are likely to be affected either by climate change or by the measures taken to moderate anticipated harm (IPCC, 2007). Thus, key stakeholders who should be consulted for climate change adaptation planning are policy-makers, managers, scientific community, local communities and interest groups. For developing adaptation plan for rhino population in Nepal involvement of Department of National Parks and Wildlife Conservation and Ministry of Forests and Soil Conservation as decision making institution is crucial. Likewise, experts in biodiversity sector and

conservation partners are vital from conservation community sector. Local people living around Chitwan National Park and individuals involved in wildlife-based tourism entrepreneurs the group of people who are most likely to be affected by impact of climate change on rhino population. Thus, their meaningful participation in adaptation planning of rhino population is very important.

FURTHER RESEARCH

Climate change is expected to have impact on ecosystem and biodiversity, but the impact of climate change on ecosystem and species is still poorly understood. Likewise, changes in population of wildlife species are poorly documented with few exceptions (Sukumar, 2000). Nepal falls under "white spot" because of the limited number of scientific studies conducted in this region (IPCC, 2007). It is imperative to acquire more comprehensive knowledge on likely impacts of climate change for the adaptation planning to be effective. There is clear lack of information on climate change and its impact on rhino population and potential measures to moderate harm. In order to develop more comprehensive and practical adaptation plan for Rhino population in Nepal, there is a need of scientific study related to risk and vulnerabilities of climate change in Chitwan National Park in general and impact of climate change on rhino population in Nepal in particular.

CONCLUSION

Climate change is a wicked problem, which is likely to continue affecting every walk of life on earth. National Adaptation Plan of Action in Nepal prepared in 2010 recognizes that climate will be uncertain and vulnerability will continue to increase in Nepal. Rhino population in Nepal is highly vulnerable to the likely impacts of climate change particularly due to serious decline in suitable habitat caused by multiple factors. Thus, there is a need of adaptation strategy to build resilience and reduce vulnerability to the rhino population. This plan has identified restoration and management of adequate suitable habitat as a key adaptation measures for rhino population in Nepal. Scientific research on relationship between climate change and rhino population and potential adaptation measures is recommended, as there is lack of information to develop comprehensive adaptation plan. Moreover, stakeholders' engagement in adaptation planning is essential to devise socially, economically, environmentally and culturally appropriate adaptation strategies and measures for rhino population in Nepal.

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23/07

Conservation Outside the Protected Areas: Local Community's Initiative in Ghoral Conservation, Nawalparasi, Nepal

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ABSTRACT

The Ghoral (Naemorhedus goral) is a goat-antelope distributed along the southern foothills of the Himalayan Mountains. The study assessed the status, distribution, habitat and threats of Ghoral (Naemorhedus ghoral) in the locally initiated Ghoral Conservation Area in Nawalparasi District, Nepal in the month of May – June 2014. Vantage Point Count at three potential habitats of ghoral and camera traps at four different sites was used in Dhaubadi VDC of Nawalparasi district to access the distribution of the species in locally declared Ghoral Conservation Area. Direct observation of animals, faecal pellets in different habitat types and record of other topographic variables were used to find out the habitat use and preference of ghoral. Questionnaire survey, focal group discussion and interviews with locals were used to assess level of threat and learnt about core habitat of ghoral.

The presence of ghoral was recorded from all five VDCs based on the focal group discussion, while 7 individuals and 19 faecal pellets were recorded from study area of Dhaubadi VDC. The encounter rate of the species is 0.27. While the sign encounter rate of the faecal pellets is 2.72, 0.54 and 0.25 per km in Taga pahad, Huhhure Danda and Luluke Danda respectively. The sighting occurred in a clear morning. There was no any record of foot prints observed during the field survey. The result suggested an uneven but wide presence of ghoral in the area. The faecal pellet survey revealed the distribution of ghoral from 1081-1552 masl in the locally initiated Ghoral Conservation Area. The ghoral were sighted with herd size of 2 and 5. Focal deposits of Ghorals observed more in grassland of south facing slopes implying grassland as their preferable habitat though few faecal pellets were observed in the mixed forest of Schima, dominated by Quercus sps. and rocky cliff.

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Following the declaration of Ghoral Conservation Area by local community, there has been control in hunting, increasing in Ghoral population and initiated conservation awareness among the peoples. However, habitat destruction and fragmentation, shifting cultivation, over grazing, fuel and fire wood collection have still been threatening the species.

KEY WORDS: goral, direct, indirect observation, Nawalparasi, near threatened**.**

INTRODUCTION

The ghoral (*Naemorhedus goral*) is a goat-antelope distributed along the southern foothills of Himalayan Mountains in East Pakistan, India and Nepal, through Sikkim, Bhutan and into northernmost Burma and Thailand (Hayman 1961; Schaller, 1977). In Nepal, ghoral occurs in eight National Parks (Khaptad, Lake Rara, Langtang, Makalu-Barun (and Conservation Area), Royal Bardia, Royal Chitwan, Sagarmatha, and Shey-Phoksundo (Wegge and Oli 1997), as well as within the Annapurna Conservation Area, Dhorpatan Hunting Reserve and Parsa Wildlife Reserve. This faunal species is listed as a Near Threatened species in the IUCN National Red List and Appendix I of CITES. Due to increasing human pressure on forest, wildlife has been a prime target with a limited area as their refuge. Status of ghoral populations is probably satisfactory. Nevertheless, they are often illegally hunted for meat even within and outside of protected areas. With continuation of such activities, population of ghoral is believed to be in decreasing order in the habitat outsides protected area. Till to date, scientific information on ghoral is scarce within the country.

Most of the projects and conservation efforts are focused on charismatic big mammals, but this initiative aims to start one of the species that is ignored by the conservation. Magar communities in rural hills of Nawalparasi who used to kill gorals ('Sarsyaa' in their language) for meat and recreation, themselves joined hand in hand for its conservation. This phenomenal change is steered by the realization to find a carcass of infant in the killed gorals. This motivated the people of five VDCs of Nawalparasi – Dhaubadi, Naram, Ruchang, Deurali and Hupsekot and one from Palpa – Jhirubas to control hunting and conserve the vulnerable species. They are now organized and actively working under an NGO called as Mahabharata Biodiversity Conservation Concern Society (MBCCS) and declared the six VDCs as Ghoral Conservation Area since 2008. They aimed to conserve the threatened species along with other life forms focusing mainly on the improvement of the

economic status of the people through various livelihood options. The study accessed status, distribution, and habitat and threat assessment of Ghoral.

STUDY AREA

This study is focused on 5 VDCs (Dhaubadi, Naram, Ruchang, Deurali and Hupsekot) of Nawalparasi, area demarcated for Ghoral conservation initiated by the locals.

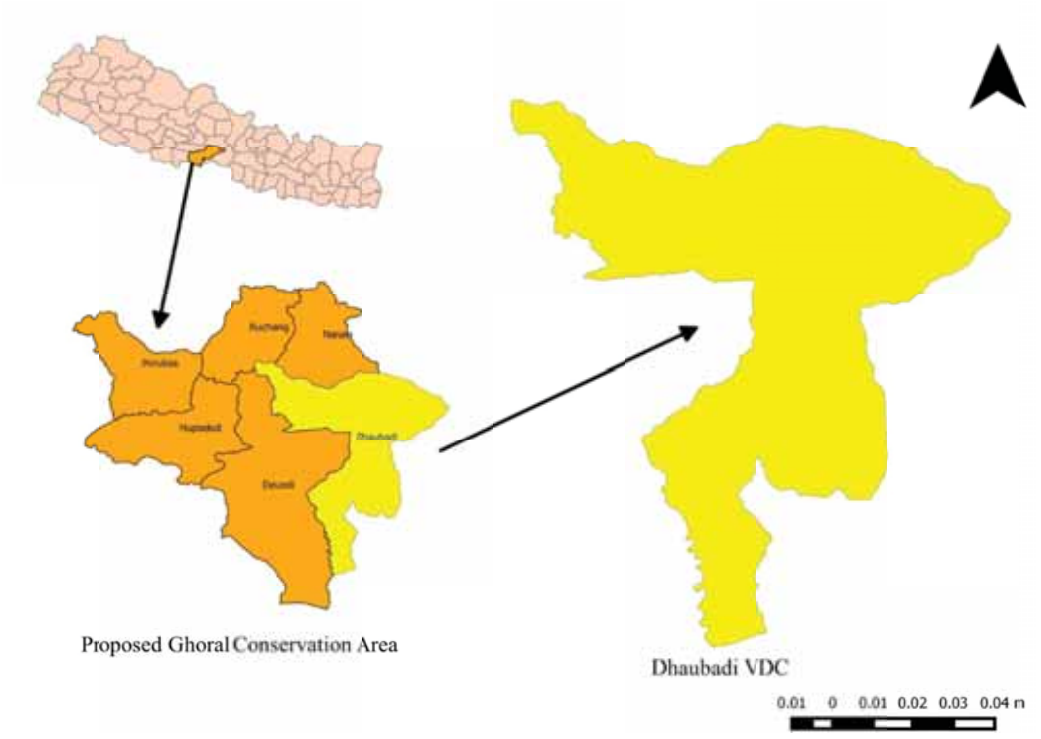

Figure 1. Map of Study Area

METHODOLOGY

Focal group discussion

Group discussion was held in all five VDCs of Nawalparasi District namely – Dhaubadi, Naram, Ruchang, Hupsekot and Deurali in which 178 people participated in total. Discussion was made on major issues of Ghoral like most sighting places, the time and month when ghoral are most seen its major food, hunting prevalence

in the area and causes of hunting, population status, threats, and conservation measures.

Direct observation and Vantage Point Count

Delineated area as per the knowledge from focal group discussion and reconnaissance survey was scanned by binoculars following the Vantage Point Count method. A vantage point is selected to the upland place that gives the wider and unobstructed view of the area. Counting is best done after dawn and before dusk. April and May are suggested as the best months for doing vantage point counts (Ratcliffe 1987a; Ratcliffe & Mayle 1992).

Pellet records survey

Focal pellets, observed during trail walks were categorized into fresh (Shiny black and great amount of moisture contained faeces) and old (no shine but greyish black without moisture). At each pellet signs, data on GPS coordinate, altitudes, aspects, slopes, and vegetation types were recorded (Burham *et al*. 1980). Special care was taken not to confuse the faecal pellets of ghoral to that of cattle (goats). For this, local knowledge was taken as reference. The individual faecal pellets of ghorals are irregular in shape with some concave facets (Gaston *et al*., 1981; Ilyas and Khan, 2003).

Camera Trapping

Four RECONYX camera traps were placed in three potential sites that are most likely visited by the species in accordance to the knowledge as per reconnaissance survey.

Habitat Evaluation

Five Circular plots (radius – 1.78m) and tree plot (10X10m) were considered for habitat evaluation.

Questionnaire Survey

NTNC – BCC carried out the questionnaire survey in the month of September, 2014. The questionnaire survey was carried out in 8 wards out of 9 in Dhaubadi VDC. Out of the 238 households, 39 households were surveyed. The selection of household was based on random sampling.

Data Analysis

Different aspects of the status of *Naemorhedus ghoral* is investigated as follows:

Encounter rate: $\frac{\text{Number of Individuals of each species observed}}{\text{Number of Man – hour spent in searching}}$

Sign Encounter rate: $\frac{\text{No. of signs encountered}}{\text{Distance walked in trail}}$

RESULTS AND DISCUSSION

Distribution Status

Vantage point counting

Seven ghorals were sighted in alternative days. 2 ghorals (1 adult and 1 sub adult) and 5 ghorals (3 adults and 2 sub adults) were observed on clear morning and showed varied activities like foraging, resting, moving, surveillance, standing, and other activities. The place had nearest water source around 200 m down the cliff. No ghoral was observed from the vantage points Hurhure Danda and Luluke Danda.

Figure 2. Sighting of Ghorals from Vantage point-Taga Pahad.

Since the encounter of ghoral occurred only at Taga Pahad, the corresponding encounter rate for the place was found to be 0.27/ hr indicating 27 percent chances of sighting per man hour. The likely possibility of sighting is during early morning (7-10 am), if the weather is clear there is good visibility.

Pellet Records Survey

Among the three different blocks, namely Taga Pahad, Hurhure Danda and Luluke Danda, the highest number of droppings were observed in Taga Pahad. Out of 19 pellet records, 73.68 % was the highest and 5.27 % was the lowest deposits found in the study field. It showed the significant difference in the faecal deposits distribution among the blocks.

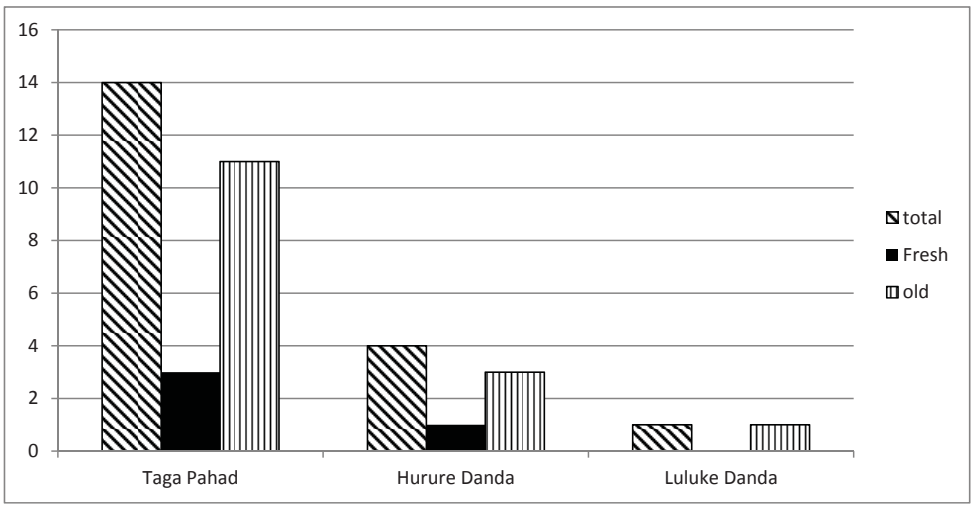

Figure 3. Graph showing blocks wise distribution of Pellet groups

Among observed faecal depositions in three blocks, 78.94 % categorized as old faecal deposits while 21.06 % as fresh. Highest old and fresh pellets were observed in Taga Pahad. While least old pellet was observed in Luluke Danda. According to local people, sighting of ghoral is highest during the spring season, March- May, when the new buds appear at the vegetation.

Camera traps

Unfortunately none of the camera was able to capture any photos of Ghoral. The reason behind the unsuccessful camera trap may be because of limited number of cameras and photography sessions.

Potential Habitats and distribution

Participants of focal group discussion revealed Deurali has the maximum possible sites of goral's presence, followed by Dhaubadi, which are the core habitat of ghoral population, out of the other VDCs in the locally initiated Ghoral Conservation Area.

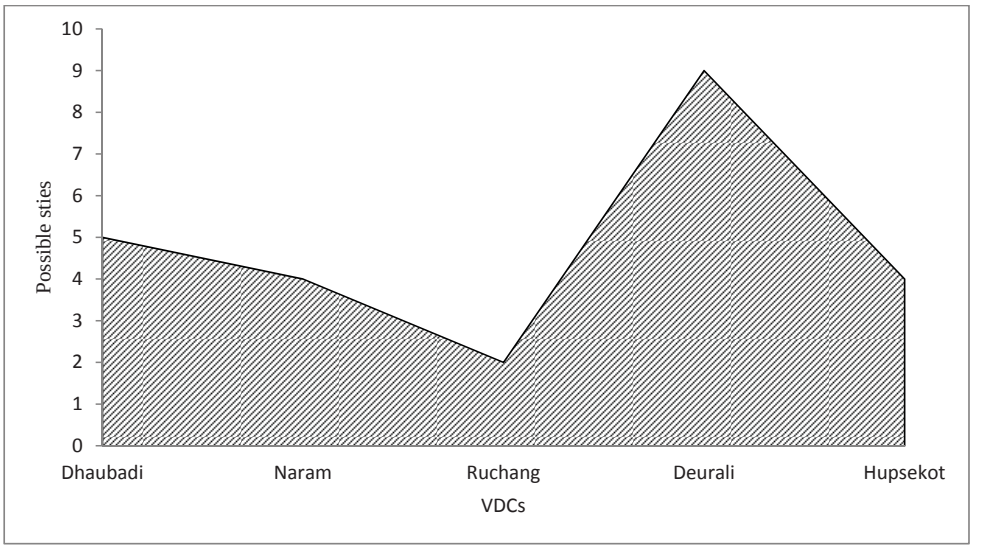

Figure 4. Sites with high Ghoral population based on Focal Group Discussion

Habitat Preference

Habitats of the study area was divided into four categories namely *Schima* mixed forest; *Quercus* dominated forest, Grasslands and rocky cliffs based on the visual observation. During the study, the highest number of faecal deposit, i.e., 37 % was found in the grassland while the least, 11 % was found in the *Schima* mixed forest. Rocky cliff and *Quercus* dominated habitat were second preferred habitats by Ghoral based on the faecal deposits recorded.

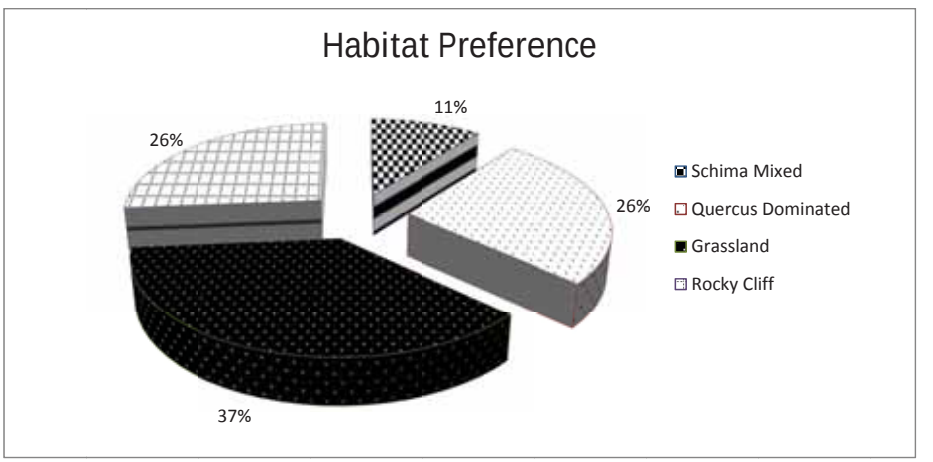

Figure 5. Graph showing percentage of faecal pellets recorded in different habitat.

In Taga Pahad, the mostly observed plant species are Banso (*Brachiaria distachya*) and Mothey (*Cyperus sp*), while Banjhi (*Quercus lanata)* is dominant tree species. In Luluke Danda, highly observed vegetation species is Banso (*Brachiaria distachya*), while Banjhi (*Quercus lanata)* high dominancy. In Hurhure Danda, the most occurred vegetations are Banso (*Brachiaria distachya*), while Banjhi (*Quercus lanata)* is the most dominant tree recorded. Overall observation, revealed, Banjhi (*Quercus lanata)* as the most dominant tree species while Banso (*Brachiaria distachya*) is the most occurred vegetation in the plots sampled.

Local Perception& commitment

The proposed Ghoral conservation area has received greater attention after the local hunters themselves showed commitment for the conservation of Ghoral species. People and youths have become more aware and informed about the importance of Ghoral conservation. This is an archetypal of conservation by community outside protected areas.

Entire respondent agreed about the need of Ghoral conservation and protection of its habitat. By conserving the species, they are hopeful to promote the tourism and economic activities in their area. Since Ghoral don't harm people, neither destroy the crops, people don't have any hostile relation with this species. They have strongly suggested that there is need of controlling the hunting of Ghoral along with the forest conservation to ensure the protection of species. They recommended a forest patrol unit to control the forest fire. They pointed out the need of awareness, unity and participation of the local peoples for effective conservation of this animal. Improvement of the livelihood and different useful skills and trainings are anticipated by the local respondents, who are below the poverty line. These changes in the attitude and behaviour towards the Ghoral conservation can be attributed to the awareness among the people after the locally initiated Ghoral conservation area came into existence after 2008. They are now actively working with the support of various other organizations.

Thirty nine respondents were asked about the present status of Ghoral population was decreasing or all of the respondents agreed about the increasing trend in the population of this mammal. This fact was supported by the evidence that 64 % of the respondents have seen the ghorals and 58 % of them have observed in the last 3 years.

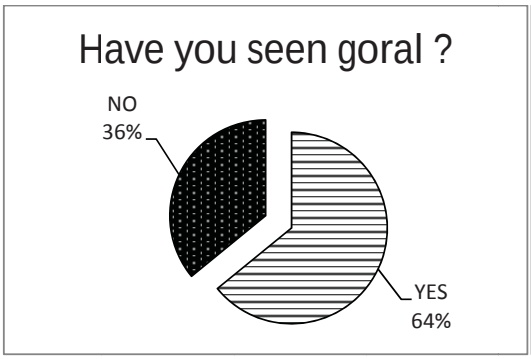

Figure 6. Percentage of people who have seen Ghoral.

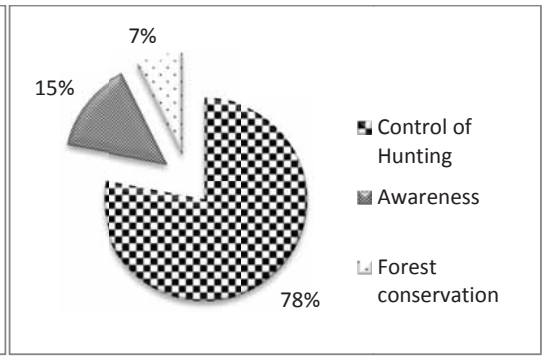

Figure 7. Causes of increment in Ghoral Population

Respondents when asked about the reason behind the increment of Ghoral population; 78% of the respondent gave credit to the control of hunting while 15% answered due to awareness and 7 % mentioned that it is due to conservation of forest. All of the respondents told that ghorals are hunted for meat and recreation, but not sold for meat or horn.

Conservation Threats

Illegal hunting

The respondents of the questionnaire survey agreed that, ghoral was primarily hunted for meat and secondarily for recreation. None of them responded that ghoral are hunted for horns or skin or selling its meat. There has been notable decline in the illegal hunting after the local people's commitment and ownership, but hasn't completely been stopped.

Shifting Cultivation

Deliberate inducing of forest fire to clear the forest for agriculture practice is observed in the area. Due to this shifting cultivation, the habitat of Ghoral is damaged and it has less area to refuge.

Over grazing

Grazing of cattle has imposed lesser availability of food for the Ghoral population. Though not reported, there are possibilities of disease transmitted by livestock to Ghoral population. The last recorded epidemic, which occurred in 1979 substantially, reduced the population of this animal in Tirthan Valley (Garson and Gaston, 1985).

Other Threats

Other threats observed for Ghoral population, are natural disasters and forest fire which can destroy the habitat of this animal. Though not studied, the ghoral population may be in danger due to disease transmission and high infant mortality rate.

CONCLUSION

This involvement from local community ensures the longevity of the project as they feel the ownership to this project. This place has the potentiality to be developed as the tourist destination and can attract the tourists that travel to Chitwan which can improve the socio – economic status of the people. The area seems to be promising in the field of conservation, because this motive to protect a species has been initiated by the people. This bottom up approach can be sustainable if the area is well managed under the rules and regulations. Some of recommendations for effective conservation and management of the locally initiated as Ghoral conservation area:

1. Detail baseline study of the species is to be carried out in all of the VDCs of Ghoral Conservation Area.
2. The recently formed local level governing bodies are to be actively participated in the conservation area.
3. Awareness should be increased and participation of more youths needed. Local and conservation clubs in schools are recommended to establish.
4. Local curriculums on Ghoral and biodiversity conservation are recommended for the schools.
5. Conservation programs should be targeted to the rural areas as well, making it more inclusive.
6. Alternative livelihood options like biogas plants and improved cooking stoves can decrease the dependency of people on forest resources which can be helpful for habitat management.

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Estimating the Abundance of Tigers and their Prey in Suklaphanta Wildlife Reserve of Terai Arc Landscape, Nepal

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ABSTRACT

Information on the abundance of tigers and their prey are crucial for managing tiger landscapes.We estimated tiger abudance in Suklaphanta Wildlife Reserve (SWR) Nepal using camera trap based Capture-Mark-Recapture and prey density and abundance using distance sampling in 2009. With effort of 1679 trap nights covering 113 camera trap stations we photo captured 7 individual adult tigers in Suklaphanta WR. The number and density (per 100 km^2) of tigers were 7 (SE 1.41) and 2.1 (SE 0.80) in SWR. Distance sampling was used to assess the prey abundance between May-June 2009 on 463 systematically laid line transects. Density of all wild prey (individuals/km^2) were 6.6 (SE 1.1) in Suklaphanta Wildlife Reserve (SWR). The density (no/Km^2) of chital was 79.0 in SWR followed by swamp deer 30, hog deer 21.6 and primate 14.8. With a total effort of 124 Km walk across 62 spatial replicate transects tiger prey abundance was estimated at 25,548. Study indicates decline in tiger in SWR even though the existing level of prey population appear to be adequate to support a higher tiger numbers. There is hope of meeting the ambitious goal

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of doubling the tiger population by 2022 set by Tiger Range Countries (TRCs) as indicated by 2014 estimates of 13 tigers for which tiger habitats outside PAs are further managed with local community based initiatives to ensure acceptance of low density tiger movement.

KEY WORDS: Camera trap, Capture-recapture, Corridor, Density, Trans–boundary Conservation

INTRODUCTION

Terai Arc Landscape (TAL) Nepal encompasses an area of 23,199 $km^{2;}$ covering 14 Terai districts from Rautahat in the east to Kanchanpur in the west, and consists of over 75 % of the remaining forests of the Terai and foothills of Churia. The protected areas (PAs) are part of the global tiger conservation landscape (Dinerstein *et al* 2007) and are source to maintain the wildlife. The corridor and connectivity within and between countries are vital for the long term maintenance of the wildlife. Thus the regular monitoring of the forest resources and wildlife is important for the management of the wildlife. The Suklaphanta Wildlife Reserve (SWR) is the site of source population of wildlife in Nepal listed in category IV tiger conservation landscape in global tiger conservation scenario (Dinerstein *et al* 2007).

The SWR used to one of the important site for the tiger conservation in the past and is regaining again in the previous direction with slow pace. In the mark of the 4^{th} year of the landmark Tx2 decision, SWR is also trying to complement in tiger and prey base along with the other biodiversity conservation measures. The transboundary initiatives with India counterpart Kishanpur WLS and Dudhwa TR and the recently established Pilibhit TR is taking momentum to make the tiger habitat a continuum.

SWR (28^{o} 45'- 28^{0} 57' N, 80^{0} 07' to 80^{0} 21' E, 305 km2, 80m-600m) in the far Western lowland is bordered by the Mahakali river on the west. Abandoned agriculture land occupies 7.87%, forest 65.02%, grassland 16.1%, shrub land 3.76% and water bodies 7.25%. National highway passes through its upper tip breaking link with Mahabharat range.

Over the past 200 years, wild tiger populations have declined by more than 98% in the Indian Subcontinent (Mondol *et al.* 2009) and probably by the same percentage through the rest of the tiger's range (Seidensticker 2010). Current global tiger population is comprised of <5% of what was estimated just a century ago

(Dinnerstein *et al.* 2007) with the current adult number estimated to be approximately 3,566 (3,192–4,009) restricted to Bangladesh 440, Bhutan 75 (67-81) Cambodia 10, China 45 (40-50), India 2226 (1945 to 2491), Indonesia 325 (250-400), Loa PDR 25, Malaysia 500, Myanmar 85, Nepal (93-97 adults), Russia 360 (330-390), Thailand 170 and Vietnam 10 (DNPWC 2007, GTRP 2010, Jhala *et al.* 2015).

Historically, tigers were distributed continuously across the lowland Himalayan forests in Nepal but the surveys, between 1987 and 1997, documented only three isolated tiger populations, Chitwan, Bardia and Suklaphanta (Smith *et al*. 1998).

In Nepal, the oldest population estimates of tiger come from CNP. The estimates till mid '90 were mainly based on either radio-telemetry (Sunquist 1981, Smith 1993, Smith *et al.* 1999) or pugmark surveys (McDougal 1999). Although they provide a minimum estimate, these methods face the issues of incomplete spatial sampling of the area of interest and incomplete detection of animals even within the area that is sampled. Thus, population sampling approaches that explicitly deal with these two problems by employing appropriate statistical models are essential for robust estimation of animal abundance (Seber 1982, Williams *et al.* 2002, Thompson 2004). This study uses the spatially explicit capture-recapture likelihood approach.

Chital (*Axis axis*), sambar (*Recervus unicolor*), swamp deer (*Recervus duvauceli duvauceli*), wild pig (*Sus scrofa*), hog deer (*Heylaphus porcinus*), barking deer (*Muntiacus muntjak*), guar (*Bos gaurus*), rhesus macaque (*Macaca mulata*) and langur (*Semnopithecus entellus*) are the main wild prey species of tiger in Nepal. The quantification of these prey species is of utmost importance in these PAs that are supporting different carnivore species including tiger, leopard and wild dog.

In this paper we describe the use camera trap based mark-recapture to obtain abundance estimates of tigers across SWR. Similarly, line transects to obtain the density of wild prey in SWR Nepal.

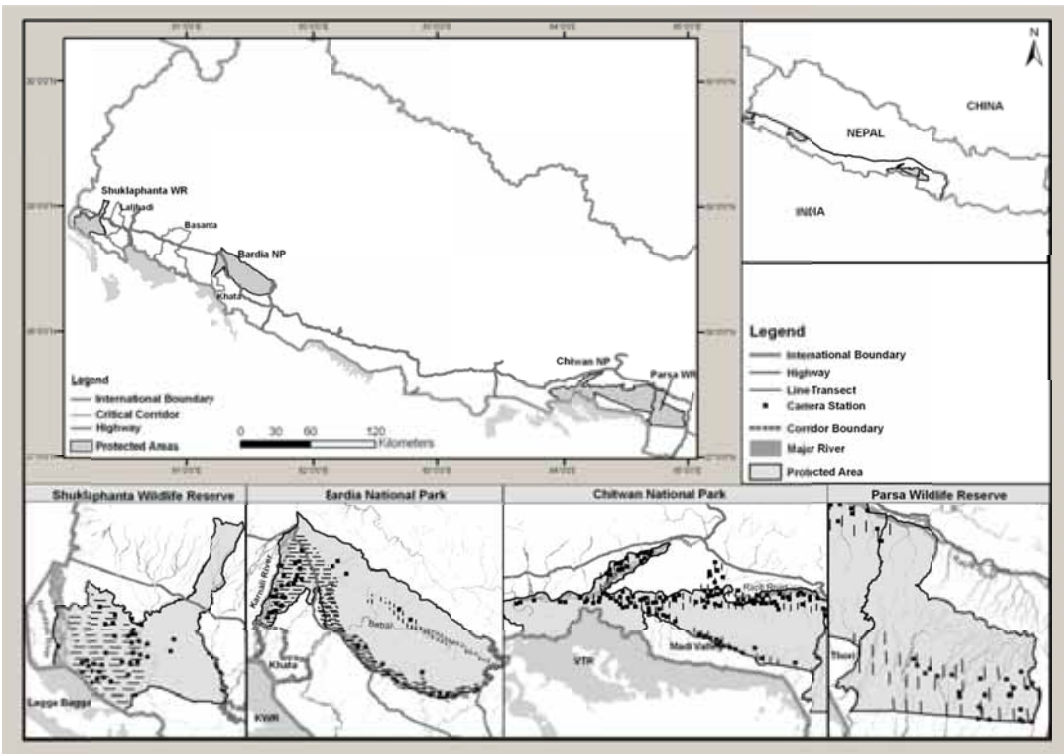

Figure 1. Study area showing the line transect and location of camera trap.

METHODOLOGY

The camera trap survey (Karanth & Nichols, 1998; 2002, DNPWC 2005, Dhakal *et al.*2014) was conducted in six blocks of 50-100 km^2 , covering a total area of 443.9 km^2 from total number of 113 trap locations in 1679 trap nights. Each block was camera trapped for 15 days between December 2008 and March 2009. Camera traps were rotated between blocks to cover the entire area. At each site cameras were deployed using 15 day sampling periods in each of the camera locations. Trap distance between two trapping stations was 1.5 Km. Care was taken not to leave any potential holes in the sampling area of interest. Stealth Cam and Moultrie passive camera traps were placed around 16:00 hours and removed after 09:00 hours.

Transects were laid out systematically using DISTANCE software (Thomas *et al.* 2009) with the random start option for tiger's wild prey. We determined minimum 30 spatial replicates in each sampled area. Computer generated transect points were laid on a map and uploaded on the GPS.

During May - June after the burning, two observers on elephant back moved between 0600-0900 hours and 1600-1900 hours when prey animals were most active along the line transect recording all prey species, number of individual animals, the radial sighting distance to the animal (or centre of the animal cluster) and the sighting angle between the transect line and the animal/centre of cluster of animals observed (Buckland *et al*.2001).

Photographic capture-recapture analysis (Karanth and Nichols 1998; Pollock et al. 1990) was undertaken to estimate tiger population parameters. Capture histories (X matrix) were developed by identifying every tiger captured on the basis of the stripe pattern on the body flanks, legs and face (Karanth, 1995; McDougal, 1977; Schaller, 1967, DNPWC 2005). Data were analyzed using the program CAPTURE (CAPTURE 2 interface, Otis *et al.*, 1978; Rexstad & Burnham, 1991; White *et al.*, 1982) for estimation of number.

We used spatial density analysis (Maximum Likelihood Spatially Explicit Capture Recapture, DENSITY software, Efford 2009) to overcome the issue of geographical closure using tiger habitat.

Tiger wild-prey first was analysed as one group and followed by species having more than 40 observations afterwards. In selecting the best model (or models) to use for generating density estimates, model robustness, relative Akaike Information Criterion (AIC) values, various goodness of fit tests, relative estimate precision and the detection function shape (wide shoulder near the y axis) were considered. The more robust group approach prior to analyses was performed in case of spiked data (Buckland *et al.,* 2001).

RESULTS

Ungulates

The density (tiger wild-prey/km$^{2)}$ estimate for Suklaphanta Wildlife Reserve was 144.8 (SE 22.8) in total effort of 197.5 Km. The model-averaged density (number/ km^2) estimate was 79.0 (SE 19.0), 30.0 (SE 16.1), 21.6 (SE 4.4) and 14.8 (SE 4.6) for chital, swamp deer, hog deer and primate (langur and rhesus macaque) respectively. Half normal model best fitted the data for chital, hog deer and primate whereas uniform model for swamp deer.

Table 1. Density of tiger's wild prey in Suklaphanta Wildlife Reserve, Nepal.

Species	ESW (SE)	Cluster size (SE)	DS (SE) / Km^2	D (SE)/Km^2 95%CI	Encounter rate (SE)/ Km
SWR-ALL Prey	26.4(1.6)	10.7(1.9)	25.1 (3.1)	144.8 (22.8) 106.3-197.2	1.3(0.1)
Chital	34.3(3.1)	12.5(2.4)	7.3(1.3)	79.0(19.0) 49.5-126.0	0.5(0.07)
Swamp Deer	58.5(7.3)	29.5(10.2)	1.8(0.6)	30.0(16.1) 11.0-81.7	0.2(0.06)
Hog deer	26.6(2.0)	2.6(0.2)	9.5(1.8)	21.6(4.4) 14.5-32.1	0.5(0.1)
Primate	38.1(5.6)	6.0(0.9)	2.1(0.5)	14.8(4.6) 8.1-27.2	0.2(0.04)

ESW = Effective Strip Width, cluster = average cluster size, DS = group density, D = Individual density, CV% (DS) and CV% (D) = coefficient of variance on estimate of Ds and D respectively, 95%CI= 95% confidence interval on the estimate of individual density, Ch=chital, KFP=Karnali flood plain, Fh=foot hill, BV=Babai valley, B+H=Barking and Hog deer.

Tiger abundance

In Suklaphanta Wildlife Reserve from 113 trap locations, seven individual tigers (2 male, 2 female and 3 genders could not be assessed) were identified. Approximately 90% of total tigers were recaptured more than once with a mean maximum distance between two capture events of 6.6 km (SD 3.4).No new tigers were trapped after 4^{th} pooled night, while the total number of captures increased steadily in the following sampling occasions. All identified individual tigers captured were encountered in the period between first five days of the pooled 15-day sampling occasion. Estimated tiger number was 7 (SE 0.2) and density (tigers/100 km^2) was 1.2(SE 0.2), 0.7(0.2), 1.4 (0.6), and 2.1 (SE 0.8) from ½ MMDM, MMDM, ML SECR and using mask (table 1) in DENSITY software respectively.

Table 2. Number and density in tigers in SWR, Nepal

PA	Best Models CAPTURE (score)	Camera Trap nights	Pop. estimate N(SE)	D(SE)(½ MMDM) ETA (Km^2)	D(SE) (MMDM) ETA (Km^2)	D (SE) ML SECR in Mask
SWR	Mo (0.98)	1679	7(0.2)	1.2(0.2) 610	0.7(0.2) 959	2.1(0.8)

DISCUSSION

Ungulate density

Density of tiger's wild prey was 144.8 Suklaphanta WRs. The comparison with the some PAs of India ranges between 5.3 to 107 shows its two extremes, highest in Suklaphanta (Table3) but only medium (about 74) in 2014 (Dhakal *et al*.2014).

In SWR, the total prey density was nominally increased to 145 from 108 compared to Yadav (2006) as he did not accounted langur and rhesus macaque (14.8) but increase in chital (56 vs.79) but reduced in 2014 to about 45 (Dhakal et al. 2014). Similarly, hog deer was also reduced in 2014 to 3.28 but increased from 6.5 to 21.6 from Yadav (2006).

Table 3. Comparison of prey density (Indi./Km^2) ± SE with some Indian PAs .

PA/Prey Habitat	D_Prey Tot	D±SE	D_Chi-tal	Sambar	Wild pig	Barking deer
Babai-BNP-09 (Malla 2009)					1.2	2.5
Karnali-BNP-'09 (Malla 2009)			50.5		3.1	3.1
Karnali-BNP-'76 (Dinerstein 1980)			33.9	3.5	4.2	1.7
Karnali-BNP-'93(Wegge *et al* 2009)					1	2.6
Chilla range-Rajaji NP-'05 and '06 (Harihar *et al.* 2006)	76.2	76.5 ± 4.1	43.5	19.6		
Chitawan NP-'76 (Seidensticker 1976)			17.3		5.8	
Chitwan NP-82 (Tamang 1982)			16.8	2.7		6.6
Chitwan NP-08,09 (2010)	113.8	113.8 (SE?)	86.3 (SE10.1)	8	10.5	4.1
Chitawan NP '14 (Dhakal *et al.*2014)	73.63	9.08	44.75	4.02	4.43	3.65
Dudwa,Valmiki,Pilibhit,Katerniaghat '10 (Jhala *et al*.2011)	24.92	24.92 (3.75)	13 (2.17)	0.14 (0.02)	1.99 (0.55)	0.72 (0.23)
Gir LS-'97(Khan and Vohra 1997)			50.8	2	2.1	
Kanha moist deci. Forest-2000 (Karanth and Nichols 2000)			49.7			
Kanha NP-'87(Newton 1987)	55.5	57.3 ±4.07	3.2	0.9	0.5	0.4
Kaziranga (Jhala *et al*. 2011)	56.1	58.1 ±6.51				

Melghat	5.3	5.3 ± 0.76				
Nagarhole-'92(Karanth & Sunquist1992)	52.9	56.1 ± 3.95	50.6	5.5	4.2	4.2
Pench TR-2000 (Karanth and Nichols 2000)			51.3	9.6		
Rajaji-Corbett'10 (Jhala *et al*.2011)	72.4	72.4 ±13.0	46.71 (13.25)	7.49 (1.78)		
Ranthmbore, Sariska '10 (Jhala *et al*.2011)	107.7	107.7 ±10.0	31.62 (10.38)	8.24 (1.82)	4.86 (7.68)	
Suklaphanta WR-'09 PS, 2014	78.62	78.62 ±16.44	41.34	NA	11.88	NA
Melghat, Pench, Tadoba'10 (Jhala *et al*.2011)	107.74	107.74 (9.95)	37 (6.06)	5.34 (0.57)	5.83 (1.11)	0.61 (0.15)

Sambar density ranges from 0.14 to 19.6 in Indian PAs (Table3). Wild pig ranges from 0.5 to 5.8 in Indian PAs (Table 3). Barking deer ranges from 0.4 to 4.2 in Indian PAs (Table 3).

The swamp deer was second dense prey after chital in SWR.

Tiger status

For density analysis, the likelihood approach (Efford et al. 2004) seems to be appropriate being comparatively less sensitive to buffer width, is based directly on parameters estimating density unlike Bayesian, is faster and both spatial methods (Baysian- Royle *et al*. 2009) have not shown any significant difference in terms of density estimation (Kalle *et al.* 2011). Thus, the likelihood approach was interpreted for discussion.

The drastic decline in SWR was consistent till this study period from 20 (Regmi 2000) to current 7 but improving to 13 individuals in 2014 (Dhakal *et al*. 2014).

A clear decline in density in Suklaphanta compared to Regmi (2000)

Table 4. Status of tiger in Nepal during different period from 1987 onwards.

	Density/100 km^2				**Number**			
	1987[2]	**1998/99[4] (no/den)**	**2000/01[3] (no/den)**	**1998[1]/(area km^2) in complex**	**1999/ 2000**	**2005**	**2009**	**2014[4]**
SWR	5.0			16(320)	16-23	16-23	7	13

[1]Smith et al 1998.[2] Smith *et al* 1987, [3] Wegge *et al* 2009, [4]Dhakal *et al*.2014.

This study strongly shows in SWR that the tiger decline is not due to prey loss compared to the dense tiger bearing PAs (Table 5 and see Barber-Meyer et al. 2013). The current effort of government to reinforce the protection and transboundary initiative is very positive (Karki et al.2015) and the GoN's commitment to double the tiger could be achieved if these densities are maintained along with the current level protection, wildlife crime control bureaus activities, ant poaching and community based ant poaching operations and transboundary initiatives are maintained. A regular habitat management for ungulates by cutting grass in early winter (Karki 1997, Peet 1997) and control burning to regulate succession in the relocated villages are essential. The current ungulate abundance can support about 50 tigers but and the past records of 20 individual tigers (D 14/100Km^2) can be attained if the poaching could be minimized as has been demonstrated in past few years. The forested habitat is linked with Pilibhit TR and Kishanpur wildlife sanctuary, where tigers are reported in higher density compared to SWR.

Table 5. Number and densities of tiger and their wild prey in protected area with higher tiger density.

Name of PA	Ñ (SE)	D(SE)/100Km^2)ML SECR	D_Prey
Corbett TR	109(5.4)	16.23(1.63)	72.4
Ramnagar FD	27 (1.5)	13.8(2.74)	72.4
Kaziranga NP	69(0.5)	12.63(1.5)	56.1
Kishanpur (Dudwa TR)	19(7.31)	4.64(1.11)	25
Katerniaghat (Dudwa TR)	20(2.61)	4.82(1.19	25
Dudhwa NP (Dudwa TR)	21(5.47)	4.79(1.28)	25
Pilibhit FD	12(0.17)	3.78(1.17)	25
Chitwan NP-'2010	125(22)	2.30(0.31)	51.7
Chitwan NP-'2014	78(15)	6.02(012)	73.63
Suklaphanta WR-'09 PS	7(0.22)	2.1(0.8)	144.8
Suklaphanta WR-2014	13(1)	6.3(0.18)	78.62

Human disturbance is the key driver of local tiger extinction and tigers can persist even in human-dominated landscapes through effective protection of source populations (Karanth *et al*. 2011).

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General Ecology & Time Budgeting for Assamese Monkey (Macaca assamensis) in Shivapuri Nagarjun National Park, Nepal

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ABSTRACT

The paper outlines the general ecology and daily time budget of Assamese monkey (Macaca assamensis) was accessed in Shivapuri Nagarjun National Park (SNNP) following Sikre khola troop. Assessment of personal and social behaviours was made for three seasons of the year from 2012 and 2013. The scan sampling method was used for recording data. Data were tabulated and analyzed using spread sheets in Microsoft excel. Simple mathematical operations were applied to draw the inference. In this study, we found Assamese monkeys had allocated 40% time in foraging/feeding, 21% time in locomotion, 16% time in grooming while 15% time inactive. Play and Sleeping claimed 6% and 1% time simultaneously. Thus the total time for personal activities was 78% and 22 % in social activities. Assamese monkeys are folivorous consuming leaves and shoots of middle-canopy and sleeping in rocky outcrops. Females took part in each grooming parties while juveniles and males claims over half of the grooming events. The inactivity does not mean true passiveness but they do sun basking, play, and resting.

KEY WORDS: Assamese monkey, Shivapuri, Nagarjun.

INTRODUCTION

Decision making on the activities to be performed based on costs and benefits is termed as behaviour (Davies, Krebs, & West, 1981). The relationship between animals-habitat and assessment of relationship is often achieved by behaviour ecology. Variation in behaviour of animal population is caused by evolutionary Nepal Biodiversity Research Society, Nepal processes primarily defined by genetic variation (Davies *et al.*, 1981) which can be tested using evolutionary theories (Maestripieri & Kappeler, 2002). Survival of individuals and groups depends largely

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on the behaviour of organism that was adopted against the given environment Davies *et al.*, 1981) and the diversity of environment shape behaviour and demography of animal population (Clutton-Brock & Harvey, 1977). Davies *et al.*, (1981) stated that efficiency of foraging, avoidance of predators, access to mates, parental cares and other strategies are often associated with ecological diversity, thereby species survival.

Assamese monkeys are rarely studied and documented throughout in its range countries Kawamoto *et al.*, 2006; Timmins & Duckworth, 2011). The wilderness ecology is least understood (Mitra, 2002, 2003 cited in Timmins & Duckworth, 2011). Behavioural study and assessment of conservation status was started early on 1980s by various biologists (Bishop, 1979; Chalise, 1995; Chalise, 2013a). The population of Assamese monkey was estimated by Chalise (2003) using direct observation and the attitude of crop raiding macaques was discussed in Chalise & Johnson (2001, 2005). The study on Assamese monkey in Shivapuri Nagarjun National Park was initiated by Wada (2005) around 70s and it was followed later on by others (Chalise *et al.*, 2013). Although, ecological and behavioural information is poor for Assamese monkeys (Jackson, 1999), the continuation of Chalise 2003; Chalise *et al.*, (2013)'s work in Nepal including Shivapuri Nagarjun National Park is substantial. The National Parks and Wildlife Conservation Act, 1973 of Nepal, has kept it as a schedule-I animal whose hunting and killing is fully restricted (NLC, 1973; Chalise, 2013c). Similarly, the World Conservation Union (IUCN) and Convention on International Trade of Endangered Species of Wild Flora and Fauna (CITES) has listed this animal under Near Threatened (NT) (Boonratana *et al.*, 2008; IUCN, 2011) and Schedule II animal (Chapagain & Dhakal, 2002; CITES, 2012).

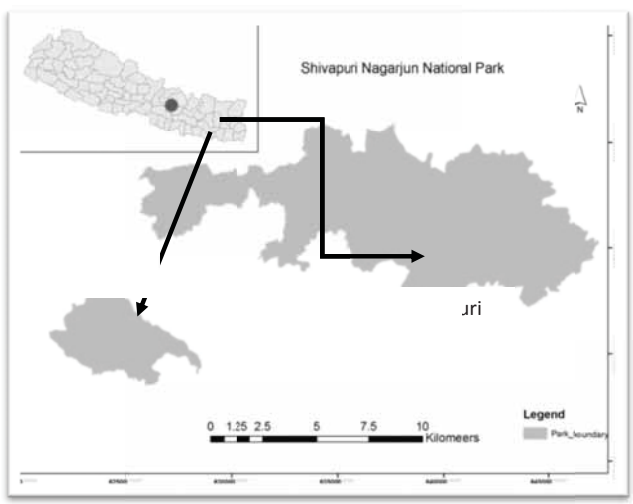
Time budgeting of Assamese monkey was studied by some researchers in Nepal and abroad (Bernstein, 1975; Chalise, 2010; Chalise *et al.*, 2013; Regmi, 2008; Sarkar *et al.*, 2012; Timmins & Duckworth, 2011; Huang *et al.*, 2011, Zhou *et al.*, 2013). Difference in sociology and behaviour is determined by availability of food for primates Altmann, 1974; Chalise, 2000. Availability of food is the key to define daily activities e.g. foraging, locomotion, and social activities in primates (Chalise, 2000; Sarkar *et al.*, 2012). Most primate forages in group adopting the strategy that all member could satisfy their dietary needs (Son, 2014). Feeding is uniformly distributed throughout the year and no seasonal variations are expected; the involvement of sex class in feeding is rather different i.e. females are fond of feeding but food choice between age class is not significant (Schülke *et al.*,

2011). Climatic factors and sociobiology of organism also effect on behaviour of animals (Bernstein, 1972; 1975). The temperature plays a leading role in Baboon locomotion in Amboseli National Park, Kenya (Stelzner, 1988). Animal behaviours are regulated by animal and incumbent habitat interaction thereby defining daily behavioural response (Sarkar *et al*., 2012). Moreover, the interaction of temperature, humidity, rainfall, snow as well as soil fertility play important role in food production. Sex and age have considerable impact on behaviour of animals particularly to the social animals. Females generally take active part in grooming and sexual responses (Bernstein, 1972, 1975) and the male dominance rank and feeding events has statistically valid association (Altmann & Muruthi, 1988). Use of forest strata is not uniform for primates e.g. Assamese monkey of Thailand spent half of the time in mid canopy and lesser in top (Schülke *et al.*, 2011). Principally it is convinced that heavy weight primates are not arboreal thereby spending more time on the ground (Thierry, 2007 cited in Schülke *et al.*, 2011).

MATERIALS AND METHODS

STUDY AREA

Shivapuri Nagarjun National Park (SNNP) is located between 27°45' and 27°52'N and 85°15' to 85°30' E (Map 1). It has two isolated islands namely Shivapuri forests and Nagarjun forests covering a sum of 159 square kilometres (DNPWC, 2010). This is the true representation of the mid-hills in the protected area system of Nepal covering sub-tropical to temperate regions. The park has elevation range from 1000 masl to 2732 masl covering part of subtropical and lower temperate region and four types of forests namely chir pine forests, lower mixed hardwood forests, upper mixed hardwood forests and oak forests (DNPWC, 2010; Pandey, 2012). SNNP has recorded 1248 vascular plants (SNNP, 2010) and three species of primates like rhesus monkey



Map 1: Location of Shivapuri Nagarjun National Park in Nepal

Macaca mulatta, Assamese monkey *Macaca assamensis*, and Hanuman langur *Semnopithecus entellus* (Wada, 2005; DNPWC, 2010; Chalise et al., 2013).

DATA COLLECTION

SCAN SAMPLING AND ECOLOGICAL DATA COLLECTION

Systematic scan sampling (Altmann, Observational study of behavior: sampling methods, 1974) was applied to record ecology and behaviour of Assamese monkey for the focal troop. Data were collected for the three seasons of the year viz. winter, spring, and autumn. Activity by the majority of the individuals was recorded for time budget calculations. The data recording interval was 15 minutes (inclusive of 1 minute scanning) followed by 14 minutes inactivity. Observation was made from 7:00 –to 18:00 hours. Altogether 45 jungle days (excluding habituation), observer managed to have 28 contact days comprising 11 partial and 17 full observation days. Altogether 765 minutes scan sampling was made (225, 270, and 270 minutes in winter, spring and autumn). Data were not considered for the calculations for partial contact time. Activities were recorded naked eyes accompanied by binoculars.

Feeding/foraging ecology was assessed by observing types of food they prefer viz. leaves, young leaves and twigs, seeds, and others (mushroom, mosses, invertebrates etc.) while locomotion in the rock, ground, middle canopy, and top canopy was recorded. Grooming behaviour was assessed by types of grooming participants like male, female, and juvenile/infants. Playing was grouped to adult and juvenile/infant groups while activity during inactive period was grouped to sun bask, play, and rest. Although, grooming is common in inactive period, it was recorded separately. Data on sleeping site was collected for selected troop categorizing sleeping on rock or tree. Time of sleeping in the night was not considered in this study.

DATA ANALYSIS

Each activity was given a numerical value of 1. All the events were summed up for each period of time. Total time budgeting for each season as well as for a year was calculated and presented using percentage of time allocated for particular activity. The values so obtained were plotted using line diagram. Preferences of food items were also given a numerical value of 1 for each event. The food preference is calculated by summing all the values allocated. The percentage was calculated to quantify the food preference and presented using bar diagram. Similarly, the medium

of locomotion was also calculated in same way. Moreover, the participation of age class and sex in grooming parties was also calculated following same way as in food preference calculations. The preference of sleeping places, minor activities during inactive period was calculated in similar way.

RESULTS

TIME BUDGETING

The summary statistics shows that feeding and foraging (39.53%)is highly performed activity during the observation period that was followed by locomotion (21.46 %) around the foraging zone. Grooming occupies third rank (16.51%) among six categories of activities of daily time budgets. Assamese monkeys can be considered as lazy primate spending considerable amount of time (14.95 %) for sun-basking and resting while they are sleepy in early morning as well as during sun basks. Playing is not common and only 1.43 %times is allocated by the group (Table 1). Playing is frequent activity for infants and juveniles while adults go sleep or remain inactive and hard to trace their activity.

Table 1. Time allocation by Assamese monkey

	Foraging/ Eating	Locomotion	Grooming	Play	Sleep	Inactive	Total
Total events observed	304	165	127	11	47	115	769
Percentages	39.53	21.46	16.51	1.43	6.11	14.95	100

Time budgeting is not similar throughout the year. Assamese monkeys spend relatively lower amount of time in feeding in spring than that of winter and autumn. Spring is the time for burgeoning twigs, flower buds, and fruits therefore monkeys need not wary about quantity of foods. Unfortunately, quality food is not available to everywhere therefore they needs extended period of time for food searching. Monkeys spend near about one third time (Table 2) in locomotion in spring and remain very active. Locomotion is relatively lower in autumn also spending about 23 % time. Social behaviour like grooming and playing is very low in winter. The selected troop allocated only 14 % in building social relationship in winter while it was common in spring and autumn (Table 2). Sleeping, resting, and sun basking is very common in winter allocating one third time while this is not the case in spring and autumn (spend around 16% time). During autumn and winter monkeys remain very active.

Table 2. Seasonal time budget by Assamese monkey

	Season	Winter			Spring			Autumn	
S.N.	Activities	Events	%	Activities	Events	%	Activities	Events	%
1	Foraging/ Eating	90	40.18	Foraging/ Eating	104	38.38	Foraging/ Eating	110	40.15
2	Inactive	45	20.09	Locomotion	72	26.57	Locomotion	63	22.99
3	Locomotion	30	13.39	Grooming	50	18.45	Grooming	48	17.52
4	Grooming	29	12.95	Inactive	31	11.44	Inactive	39	14.23
5	Sleep	28	12.50	Sleep	12	4.43	Sleep	7	2.55
6	Play	2	0.89	Play	2	0.74	Play	7	2.55

FORAGING/FEEDING

Assamese monkeys were found folivorous (Figure 1) but they are fond of fruits as and when available. Assamese monkey are highly dependent on leaves in winter than other food item. They rely least on leaves in spring and intermediate dependency on autumn. During spring season shoots, twigs, and flowers cover majority of dietary equation while they go to seeds on that season. Twigs, shoots, flowers are primary source of food in spring while seeds autumn has similar equation. Monkeys are fond of seeds and they go on fruits and seeds as and when available. During spring they go for immature fruits while matured seeds are available in autumn. Hence, it can be inferred that plant foliage like leaves, twigs, and shoots cover major dietary proportion.

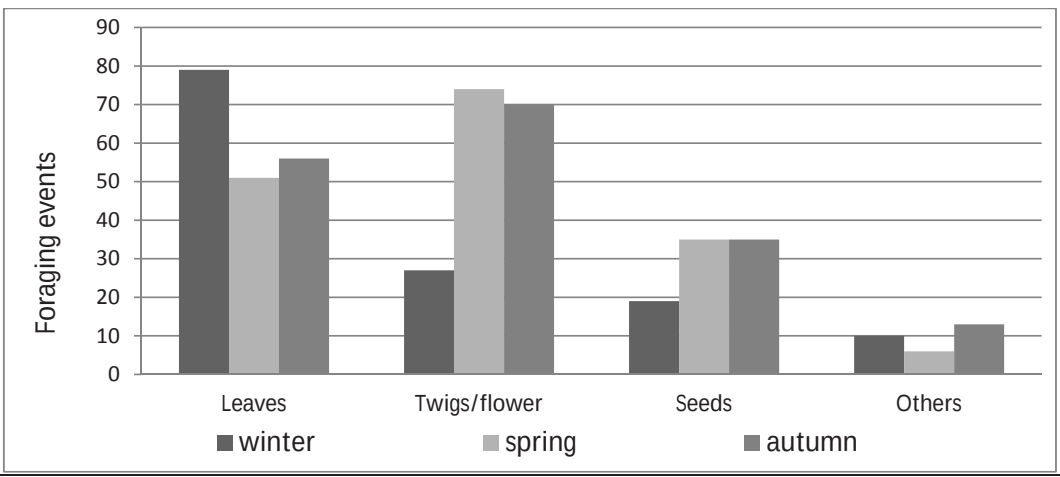


Figure 1. Food preference (plant parts) by Assamese monkey in SNNP.

It was found that when availability of high quality food is available then monkey wander in search of burgeoning twigs and fruits thereby increasing the locomotion behaviour in spring and autumn than that in winter. Monkeys usually take leaf as food source early in the morning possibly due to hunger in early morning. They search for quality food late noon when they get rid of hunger. Other food sources taken were mosses, mushroom, plant gum, invertebrates and their products. Drinking water was never observed during study period.

Out of 65 and 52 species identified in Assamese monkey foraging areas 34 and 26 types of plants were used by monkeys as food and 7 species of each islands were non-food trees while use of other plants was unknown (Table 3). Among the tree species majority of it bears seeds and monkey uses these plant for food.

Table 3. Number of plants species in Assamese monkey foraging area in SNNP.

Forest area	Total species in foraging area	Food Plants	Leaves	Shoots	Seed	Flower	Other	Non-food plants	Use un-known
Nagarjun	52	26	6	5	20	5	1	7	19
Shivapuri	65	34	7	10	26	5	0	7	24

Although, feeding is a most frequent activity throughout the day, Assamese monkey starts foraging and feeding around 8:00 and peaks around 9:00-10:00. During the peak time monkey voraciously consume everything they find. During the first foraging peak time they can be found around sleeping sites although quality food is rarely available. Monkeys seem to satisfy the night long hunger and starts performing social works. The afternoon time is the time of searching quality food and they search extra food item like mushroom, invertebrates etc. along with seeds and shoots. The second peak foraging time comes around 13:30 and lasts longer than morning feeding time (15:30). Then they start travelling back to sleeping sites along with some social activities. The sin function model with R^2 values of 67% shows that foraging model has bimodal distribution (Figure 2).

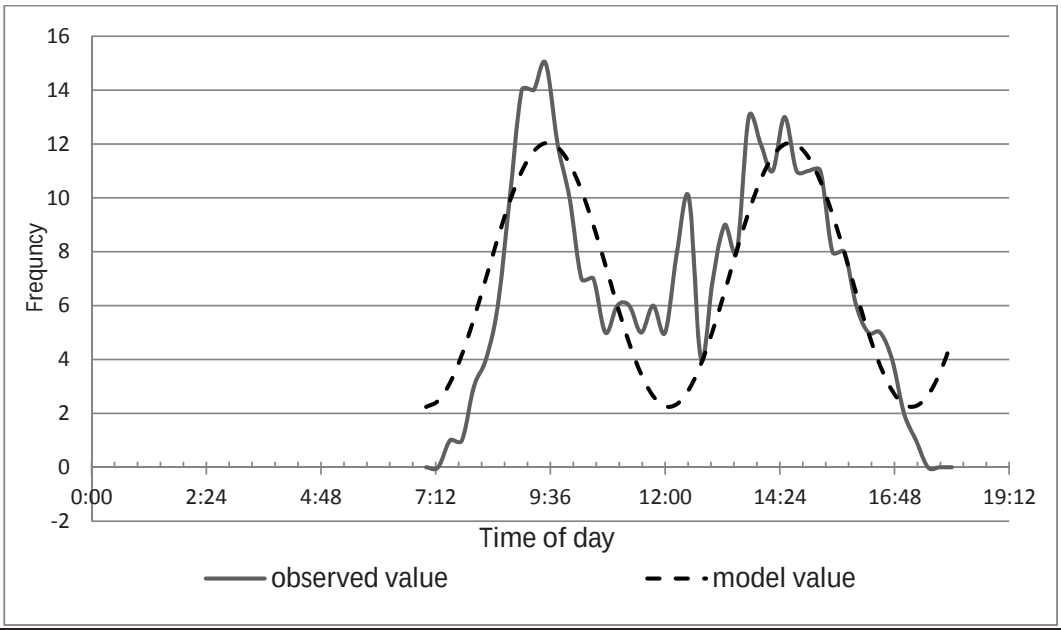


Figure 2. Foraging model for Assamese in Nagarjun-Shivapuri NP.

LOCOMOTION

Locomotion is common in first hours of activity following wake up and few minutes rest. Assamese monkey loves walking through the middle canopy but they go for climbing cliff series due to their compulsion. Similar is the case for them to travelling back to the sleeping site in the evening. Locomotion through ground was mainly focused for invertebrates and ground food. These monkeys never jump from tree to tree unless there is no compulsion. Monkey drags the nearest branch and slowly rides upon it. Majority of individuals follow the same path used by initial traveller. Usually juveniles are active to left the sleeping sites earlier than adults. Assamese monkey uses middle canopy (51%) for travel (Figure 3) and 31 % locomotion events are for rock climbing/downing, 6 % walking around the ground, and about 13 % through canopy.

Locomotion behaviour follows the sin model but the R^2 value is poor. The sin function model is among the best model fitted with the locomotion data. The frequency of locomotion against time of day was plotted and the resultant outcome is given in following Figure 4. It is clearly visible that locomotion has multimodal distribution peaking early in morning, noon, and evening. Locomotion can be observed before

morning foraging, after mid-day resting, and before sleeping. The data has inverse relationship with foraging and lower frequencies are observed when foraging has highest crest.

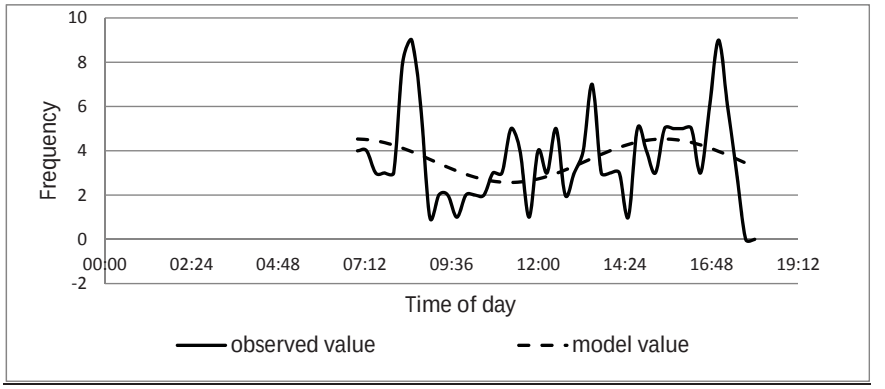


Figure 3. Locomotion pattern during the time of observation in SNNP.

GROOMING

Grooming is an important social behaviour to harmony the relationship between individuals. Assamese monkey spends considerable amount of time during sun basking, and the period after they satisfied against hunger. Copulation is also followed by grooming, and juvenile remains busy in playing when adult are busy to groom.

Grooming is mutually exclusive to the time of foraging and it has direct relationship with inactivity period (Figure 4). Grooming and inactivity starts early in the morning ceases around peak foraging time i.e. between 9:00 and 10:00 and again around 13:00 to 15:00. It peaks during noon time and reaches its maxima in evening.

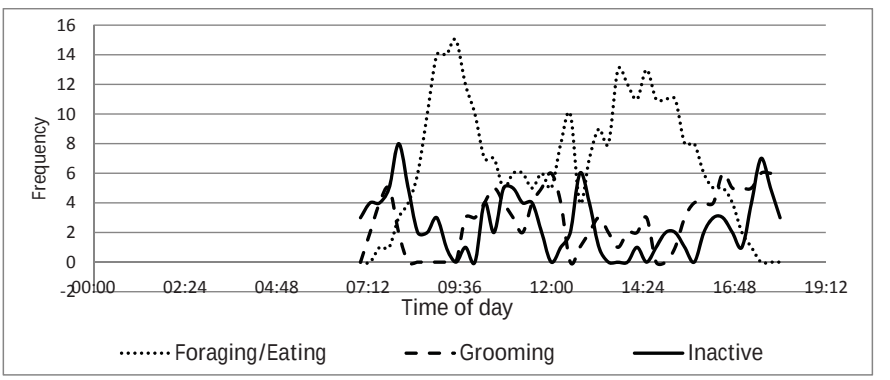


Figure 4. Grooming versus foraging and inactivity of Assamese in SNNP.

Participation of sex and age class was calculated for the grooming events (Table 4). Females are taking part in almost all grooming occasions often accompanied by juveniles and infants. Males are relatively reluctant on grooming although they have 55 % participation in grooming events.

Table 4. Participation of age and sex class in grooming parties of Assamese in SNNP.

S.N.	Season	Male	Female	Juvenile/infants	Remarks
1	Winter	51.72	100	65.52	% participation in each event
2	Spring	46.00	100	92.00	
3	Autumn	66.67	97.92	37.50	
	Average	55.12	99.21	65.35	

Inactivity and sleeping

Assamese monkeys were observed inactive during winter season. One third of time is spent by them doing nothing (i.e. active works like moving, foraging etc.) and do sleeping, resting, and sun basking while they are more active during spring and autumn. On an average, Assamese monkey spend about 16 % time when they remain inactive during spring and autumn. The selected troop was always using the rock cliff for night sleeping while tree is used during day time. Monkeys form separate family groups accompanied by both sexes and all age classes. Sometimes sleeping lasts till 9:00 AM. Generally infants and juveniles sleep between adult. Following photograph shows how Assamese monkeys sleep in night.

Playing, resting, and sun basking is common activity performed by monkeys during general resting or inactive period (Tab 5). Most of time (53 %) monkey remain at rest during the period of inactivity. Infants remain playing 27 %) when adult goes for rest. On an average sun basking covers 29 % throughout the year which is intensive during winter (49 %). Following table gives details on inactive period.

Table 5. Activities during general inactive period of Assamese in SNNP.

S.N.	Season	Inactivity					
		Sun basking	%	play	%	Rest	%
1	winter	22	48.89	12	26.67	25	55.56
2	spring	0	0.00	17	54.84	13	41.94
3	autumn	11	28.21	2	5.13	23	58.97
	annual	33	28.70	31	26.96	61	53.04

DISCUSSION

Assamese monkey of Shivapuri Nagarjun National Park are allocating considerable amount of time in foraging and feeding events (excluding the chewing during rest). Altogether, 40% time spent in foraging and feeding which is similar to Sarkar, *et al.* (2012), Srivastava, 1999 (cited in Schülke *et al.*, 2011). The result is rather different from Thai Assamese monkey (31.2%) for feeding (Schülke *et al.*, 2011) but similar with *Sebrubeshi* monkeys of Langtang National Park (LNP) (43.4%) (Chalise, 2010). Similarly, Chalise *et al.* (2013) has estimated 46% time spending on feeding and foraging in winter season and (52.9%) in case of Makalu Barun National Park(MBNP) monkeys Chalise, 1999). Moreover, it is lower to the latest troop in 1997 and 1998 data where 47 % and 44 % time was allocated for foraging and feeding Chalise (2003). Contrary to the result of this study, Chalise (2003) has found 20%, 37 % foraging events in Langtang National Park, Nepal in 2000 and 2001 respectively. The data from 2000 AD is quite low than the data of this study while the data from 2001 year is closer to Shivapuri monkeys (difference is 3%). The data from this study do not show any considerable seasonal variation in foraging/feeding i.e. 38-40%. The seasonal variation is within the range of Indian Assamese monkey i.e. 45% in pre-monsoon, 39% after monsoon/autumn, and 38% in winter (Sarkar *et al.*, 2012). Similar pattern in *Phu Khieo* Wildlife Sanctuary, Thailand (Schülke *et al.*, 2011) were recorded.

Assamese monkey in Shivapuri spends more time in locomotion in spring claiming 27 % time and 13% in winter. Schülke *et al.* (2011) also observed daily higher journey in spring and lower in winter months. On average they spend 21% time in locomotion excluding minor travel during foraging. The results are relatively similar to Chalise (2003) spring data where the LNP Assamese monkeys allocated 24 % time in 2001. Although, the average locomotion time is different to Chalise (2003) in MBNP (29 % and 25 % in 1997 and 1998 AD), the spring data is similar to Chalise (2003) of spring season. The difference is larger to Sebrubeshi monkey of LNP where monkey spends 31.7% time in movement (Chalise, 2010). The seasonal locomotion pattern is different each season 13% in winter, 27 % in spring, and 23% in autumn. Although, the average time is closer to Indian monkeys of Assam (25%) the later has lower seasonal deviations i.e. winter 25.61%, pre-monsoon 24.76%, after monsoon/autumn 23.46% (Sarkar, 2012.

In Wayang troop of MBNP, Assamese monkeys spent up to 32.1 % time in grooming followed by no grooming at all (Chalise, 1999) while the Shivapuri monkeys

are using only 17% time in grooming and 1% in playing. Grooming is higher in spring season and lower in winter when most of the individuals are taking sun bask and resting. Chalise (2003) observed 9/13 % grooming in 1997/98 respectively in MBNP. Social behaviour observed in this study is within the range of Chalise (2003) in case of LNP where 12% time is allocated in autumn (2000) and spring season of the year 2001 (Chalise, 2003). Grooming is relatively lower in Sebrubeshi monkeys allocating only 3.4% time (Chalise, 2010) and 7% in Assam (Sarkar *et al.*, 2012). The winter data of this study is closer to Chalise *et al.* (2013) data where the monkeys allocated only 6 % time in grooming and 1% time in playing. Data from other season thereby the annual average is quite different from Chalise *et al.* (2013). In winter season these monkeys spend considerably less time in social behaviour (14%) and remain busy in sun bask and resting while social behaviours are almost similar in spring and autumn (19% and 17% respectively). The social behaviour observed by Sarkar *et al.* (2012) is pre-monsoon 9+1%, 6+1% monsoon, 12+1% after monsoon, and 14+1% (grooming + playing) in winter. The winter data is identical with Sarkar *et al.* (2012). Monkeys of Assam were observed by Sarkar *et al.* (2012) from another angle i.e. monitoring with 7% time in pre-monsoon, 7% in monsoon, 12% after monsoon, and 12% in winter (Sarkar *et al.*, 2012). Social activities are lower in case of crab-eating monkeys which spent about 10% time (Son, 2014).

Inactivity of MBNP (15/18 %) in the year 1997/98 (Chalise, 1999) and Assam (India) monkeys (13%) (Sarkar *et al.*, 2012) which are similar to Shivapuri monkeys (15 %). Contrary to this the Langtang monkeys are spending more time in sitting/resting i.e. 38/19 % in the year 2000 and 2001 respectively but quite lower in Sebrubeshi monkey of Langtang (Chalise, 2010). The result is closer to the findings of Chalise *et al.*, 2013) where the Shivapuri monkey was spending 19 % of its time in resting and sun basking. There is difference in inactivity throughout the year; the monkeys spend considerable time in winter (20%) while spring and autumn has smaller difference in inactivity i.e. 11% and 14% respectively. Contrary to this result Sarkar *et al.* (2012) observed much lower record (7.31% in winter, 10.6% in pre-monsoon, and 11.58% in after monsoon). The resting in monsoon is larger about 1/5th of total time (Sarkar *et al.* 2012). Contrasting result was observed for crab-eating monkeys where 34% time was allocated (Son, 2014). The foraging and resting is the function of food availability. Altmann & Muruthi (1988) has estimated 20% and 50% time in feeding and resting in semi provisioned baboons while the result of time budgeting in wilderness baboons is much closer to Assamese monkey in SNNP. The later troops of baboons spend 60% time in foraging while resting has only 10% time.

The summary of time budgeting by Assamese monkey in Shivapuri Nagarjun National Park for three seasons is given in Figure 5.

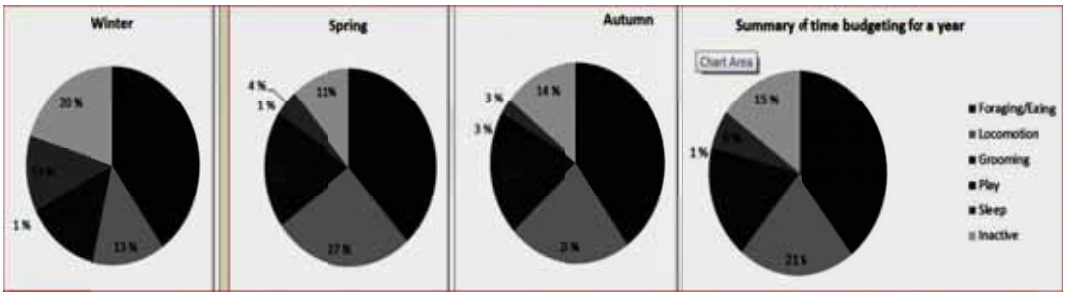


Figure 5. Seasonal time budget of Assamese in Shivapuri Nagarjun area.

Assamese monkeys are folivorous (Chalise *et al.*, 2013; Zhou *et al.*, 2011; Zhou *et al.*, 2013). Combining leaves and tender shoots are the primary food item in winter season for Assamese monkey in SNNP supplying more than 38% food requirement (Chalise *et al.*, 2013). Zhou *et al.* (2011) found that young leaves is the primary food source for them supplying over 74% food accompanied by >17 % dependency on seed in Nonggang nature reserve, China. Although, monkeys are fond of seed and feed on seed as and when available, its coverage for food budget is limited around 17% in case of Nonggang nature reserve (Zhou *et al.*, 2011) and 35 % in SNNP (Chalise *et al.*, 2013). In contrast, Thai Assamese monkey have 40% dependency in fruits, and 21% in leaves ((Schülke *et al.*, 2011). Mosses, wetland plants, insects, and mushrooms etc supply around 26 % food supply in case of SNNP for winter (Chalise *et al.*, 2013). Interestingly, Schülke *et al.* (2011) has found animal food for Assamese monkey up to 22% in Thailand.

Assamese monkeys consume multiple plant parts i.e. some feeding on leaves while other in shoots or seeds or other parts. During 1 minute scan period monkeys frequently consumed multiple plant parts not only by all members but sometimes also by a single monkey. The calculated data shown in following diagram is quite different to those monkeys from Thailand where Assamese monkey are focusing on seeds/fruits totalling up to 42.4% while it covers only 28.86% which is rather low. The dependency of monkeys on leaves is relatively similar to that of Indian Assamese monkey where Shivapuri monkey have 62.58% dependency in leaves while it is lower 52% in later case (Srivastava, 1999 cited in Schülke *et al.*, 2011). Srivastava 1999 have found that Indian monkeys spend 37% time in shoots and flower which is larger in Shivapuri (54.93%). Here, I have recorded other food item

including animal matters, mosses, mushroom, salt lick etc which is relatively low around 10%. On the other hand the Indian monkeys are using 2% time in ingesting animal matters (Schülke *et al.*, 2011). The previous study for the same troop by Chalise *et al.* (2013) has found that Assamese monkeys have 38% dependency in leaves and twigs while 35% in seeds. The moss and epiphytes covering 14.7%, insects 5.9% and others 6% only in winter season (Chalise *et al.*, 2013). The salt licking was observed only one time in this study but it covers considerable period in Sebrubeshi monkey of LNP (1.7%).

Although, I have not recorded the time spent in each strata of forest for Assamese monkeys, the medium of locomotion was recorded and found that monkey use middle canopy as the prime medium of locomotion. It is supporting from Eastern group of Assamese monkey from Thailand where Schülke *et al.*, (2011) have observed 50% time spent on middle storey. In contrast, the selected troop in Shivapuri has rarely used ground for locomotion and sometimes during foraging on benthic organisms and wetland plants but the far eastern troop of its range: the Thai troops are using considerable time in ground or lower strata (Schülke *et al.*, 2011).

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Nepal Owl Festival: A Comprehensive Approach to Owl Conservation

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ABSTRACT

We analysed the impact of Nepal owl festival after four years of its inception, based on what has been published and disseminated, on the attitude of people who are the primary stakeholders on owl conservation. Four owl festivals in four years (2012-15) have been organised with a fair amount of people's participation. However there has not been any study on the impact it has generated on people's mind and whether it has influenced the way they think about owls or not?

KEY WORDS: Owl, conservation, festival.

INTRODUCTION

Owl research and conservation in Nepal was not systematically documented before 2008, except some odd owl sightings during different birding trips. Owls' status and threats was not properly documented for 220 years of ornithological exploration in Nepal (Baral *et al*., 2013). With no owl species listed as threatened by IUCN in their Red List, securing funding for research and conservation project would be difficult indeed from international donor agencies.

Live seizures of owls (primarily rock eagle owl) during nationwide raids by law enforcement agencies were also a matter of great concern. There were concrete evidences of owl species being traded to both India and China (Acharya & Ghimirey, 2009b). The first ever documented owl conservation awareness programme was conducted in May 2008 by Friends of Nature (FON) Nepal where 34 students participated. An inter-school owl painting competition followed with the theme "Environmental Damage: Threat to Owls" on July 11 2008 (http://fonnepal.org/school_program.html). The first rigorous research and conservation initiative followed later in 2008-09 in the districts of Mustang and Manang with financial support from

1 Friends of Nature (FON), Kathmandu, Nepal

the World Owl Trust, UK. Fourteen owl monitoring points were established and monitored for the first time in the country (Acharya & Ghimirey, 2009a). Posters and pamphlets were widely distributed across various districts in the country and a large mass of people were informed of the plight of owls via formal and informal education.

Approach

The 'International Festival of Owls' started in 1997 in USA. In 2012, FON Nepal initiated owl conservation programme to celebrate the international festival of owls in Nepal. The aim was to disseminate owl conservation message across a wide audience through a single event and the programme was imitated with adaptations and modifications from international festival of owls. The programme was continued with the name "Nepal Owl Festival" in the succeeding years. Various events such as photo exhibition face paintings and cultural programs were included in the festival. The local games were also included in the festival in order to attract local youths towards owl conservation.

Figure 1. Map of Nepal showing the Nepal Owl Festival districts.

Nepal Owl Festival 2012

The first Nepal owl festival was organised at Ghumaunedanda Bhageruthan Community Forests in Sangkosh VDC of Dhading district. This festival was a one day event and took place on March 3, 2012. Around 200 people visited the festival. Various events such as face painting of owls, owl conservation hymns (bhajans), owl conservation skit, bird watching and cultural programmes were part of this festival. The programme was very small in magnitude however the impact was huge as the hosting Community Forest users' group also declared a small part of their forest as an "Owl Conservation Area" to mark the event. Nature Conservation Awards were presented to Ghumaunedanda Bhageruthan Community Forest Users' Group and Hariyali Bhajan Samuha.

Nepal Owl Festival 2013

Nepal owl festival 2013 was held at Setidevi Community Forest in Mangalpur VDC of Chitwan district on March 6, 7 and 8. The event was larger in magnitude in terms of duration and larger number of visitors compared to Dhading. A total of 1850 people visited the festival and obtained information on ecological and conservational aspects of owl. The events organized during the festival were local game competition (dandi biyo), owl face painting, bird watching competition (big day), owl poem competition, owl essay competition, owl painting competition, owl photo exhibition, owl sketch exhibition, display of interesting information on owls and cultural programs. The cultural programs included local traditional dances such as Ghatu and traditional hymns (Bhajans) on owls. Dandi biyo competition was held among the local people with an aim to conserve this game at the same time involving youth towards owl conservation initiatives in the area.

Nepal Owl Festival 2014

Nepal owl festival 2014 was held at Amaltari buffer zone Community Forest in Baghkhor VDC of Nawalparasi district. Information on the ecological and conservational aspects of owls was conveyed to a total of 3500 people who visited the festival. The number and magnitude of events were larger than both 2012 and 2013. The events of this festival included owl face painting, bird watching competition (big day), nature photo walk, owl poem competition, owl conservation camps, owl documentary shows, owl essay competition, owl painting competition, owl photo exhibition, owl sketch exhibition, display of interesting information on

owls, owl mascot display, owl call device, nature conservation award distribution and cultural programs. The cultural programs included Tharu and Bote cultural dances and bird conservation hymns (bhajans).Completion was held of the local game ‘Bhodi' among the teams of the local youths and the visitors too.

Nepal Owl Festival 2015

Nepal owl festival 2015 was held at Shree Himalaya higher secondary school, Barpak VDC of Gorkha district. A total of 3000 people (including students) visited the festival and benefited from the information on the ecological and conservational aspects of owl. The number and magnitude of events were larger than the previous events. The events of this festival were local game competitions (Phupu, Bhruji and Topi Jhikai), owl face painting, bird watching competition (big day), nature photo walk, owl poem competition, owl essay competition, owl painting competition, owl photo exhibition, photo story on rescue of rock eagle owl in Pokhara, Nepal, owl sketch exhibition, owl straw arts, display of interesting information on owls, owl mascot display, owl call device, owl robot exhibition, owl food chain exhibition through taxidermized specimens of owls and their prey, owl masks, owl origami, display of equipments used in the study and research of owls, nature conservation award distribution and cultural programs. The cultural program included local traditional dances such as Ghatu, Maruni or Sorathi, Lingema, Lama-Jhakri dance and Lok dohori (folk-duet) song. In addition to the regular ‘Nature Conservation Award' to Nepali nationals an international award was presented to an Indian researcher in recognition of his extensive research on illegal trade and killings of owls in India.

Media coverage and impact

In the first year of its inception, a local daily newspaper from Houston, Minnesota highlighted the festival as an inspiring step replicated from owl festival in US without losing the theme while also adapting in local way. The programme is frequently highlighted by the media, both in electronic and print, in Nepal. Reputed national dailies such as Kantipur, Nagarik, Naya Patrika, and Annapurna Post published Nepal owl festival news every year. English dailies also highlight the programme regularly. A two minute report was also presented by BBC Nepali service in Nepal in 2013 while it also covered owl festival in 2014 and 2015. Aankhijhyal, a popular

programme telecasted by government owned Nepal Television (NTV) presented an 11 minute programme on Nepal Owl Festival 2015 while NTV plus telecasted the event in its program Naya Pusta (the new generation).

BBC Nepali service, which is believed to have six million listeners, is the most widely listened radio programme in Nepal. BBC Nepali service is regularly reporting Nepal owl festival for the last three years. The reporting of Nepal owl festival in BBC Nepali service is an excellent way to disseminate owl conservation message across the country and even abroad. Aankhijhyal is also a widely watched and highly appreciated programme in the field of environment. The number of cases of people reporting abandoned owls has increased considerably in the recent years, which, we believe, is a result of owl conservation initiatives carried out by FON Nepal. However, due to more reporting of such incidents it has been imperative that a moderate facility rehabilitation centre for birds including owls is opened soon to help in rescue of such birds.

Beside the media coverage, people's perception towards owl conservation have also changed, both in the festival venues and other places, because of effective relay of owl conservation message for an extended period of nearly a week. The festival organizing team usually stay at the site for preparation of the festival during which they interact with community people as much as they can, conveying messages on owl conservation. One excellent example can be taken from the festival venue of 2014 where people have put locally made owl nests at the middle of their farms after learning that owls are an excellent predators of rats and mice and that they protect farmers' wealth i.e. crops.

CONCLUSION

Owl conservation is important in Nepal and elsewhere. There are different ways and approaches to owl conservation. Celebrating ‘Nepal Owl Festival' has proved to be an effective way of disseminating owl conservation messages to citizens of different age classes across Nepal. This festival also seems to carry a lot of impact on the minds of students as well as people. The festival, aided by other owl conservation initiatives, has played an important role of catalyst to speed up the owl conservation efforts in Nepal.

ACKNOWLEDGEMENT

Nepal Owl Festival would not have been possible without generous support from many people. We would like to thank local people from Dhading, Chitwan, Nawalparasi and Gorkha district who contributed significantly towards the success of the festival. We are also grateful to the media for supporting the festival by covering this event in their dailies, weeklies, FM stations and television channel. Last but not least, we would like to offer our deepest gratitude to the Accordeos Foundation, Switzerland, who has been supporting Nepal Owl Festival since 2012.

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Plant Communities and Local Uses: Observations from Chitwan National Park

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ABSTRACT

Plants, animals and humans are interlinked and interdependent in ecosystems. Humans and animals consume plant resources in different forms and ways. This paper describes the composition and population of trees in the forests of Chitwan National Park (protected area) and local uses of the tree species in rural settings.

Keywords: Plants, ecosystem, resources, community

INTRODUCTION

Chitwan National Park (CNP) is the first national park, located in the subtropical Inner Terai lowlands of south-central Nepal in the Chitwan district in Nepal. It was established in 1973 and granted the status of a World Heritage Site in 1984. It covers an area of 932 km^2 and ranges from about 100m in the river valleys to 815m in the Churia Hills (Bhuju et al., 2007).

CNP has Narayani and Rapti river system in the north and west forming a natural boundary to human settlements. Adjacent to the east of Chitwan National Park is the Parsa Wildlife Reserve; contiguous in the south is the Indian Tiger Reserve Valmiki National Park.

Vegetation of CNP is subtropical broadleaf forests with predominantly sal trees covering about 70% of the national park area. Along the southern face of the Churia Hills sal is interspersed with chir pine (*Pinus roxburghii*). Other forest types include *Acacia-Dalbergia* along Narayani River and *Trewia-Bombax* along the Rapti river banks. Grasslands are the main vegetation along the riverbanks of CNP, covering about 20% of the park's area with more than 50 species. The grassland vegetation

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composes of the world's tallest grasses. Kans (*Saccharum spontaneum*) is one of the first grasses to colonize new sandbanks and to be washed away by the yearly monsoon floods (Shrestha and Dangol, 2006).

The wide range of vegetation types in the Chitwan National Park is haunt of more than 700 species of wildlife. This protected area is the habitat of many fishes, amphibians and reptiles. It is also home of gedhan 43 species of mammals. Rhinoceros, Bengal tigers, leopards, sloth bears, otters, foxes, hyenas are the few among the animals. Gaurs, wild boars, sambar deer, barking deer, hog deer, four-horned antelopes and chital inhabit the park (Bhuju *et al*., 2007).. In 2006 they recorded 543 species in the Chitwan National Park, much more than in any other protected area in Nepal

The studies on the CNP vegetation received more attention compared to other forest types of the district (Dienerstein, 1975; Lehmkuhl, 1994; Sharma, 1995). Some authors also linked their vegetation studies with human population (Lehmkuhl *et al*., 1986, Nepal and Weber, 1993), or food habits of wild mammals (Shrestha, 1984) or with tourism industry (Johnson and Orland, 1996) or environmental impact of fire (Moe and Wegge, 1997). Matthews *et al*. (2000) also discussed on reciprocal relations between population and the environment including vegetation. Dangol and Shivakoti (2001ab) reported floral diversity, species composition and dominance of forests and common lands of western Chitwan. This paper reports tree species of the forest of the Chitwan National Park and their uses.

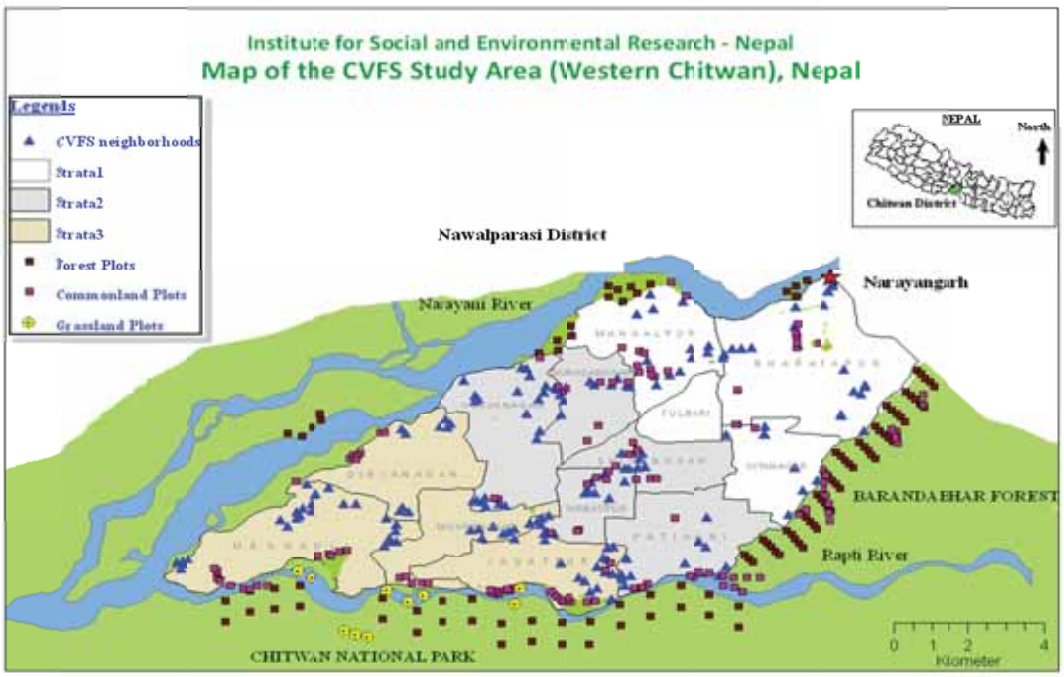
METHODOLOGY

To understand plant communities, I used survey data collected from January to April of 2007 from the Chitwan National Park forest of Central Nepal as a part of a multi-method longitudinal study of the reciprocal relations between population and the environment. The number of trees encountered in 10x10 square meter plots was used to analyze tree species composition and population of the vegetation. To know the uses of plant resources, local experts were consulted.

RESEARCH PLOTS

Chitwan National Park is the southern boundary of the study site. It expands between the Jarneli post in the east to confluence of the Reu khola (stream) and Rapti River to the west. Cattle grazing and grass cutting are strictly prohibited. This jungle is open to the public in the month of January to collect grasses and dry wood for one month.

In this block, 34 sample plots were located in 17 rows, each row with two research plots (Map 1). The first research plot (the exterior one) was located 250m inward and due south from the forest edge along the Rapti River. The second research plot (the interior one) was located 1 km southwest from the first research plot.



Map 1. 34 Research plots in 17 rows in Chitwan National Park.

The voucher specimens are housed in the Herbarium of the Department of Environmental Science, Institute of Agriculture and Animal Science, Rampur, Chitwan, Nepal.

RESULTS

Tree Species Composition and Association

Trewia nodiflora and *Bombax ceiba* were found associated in 6 exterior research plots as Trewia-Bombax community. However, Trewia composed a pure stand in three plots. Compared to Trewia nudiflora, Bombax ceiba was recorded more times in interior plots. *Shorea robusta* was the principal species in the interior research plots and associated with other tree species such as *Butea monosperma, Cleistocalys opperculatus, Syzigium cumini*, etc. *Adina cordifolia, Aegle marmelos and Ehretia*

laevis were the species recorded only from the exterior plots. *Butea monosperma* and *Gmelia arborea* were noted only in the interior plots. Eleven tree species were found both in exterior and interior plots. In exterior plots, where Trewia absent, vegetation was formed in combination of Shorea robusta with other species in 4 plots and *Mallotus phillipinensis* with other species in 3 plots. Similarly, in 4 interior plots, *Holarrhena pubescens* with other species formed the vegetation (Table 1).

Tree Population

In exterior plots, along the Rapti river, *Trewia nudiflora* had highest number of individuals (17 in 9 plots) followed by *Bombax ceiba* (9 in 6 plots) and *Shorea robusta* (9 in 4 plots). In interior plots, *Shorea robusta* is the dominant species with 32 in 12 plots, followed by *Dillenia pentagyna* (9 in 6 plots) and *Cleistocalyx operculatus* (9 in 5 plots) (Table 1).

Local Uses of Plant Resources

Local people have knowledge on uses of plant resources found inside the National Park. Trees are used for different purposes. Some trees are valuable for medicine (fruits of Aegle marmelos), some for food (flowers of *Bombax ceiba*, *Bauhinia malabarica, fruits of Aegle marmelos*), some for constructing houses (*Shorea robusta*) and some as artifacts. Indigenous people use parts of some trees for religious purposes. Most of the trees are valued for the food of wildlife and domestic animals and fuelwood (Table 3). *S. robusta* is the most valuable timber. Food habit of wild mammals of Chitwan National Park has been studied by Shrestha (1984).

CONCLUSION

Trewia and *Bombax* formed the vegetation of riverine forests and Shorea made up the vegetation of interior part of the forest of Chitwan National Park. The tree species are useful to the wildlife as habitat and food. The local people have knowledge on uses of trees for different purposes.

Table 1. Composition and Popution (number of species in 10x10 square meter plots) in exterior (O) and interior parts of the forests of Chitwan National Park (2007) {PP: plot position; TP: total plants; and frequency of occurrence}

PP	Local names	Scientific names	Plot rows																	TP	F
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		
I	Sal	*Shorea robusta* Gaertn.	2	2	1	6	2	1	1	4	6	4	1	2						32	12
I	Tantari	*Dillenia pentagyna* Roxb.		2	1	1	3	1											1	9	6
I	Kyamun	*Cleistocalyx opperculatus* (Roxb.) Merr. ex Perry					3	1	2	2				1						9	5
I	Simal	*Bombax ceiba* L.										1	1		1				1	4	4
I	Botdhairo	*Lagerstroemia parviflora* Roxb.						2			1	1								4	3
I	Kutmiro	Litsea monopetala (Roxb.) Pers.													1		1		2	4	3
I	Dudhkhirro	*Holarrhena pubescens* (Buch.-Ham.) Wall. ex G. Don											2	1						3	2
I	Sindure	*Mallotus philippensis* (Lam.) Mull.-Arg.																1	1	2	2
I	Amili Tanki	*Bauhinia malabarica* Roxb.		1																1	1
I	Jamun	*Syzygium cumini* (L.) Skeels																1		1	1
I	Khamari	*Gmelina arborea* Roxb.			1															1	1
I	Palans	*Butea monosperma* (Lam.) Kuntze													1					1	1
I	Unknown tree	Unidentified tree												1						1	1

I	Vellar	*Trewia nudiflora* L.														1				1	1
O	Vellar	*Trewia nudiflora* L.		1	2	4	3					1	1	1	2			2		17	9
O	Simal	*Bombax ceiba* L.		2	2		1					1	1	2						9	6
O	Sal	*Shorea robusta* Gaertn.	2						4	2	1									9	4
O	Sindure	*Mallotus philippensis* (Lam.) Mull.-Arg.														2	3		1	6	3
O	Jamun	*Syzygium cumini* (L.) Skeels												2		1			1	4	2
O	Tantari	*Dillenia pentagyna* Roxb.	3								1									4	2
O	Kutmiro	*Litsea monopetala* (Roxb.) Pers.					1					1					1			3	3
O	Dhatrung	*Ehretia laevis* Roxb.														1	1			2	2
O	Karam	*Adina cordifolia* (Willd. ex Roxb.) Benth.& Hook ex Brandis					1							1						2	2
O	Amili Tanki	*Bauhinia malabarica* Roxb.									1									1	1
O	Bel	*Aegle marmelos* (L.) Corr.		1																1	1
O	Botdhairo	*Lagerstroemia parviflora* Roxb.							1											1	1
O	Dudhkhirro	*Holarrhena pubescens* (Buch.-Ham.) Wall. ex G. Don								1										1	1
O	Kyamun	*Cleistocalyx opperculatus* (Roxb.) Merr. ex Perry					1													1	1

Table 2. Local uses of trees of the forest of Chitwan National Park

Local names	Scientific names	Fruit	Vegetable	Medicine	Fodder and forage	Timber	Fuelwood	Religious	Household artifacts	Tannin	Fiber	Paper and pulp	Dye	Ornamental
Amili	*Bauhinia malabarica* Roxb.	x	x		x					X				
Bel	*Aegle marmelos* (L.) Corr.	x		x				x						
Botdhairo	*Lagerstroemia parviflora* Roxb.				x		x					x	x	x
Dhaturum	*Ehretia laevis* Roxb.				x									
Dutkhirro	*Holarrhena pubescens* (Buch.-Ham.) Wall. ex G. Don			x							x			
Jamun	*Syzygium cumini* (L.) Skeels	x		x	x	x	x			X			x	
Karam	*Adina cordifolia* (Willd. ex Roxb.) Benth.& Hook ex Brandis				x	x	x							
Khamari	*Gmelia arborea* Roxb.				x	x								
Kutmiro	*Litsea monopetala* (Roxb.) Pers.				x		x							
Kyamun	*Cleistocalyx operculatus* (Roxb.) Merr. ex Perry			x	x		x							
Palans	*Butea monosperma* (Lam.) Kuntze			x	x		x	x	x		x	x	x	x
Sal	*Shorea robusta* Gaertn.			x	x	x	x	x		X			x	
Simal	*Bombax ceiba* L.	x	x	x	x	x	x	x			x	x		x
Sindure	*Mallotus philippensis* (Lam.) Mull.-Arg.			x	x		x			X			x	
Tantari	*Dillenia pentagyna* Roxb.		x	x	x					X	x			
Vellar	*Trewia nudiflora* L.	x			x		x		x					

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Some Lycaenid Butterflies (Lepidoptera: Lycaenidae) of Shivapuri Mountain Forest, Central Nepal

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ABSTRACT

Shivapuri mountain forest is encompassed into the Nagarjun–Shivapuri National Park where high diversity of butterflies of different status categories is found. This study conducted in different years resulted a list of 26 species of Lycaenids (Blues) distributed in diverse habitats at 1400 to 2700 m of this mountain range. This included 14 species as rare on local status scale. Among the recorded species Syntarucus plinius and Everes lacturnus were represented by 2 individuals only.

KEY WORDS: Lycaenidae, Papilionidae, Shivapuri, Nagarjun.

INTRODUCTION

Nepal so far represents 660 species of butterflies which is 3.30% in global context (Smith 1989). More than 360 species of butterflies have been recorded in Kathmandu and its surrounding hills (Khanal & Smith, 1997). Nagarjun-Shivapuri National Park is one of the potential spots where distribution of butterflies has interestingly been displayed at different altitudinal pockets. Study conducted in the past revealed the existence of 108 species of butterflies in this park (Khanal, 2013). Rare species like *Papilio krishna* (Papilionidae), IUCN Red listed, has been reported at an elevation of 2,120m of this mountain forest.

The family of blues called Lycaenidae is the second-largest family which constitutes about 30% of the known butterfly species in the global context. A total of 176 species of lycaenids has been recorded in Nepal hitherto (Smith, 1989).

Members of this family are small, less than 5 cm in sizes, brightly colored and some with metallic gloss, females are generally dull or brown. Adults often bear hairy

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thread like tails with black and white ring like appearances. Many species bear a spot at the base of the tail called the tornal spot.

STUDY AREA

Shivapuri Mountain is located at 27° 74'N and 85° 38' E inside the National Park System at the northern part of the Kathmandu Valley.

VEGETATION

Forest types and vegetations play significant role to increase the diversity and distribute butterflies in nature. These insects depend upon vegetations for food during their larval stage. These are well known cross pollinators among the plant species.

Shivapuri Mountain at 1400 to 1800 m of elevation has good representations of the forest trees like *Castanopsis indica, Schima wallichii* and *Alnus nepalensis*. Other prominent species noted here are *Lyonia ovalifolia*, *Castanopsis tribuloides*, *Pinus roxburghii*, *Eurya acuminata,* etc.

Floral components displayed at 1800 to 2700 m are *Quercus semicarpifolia, Alnus nepalensis*, *Pinus roxburghii*, *Rhododendron arboreum*, *Castanopsis tribuloides*, *Gaultheria* sp., *Quercus lamillosa*, *Ilex excela,* etc.

The top of this mountain at 2700 m of elevation accommodates tree species like *Quercus semicarpifolia*, *Quercus lanata*, *Quercus glauca*, *Rhododendron arboretum,* etc.

METHODOLOGY

This diversity record is the outcome of study conducted in different years and seasons within the elevation ranges of 1400 m to 2700 m, covered different altitudinal habitats from the base to the top of this Mountain forest. Identification was done in the field without collecting any of the specimens. Smith (1989) and Khanal and Smith (1997) were consulted for field identification. Some of the vegetations were

identified using Polunin and Stainton (1984) and Stainton (1988). Photographs of some of the confusing species of butterflies were also taken which later were identified at the Natural History Museum in Kathmandu.

RESULTS & DISCUSSION

This forested mountain where ecosystem is less disturbed displayed various species of butterflies of different status categories. The species of lycaenid like *Chliaria kina*, with total count of 12 individuals was observed common at 1400 m of elevation. *Zizeeria maha*, a widely distributed species across country was noted very common at the lower belt of this mountain.

Elevation at 1900 m displayed *Everes lacturnus* (Lycaenidae), a rare species, was represented by 2 individuals only. Among the recorded species at 2400 to 2700 m, *Actyolepsis puspa* was seen abundant low to the ground. The rare species at this elevation was *Oreolyce vardhana* represented by 2 individuals only.

The species diversity was noted decreasing as per altitudinal rise. Some rare species recorded in this study include *Syntarucus plinius, Everes lacturnus, Panchala birmana, Arophala pseudocentaurus, Creon cleobis* etc which were confined within the elevation range of 1400 to 2200 m where good and preferred habitats for these species occur. All the lycaenids are diverse in their food habits and apart from phytophagy; some are entomophagous feeding upon scale insects.

The ecological factors affecting the distribution of butterflies are the biotic and abiotic. The biotic factor includes plants and plant parts. Plants are the food of the larvae and the flowers which provide nectar to the adult butterfly. This also maintains habitat of this insect. The abiotic factor arises from the non-living environment and comprises climatic, geographical gradients and local influences.

This study though conducted in different years and months still is not enough to provide a complete species record of butterflies of this park. So an extensive study covering all the areas of the Nagarjun-Shivapuri National Park is essential which may come up with many interesting findings and complete species data of this fauna occurring in this national park.

A list of Lycaenids documented in Shivapuri Mountain Forest is provided in Appendix I at the end.

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Appendix I

List of Lycaenids documented from Shivapuri Mountain Forest

SN	Scientific Name	Common Name	Elevation(m)	Local Status
1.	*Arophala pseudocentaurus* Doubleday	Centur Oak blue	1400	Rare
2.	*Arophala rama* Kollar	Dark Himalayan Oak blue	2400	Common
3.	*Arophala paramuta* DeNiceville	Hooked Oak blue	1900	Rare
4.	*Chliaria kina* Hewitson	Blue Tit	1400	Common
5.	*Jamides celeno* Cramer	Common Cerulean	1400	Rare
6.	*Zizeeria maha* Kollar	Pale Grass Blue	1400	Common
7.	*Panchala birmana* Moore	Burmese Bush blue	1400	Rare
8.	*Everes argiades* Pallas	Chapman's Cupid	1400	Rare
9.	*Everes huegelii* Gistel	Tailed Cupid	1900	Rare
10.	*Everes lacturnus* Godart	Indian Cupid	1400	Rare
11.	*Deudoryx epijarbus* Moore	Cornelian	1400	Rare
12.	*Chaetoprocta odata* Hewitson	Walnut Blue	1400	Common
13.	Creon cleobis Godart	Broadtail Royal	2200m	Rare
14.	*Syntarucus plinius* Fabricius	Zebra Blue	1900	Rare
15.	*Flos areste* Hewitson	Tailless Plush Blue	1900	Rare
16.	*Euaspa miliona* Hewitson	Water Hairstreak	1900	Common
17.	Ancema ctesiaHewitson	Bispot Royal	1800 m	Rare
18.	*Udara dilecta* Moore	Pale Hedge blue	2400	Common
19.	*Udara albocerulea* Moore	Albocerulean	2400	Common
20.	*Celatoxia marginata* DeNiceville	Margined Hedge Blue	2400	Common
21.	*Actyolepsis puspa* Horsfieldii	Common Hedge Blue	2400	Common
22.	*Rapala manea* Hewitson	Slate Flash	1760	Common
23.	*Lampides boeticus* Moore	Pea Blue	2700	Common
24.	*Spindasis nipalicus* Moore	Silver Grey Silver line	1800	Rare
25.	*Heliophorous epicles* Godart	Purple Sapphire	1600	Common
26.	*Pratapa icetas* Hewitson	Dark Blue Royal	2000	Rare

Tiger Conservation Efforts, Achievements and Challenges in Nepal

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ABSTRACT

As tiger is an iconic and umbrella species, the Government of Nepal has been giving highest priority to protect the species and conserve its habitat. The Government is also committed to double the tiger number by 2022 following the sent Petersburg declaration in 2010. In order to save the tiger and its habitat, the government, conservation partners including international donors and local communities are working together in the team. However, tiger conservation efforts are not enough as it is interrelated with multiple factors and additional efforts are required. The article assessed the efforts made by the government of Nepal with reference national tiger conservation program and policy level suggestions were made based on the five experiences so far implemented in the field. Wetlands and grassland management together with local communities, allocation of adequate amount to human-tiger conflicts management and strong law enforcement may support to fulfill the government commitment to double the tiger number by 2022.

KEY WORDS: Tiger, Terai, Mikania, local communities.

INTRODUCTION

Tiger (*Panthera tigris*) is a magnificent big cat, sits at the top of the ecological pyramid of terrestrial ecosystem particularly vast forest landscapes of South East Asia and South Asia. The tiger is one of the charismatic species, also known as an iconic species, survives in the wild with less than 3500 individuals of remaining five sub-species (GTI, 2010). Five sub-species of tiger are still surviving in the wild; the Royal Bengal Tiger survives with the largest population, ecologically restricted to South Asia.

Among the thirteen tiger range countries, the Royal Bengal Tiger is found in four South Asian countries namely Bangladesh, Bhutan, India and Nepal. India has the largest population (2246 wild tigers as of 2015) while Bangladesh, Bhutan,

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and Nepal have 400, 75, and 198 tigers respectively. Nepal and India are only two countries, carried out a nationwide census using same methods and able to publish a joint tiger report of the results in 2014 and 2015 respectively (Chanchani *et al*, 2014). Conservation always aims to manage, preserve, protect, and enhance wildlife habitats in one side and control poaching and illegal trade of wildlife parts, reducing human-tiger conflicts and maintain harmony between people and nature on the other.

As a part of Global Tiger Recovery Program (GTRP) and Sent Petersburg declaration, the Government of Neal is committed to double the tiger number by 2022 (GTI, 2010). However, the tiger conservation includes bundles of activities, not linear to achieve the target as expected without collective efforts of state and non-state partners. Despite various conservation efforts from either side, the tiger conservation at landscape level has been facing various challengers. The major challenges are habitats shrinkage; degradation and loss due to invasive species and unplanned development works, loss of prey-base due to degradation in wetland and grassland conditions, poaching and illegal trade of tiger parts and its derivatives, human-tiger conflicts. The limited tiger habitat may pose doubt over objective of doubling the tiger number by 2022 (Aryal *et al*, 2014).

Tiger Status in Nepal

Terai Arc Landscape (TAL) in general and six tiger bearing protected areas and nearby national forests are the major tiger habitats in Nepal (Figure 1). Nepal is managing tiger habitats in TAL as a priority conservation landscape focusing on core areas, buffer zones, and corridors (managed as the protection forests). The activities are targeted to conserve tigers as a meta-population with trans-boundary ecological linkages and doubling the tiger number by 2022 at large. The Chitwan National Park has the highest tiger population, one of the unique protected areas in the world having more than 100

Figure 1. TAL and tiger bearing protected areas in Nepal

tigers within the same habitat. Because of rich ecological and cultural resources, this is enlisted in UNESCO World Natural Heritage Site in 1984. Besides, the Bishazaari Lake of the park is included in the Ramsar Site in 2003 and the first tiger bearing protected areas under Conservation Assured/Tiger Standard (CA/TS) in 2014.

National Tiger Recovery Program aims doubling the tiger number by 2022. As of 2009, the tiger population of Nepal was estimated 121 while it is expected to be around 250 tigers by 2022. The Government of Nepal together with conservation partners has been carried out various tiger conservation activities. It is essential to assess against the GTRP targets to the progress so far made as already five years of GTRP implementation has been completed. The intervention made by the Government of Nepal together with conservation partners and local communities need to be analyzed and gaps should be identified. Involvement of local communities in conservation, day-to-day patrolling by Nepal Army and tactful intelligence of Nepal Police has been producing measurable achievements to reduce poaching, bring wildlife crime culprits into the frame of law enforcement and eventually increasing tiger and rhino population. The role of conservation partners particularly National Trust for nature Conservation and WWF Nepal is crucial to assist financial and technical support for tiger conservation. However, shortfalls in the targets should be identified and need to take initiative to fulfill the gaps.

Tiger Conservation Efforts and Achievements

Habitat management: Terai Arc Landscape (TAL) is one of the priority tiger landscapes expanded both Nepal and India trans-border areas. In Nepal side, there are six protected areas belongs to tiger conservation and its habitat namely Parsa and Shuklaphanta Wildlife Reserves, Krishnasar Conservation Area and Chitwan, Banke and Bardia National Parks. Habitat management as the fundamental task of tiger conservation, the Government of Nepal has applied two approaches to tiger habitat management in (TAL). First, expansion of tiger habitat through additional protected area and protection forest declaration was initiated. Comparing to the area as of 2010 against 2015, the Government of Nepal succeeded in expanding the 1375 km^2 core area and 343 km^2 buffer zone area in 2015, which is 50% of the core area and 19% of buffer zone respectively (Table 3). The protection forests were managed as the tiger corridors and connectivity following the TAL strategy and Action Plan 2004 and 2006 respectively. It was largely believed that these corridors could be the lifelines to follow the gene from one tiger habitat to another. The second approach

is to improve the quality of the remaining habitat through grassland and wetland management efforts. Besides, the Government has been implemented various conservation efforts together with conservation partners in terms of financial and technical inputs. However, the financial and technical assistance to grassland and wetland management is very limited. Both the Government and conservation partners should revise the their planning system and need to focus on wetlands and grasslands focusing to the prey-base and tiger population, if they really want to double the tiger number by 2022 as stipulated in GTRP. Over grazing, encroachment, deforestation and forests degradation, uncontrolled forest fire, expansion of invasive species like *Mikania micrantha* are major threats to tiger habitat management. Besides, construction of development infrastructure without EIA and IEE and fragmentation of tiger habitat such as Hulaki Road and proposed Railway construction are major threats to keep the tiger habitat intact in Nepal. Policy advocacy and strong coordination among the stakeholders need to be focused in order to minimize and eradicate such threats. Trans-boundary cooperation with India is equally imperative to maintain ecological links as all protected areas of TAL are interconnected with tiger reserves of India. Such cooperation is also reciprocally expected from India side as well

Table 1. Tiger habitat expansion in 2010 and 2014 (Area in km^2)

SN	Major tiger habitat area	Before 2010			After 2014		
		Core	Buffer Zone	Total	Core	Buffer Zone	Total
1	Chitwan National Park	932	750	1682	932	750	1682
2	Bardia National Park	968	507	1475	968	507	1475
3	Banke National Park	-	-	-	550	343	893
4	Shuklaphanta Wildlife Reserve	305	244	549			
5	Parsa Wildlife Reserve	499	298	797	499	298	797
6	Krishna Conservation Area	-	-	-	16	-	16
7	Brandabhar Protection Forest	-	-	-	104	-	104
8	Khata Protection Forest	-	-	-	50	-	50
9	Baanta Protection Forest	-	-	-	408	-	408
10	Laljhadi Protection Forest	-	-	-	247	-	247
Total		**2704**	**1799**	**4503**	**4079**	**2142**	**6221**

Source: DNPWC (2014)

Controlling prey and tiger poaching: Tiger being an apex species of terrestrial ecosystem, secure of prey base for ecological integrity is fundamental. Higher density of prey base is an indicator healthy and hygienic ecosystem. Reducing tiger and prey base poaching is also supportive to maintain healthy ecosystem. Various species of deer, wild boar, bison, blue bull, and monkeys are the major prey base to tiger. In order to collect prey-base information and surveillance information, the Government of Nepal has been implemented Management Information System Technology (MIST) with technical and financial assistance of WWF Nepal and National Trust for Nature Conservation (NTNC). Park personnel and Nepal Army staff are doing patrolling together and collecting all the information mainly sighting species and their name, forest fire, grazing and illegal activities including poaching of animals. The GPS is used to trace out the map based on the patrolling distance and sighted species. This information is useful to law enforcement process and takes day-to-day decisions to the park manager. Initially, the system was piloted in Shuklaphanta Wildlife Reserve and replicated other protected areas. MIST is found very useful to mobilize the frontline staff and develop chain of commands based on the performance based patrolling in the field. Following the experience of MIST, the government is decided to advance the system through application of SMART and develop independent patrolling system of Nepal based on real time information. The advance of SMART is piloted in Banke National Park and planning gradually to replicate to other protected areas. The system is also piloted during rhino count 2015 and it is suggested that more training is required to make it robust.

Institutional Strengthening and capacity building: Enhancing tiger conservation polices, strengthening institutional reform and capacity-building of frontline staff, strengthen law enforcement system and create an enabling policy environment at landscape level are major objectives of National Tiger Recovery Program. In order to achieve these objectives, around US$ 5.6 million is estimated for first five years for NTRP implementation. National Tiger Conservation Committee (NTCC) under the chairmanship of Prime Minister, National Wildlife Crime Control Coordination Committee (NWCCCC) under the chairmanship of Minister, Wildlife Crime Control Bureau (WCCB) under the coordination of Director General of DNPWC, and establishment of 16 WCCB units that covered 18 districts (WCCB Kathmandu: DFO Kathmandu, DFO Lalitpur and DFO Bhaktapur) are major institutional reforms. Community Based Anti Poaching Units (CBAPUs) at grass root levels are found crucial to organize the local communities and involve them in anti-poaching activities.

Despite the fact, the organization structure of DNPWC is small compare to work nature and working lads. In many instances, the quality of park management is poor. Expansion of present organization structure and training to the frontline staff should be the focus of the department.

Human-tiger conflicts and engagement of local communities: Nepal is one of the pioneering countries to involve the local communities in wildlife conservation. After the introduction of buffer zone policy, Nepal is a witness of involvement of local communities and it has twin benefits in overall. First, it has enhancing the participation of local people in biodiversity conservation and enhancing their ownership, second, it has positive role to reduce the conflicts between human and wildlife. Nepal has also introduced the relief policy to wildlife victims and it has also positive response to increase the community stewardship in wildlife conservation including tiger. Community development activities such as school, health post, public building has also observed positive roles to create income and employment opportunities to the local communities who depended on the forests for their daily livelihoods. Despite the fact, human-tiger conflicts are constantly increasing. Adequate amount of relief package and quick response to the victims is always fundamental to maintain the co-existence.

Controlling illegal trade and reducing demand: Though still no-one knows the actual use of tiger skin and bones for what purpose, many people believed that tiger skin is a hobby for rich an sophisticated people in the East and South-East Asian countries while tiger bone is used for some traditional medicinal purposes. In order to control poaching and illegal tiger trade, National Parks and Wildlife Conservation Act 1973 envisaged a sanction of NRs. 50,000 to NRs. 100,000 or 5 to 15 years jail or both to the culprits who involved in the tiger crime. As the tiger crime is well organized and expanded at trans-national level, control of poaching in source country is not enough unless the demand country does not cooperate to combat the wildlife crime. As a result of collective efforts, Nepal is able to maintain the zero poaching of rhino since last five years, but the tiger poaching remains rampant. Harmonization in policy provision among the tiger range countries is another critical issue to save the tiger from poacher.

Scientific monitoring, survey and research: Though Nepal has started tiger ecology project in 1970s, most of the research in tiger are fragmented and lacks institutional memory. We can read the piece of papers on tiger research from various perspectives including tiger ecology and human-tiger conflicts, but lacks

database and base line survey. Pugmark and camera trapping are the major tools to estimate the tiger population. A rigorous tiger count was carried out in 2012 and it is estimated 198 individual tiger across the Terai Arc Landscape. The tiger count showed that 120 tigers in Chitwan National Parks, which is one of the largest population in the world within the single habitat. The tiger population in the Bardia National Park, on the other hand, is constantly increasing (Table 2). Similarly, the prey base situation is well maintained in Shuklaphanta Wildlife Reserve, Bardia and Chitwan National park while additional efforts are needed in Parsa Wildlife Reserve. The Banke National Park area was also excluded. Following the Sent Petersburg Global Tiger Forum, which was held on November 21-24, 2010, and the doubling the tiger number objective by 2022, the Government of Nepal together with WWF Nepal and National Trust for Nature Conservation. As of 2014, the tiger population of Nepal is 198 while the number is increased by 63% as of 2008/09 (Table 2).

Table 2. Tiger population in Nepal

SN	Protected Area	Estimated Tiger Population			Tiger (Density/km^2)	
		Mean	SD	95% CI	Density	SD
1	Parsa WR	7	2.9	4 – 13	0.65	0.3
2	Chitwan NP	120	10.6	98 – 139	3.84	0.3
3	Banke NP	4	1.2	3 – 7	0.16	0.1
4	Bardia NP	50	2.85	45 – 55	3.38	0.2
5	Shuklaphanta WR	17	2.27	13 – 21	3.4	0.4
	Total	198		163 -235		

Source, Dhakal *et al.* (2014)

The tiger monitoring result showed that the tiger population in Nepal is constantly increasing (Figure 2). However, still we have to refine the tiger counting methods and verification with other methods such as scat analysis together with camera trapping methods.

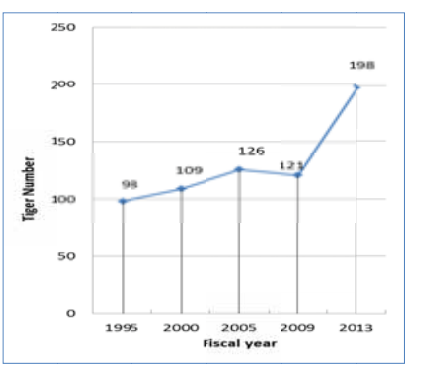

Figure 2. Tiger population in Nepal (Dhakal *et al.*, 2014)

Trans-boundary cooperation: All tiger bearing protected areas including Terai Arc Landscape are expanded along with Indian border. In many

instances, a tiger shares the habitat at trans-boundary level. Nepal and India have established a legacy of trans-boundary cooperation through local to national of level trans-boundary meetings on annual basis since 1997. Similarly, Nepal has signed a Memorandum of Understanding (MoU) with India in 2010. Besides, the secretariat of South Asia Wildlife Enforcement Network (SAWEN) is established in Nepal and coordinated all eight countries of South Asia including tiger issues.

Gap Analysis: No doubt that tiger conservation is a long-term process. It requires patient and dedication among the conservationists and policy-makers. Tiger as an umbrella species; in many instances, the species represents the ecosystem as a whole. Therefore, while doing tiger conservation we have to take into account all components of an ecosystem that interact each other. Tiger conservation in isolation i.e. government efforts alone are not enough. Such conservation should be together with local communities who are living nearby the forests and deserve to use conservation benefits. Small government organizations with limited capacities always loose the quality of protected area management. Their delivery always sighted problem to service delivery. On the other hand, the old laws do not represent the present communities demand and expectation. Therefore, pragmatic policy and program in one side and adequate budget allocation to reform and re-build old guard posts and construct all-weather roads on the other are fundamental parts of tiger bearing protected area management. Along with tiger population increment, there is a possibility of human-tiger conflicts. Both preventive and curative measures need to be applied to reduce the conflicts. Meaningful participation of local communities and their stewardship in conservation outcomes is essential to reduce the conflicts and keep harmony between human-being and nature. However, increasing trend of human-tiger conflicts and unnecessary law enforcement to poor and marginalized people sometimes has been reducing the trust. Lack of research and monitoring of tiger and its habitat is also pouring the problem to designing the innovative policy and programs. Though the government of Nepal has been reformed various hierarchies of supportive institutions from people to prime minister, the functionality among the newly reform institutions and wildlife crime data base system remains poor.

Ways Forward: In order to double the tiger population as of 2010 by 2022, the Government of Nepal should expand the potential area of tiger habitat either in terms of protect areas or protection forests. Only better management of wetlands and grasslands can ensure the tiger population. Similarly, functionality of corridors and connectivity's is equally important. The habitat management is directly correlated to determine the prey base and predator relationships. The Parsa and

Banke are observed poor to secure sufficient tiger prey base while Chitwan, Bardia and Shuklaphanta have better condition. Assessment of land cover use may guide the budget and program planning and move forward. Better intelligence and investigation of wildlife crimes, functionality of district level wildlife crime control bureau, record-keeping and reporting of wildlife crime need to be strengthened. Allocation of adequate budget to preventive and curative measures may reduce the human-tiger conflicts. However, quick response with relief package is essential rather than providing large relief amount with slow process. Simplification in relief fund releasing and genuine evidence collection need to be improved. Regular research on tiger, prey base, local communities and their involvement in conservation with multiple perspectives and trans-boundary cooperation is equally important as the conservation is concurrent matter and issue of beyond the boundary.

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Wildlife Ecotourism for Conservation of Nepalese Protected Areas

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ABSTRACT

Approximately one fourth portion of Nepal's total area has been declared protected areas, which is undoubtedly one of the major tourism areas in addition to the conservation of the unique and endemic fauna and flora of the country. The wildlife ecotourism, which encompasses the careful and responsible tourism, needs to be promoted in lieu of normal tourism. This paper tries to elaborate some of the negative and positive impacts of normal tourism that are noted in the protected areas.

KEY WORDS: Ecotourism, wildlife, conservation, protected areas, tourists.

INTRODUCTION

Wildlife tourism is one of the major aspects of tourism in Nepal since a long time. And, wildlife tourism is supposed to be eco–friendly wildlife ecotourism, in which, usually tourists and or viewers observe animals in their natural habitats. In the current contemporary times more and more persons are aspiring for such tourism. Thus, wildlife ecotourism has become an important part of tourism trade in many countries and is a multi–million amount of money industry in the world offering customized tour packages and wildlife safaris.

The Australia Ecotourism defines ecotourism as "ecologically sustainable tourism with a primary focus on experiencing natural areas that fosters environmental and cultural understanding, appreciation and conservation".

The 7 key principles of ecotourism are: 1) tourists who are involved in travelling to natural destinations, 2) tourists who minimizes impacts, 3) tourists who builds environmental awareness, 4) tourists who provide direct financial benefits for

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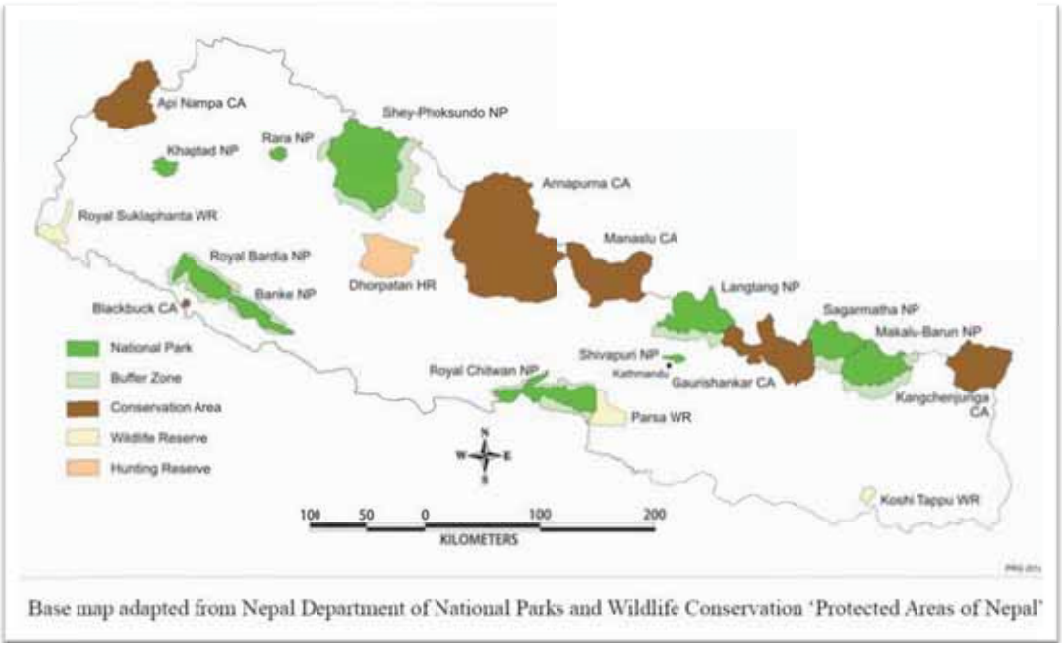
conservation of the target groups, 5) tourists who provides financial benefits and empowerment for the local people, 6) tourists who respect local cultures and 7) tourists who support human rights and democratic movements.

So, keeping all these points in mind, which is obviously relevant and acceptable in the context of Nepal, wildlife ecotourism is definitely one of the several means of conservation of Nepalese protected areas and her natural resources.

PROTECTED AREAS OF NEPAL

One of the most interesting facts is that approximately ¼th portion of Nepal's total land area (147,181 km^2) is covered with the network of 23 protected areas and 11 buffer zones (34,185.62 km^2). The Government of Nepal initiated the concept of declaring and establishing such protected areas since 1973 in order to preserve the extant natural resources which are unique to the country. Nepal occupies the central part of the great mountain chain of Himalayas between the Palaearctic and Indo–Malaya ecozones. Uniquely, the altitude of the country ranges from just 67 m above sea level in the south–eastern Terai to 8,848 m at the tip of Mt. Everest (Sagarmatha), the highest mountain in the world, within a short span of area. The extreme altitudinal gradient has resulted in the formation of some 11 bio–climatic zones ranging from lower tropical below 500 m to above 5,000 m in the high Himalayas, encompassing nine terrestrial eco–regions with 36 vegetation types. It has been estimated that there are some 1,120 species of non–flowering plants and 5,160 species of flowering plants ranking Nepal as 10th in terms of richest flowering plant diversity in Asia and 26th in the world. Some 181 mammal species, 844 bird species, 100 reptile species, 43 amphibian species, 185 freshwater fish species are recorded. The number of butterfly species known is 635. Furthermore, there are still many many species of different phyla yet to be tracked and recorded.



After the introduction of bills for the establishment protected areas in Nepal in 1973, there are 10 national parks (10,853 KM^2), 3 wildlife reserves (979 KM^2), 1 hunting reserve (1,325 KM^2), 6 conservation areas (15,425 KM^2), 3 ramsar sites KM^2) and 12 buffer zones (5,602.67 KM^2).

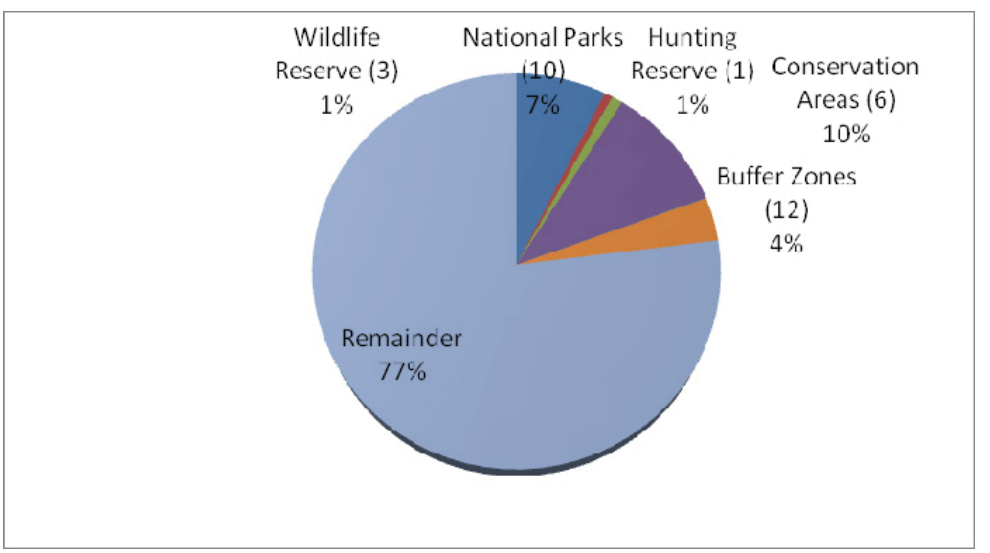


Figure 1. Protected areas within the country.

It is true that tourists visit Nepal for several reasons like visiting the cultural and historic places, trekking and hiking purposes, business and many more. At the present time there is a great portion of tourists who aspire to visit some protected areas in Nepal for the purpose of wildlife tourism only. According to Department of National Parks and Wildlife Conservation (http://www.dnpwc.gov.np/index.php/programs) ecotourism is a major contributor to the income of protected areas. Considering the great potentials of ecotourism in protected areas, domestic elephants riding, visitor information centre, information corners, flyers, jungle drive, camping, boating etc have been provisioned. Following simple table shows the figure of tourist arrival in Nepal, which displays that there is a sharp increase in the number every succeeding year. This means that there is a great opportunity for people engaged in this industry. There is no doubt that tourism in protected areas of Nepal is supposed to be one of the major income generating sources and are several opportunities. Of course, with opportunities there are challenges also.

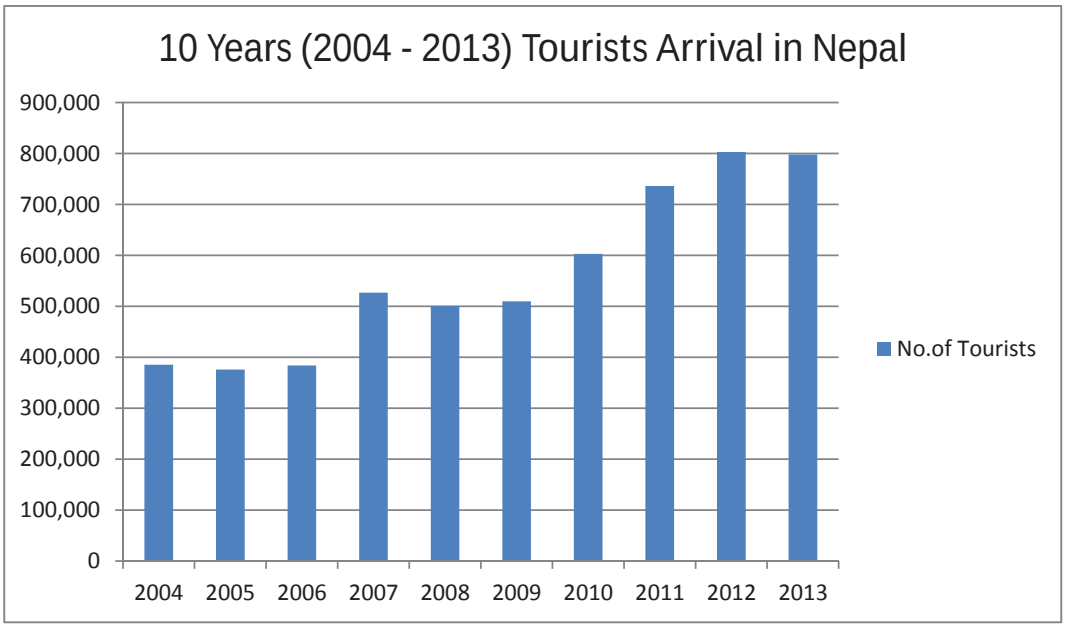


Figure 2. Number of Tourists arrival in Nepal (2004 –2013) Source: Nepal Tourism Board.

Fundamentally, wildlife ecotourism means making as little environmental impact as possible and helping to sustain the indigenous populace of wildlife and thereby encouraging the preservation of wildlife and habitats when visiting a place. This is an extremely responsible form of tourism and tourism development, which

encourages going back to natural products in every aspect of life. It is also the key to sustainable ecological development. The International Ecotourism Society defines ecotourism as *responsible travel to natural areas that conserves the environment and improves the well-being of local people*. This means that those who implement and participate in ecotourism activities should follow the following principles:

- Minimize negative impacts.
- Build environmental and cultural awareness and respect.
- Provide positive experiences for both visitors and hosts.
- Provide direct financial benefits for conservation.
- Provide financial benefits and empowerment for local people.
- Raise sensitivity to host countries' political, environmental, and social climate.
- Support international human rights and labour agreements.

IMPORTANCE OF WILDLIFE ECOTOURISM

When the rules and ethics of wildlife ecotourism are applied, then the local community benefits financially so that the conservation efforts of its wildlife and environment are funded for future protection. The principle export for 83% of developing countries is the tourism of its wildlife in their natural environment, which is the second most important source of income for the world's 40 poorest countries.

As stated our country with approximately ¼th area covered with protected areas means that it is high time to know the facts of ecotourism in such areas. At this time, there are no or insufficient regulations of ecotourism in protected areas exist in our country. This means that tourism business houses are using the term as a marketing tool only without fulfilling the basic principles. It has been noted in many areas that the visitors are impacting the ecological systems either by being ignorant about the systems or the tour providers are not orienting them about the actual facts. For example, in Annapurna Circuit, ecotourists or the tourists have worn down marked trails and created alternate routes, which resulted in soil erosion and plant damage. The wildlife tourism also results in scaring away animals, disrupting their feeding and nesting sites, or getting them used to the presence of people. Ecotourism in Nepal is still at a very nascent stage, but there are for sure conscious efforts to save

the fragile Himalayan ecosystem, culture and heritage of the indigenous Nepalese people and natural resources. The Department of National Parks and Wildlife Conservation of Nepal Government had implemented some conservation rules and regulations, which does not allow:

- Hunting and or damaging any animals.
- Building and or occupying any form of shelter or house.
- Occupying, clearing or cultivating land.
- Grazing and or watering any domestic animals.
- Damaging, cutting or removing any trees or other plants.
- Mining, quarrying or removing stone, minerals or earth.
- Carrying and or using any weapon, ammunition or poison.
- Carrying any domestic or other animal or trophy, except by a government official on duty or by a person travelling along an existing right of way.
- Blocking and or diverting any river, stream or other sources of water flowing into a national park or introducing any harmful or poisonous substance therein.
- Damaging and or removing any boundary marks, signposts or notices.

DIRECT NEGATIVE IMPACTS OF WILDLIFE ECOTOURISM

The effect that wildlife tourism will have on wildlife depends on the scale of tourist development and the behaviour and resilience of wildlife to the presence of humans. When tourists activities occur during sensitive times of the life cycle (for example, during nesting season), and when they involve close approaches to wildlife for the purpose of identification or photography, the potential for disturbance is high.

1) Disturbing breeding patterns: The pressures of tourists searching out wildlife to photograph or hunt can adversely affect hunting and feeding patterns, and the breeding success of some species.
2) Disturbing feeding patterns: Feeding of wildlife by tourists can have severe consequences for social behaviour patterns. Artificial feeding by tourists caused a breakdown of the territorial breeding system
3) Disruption of parent-offspring bonds: Wildlife tourism can also cause disruption to intra-specific relationships

4) Increased vulnerability to predators and competitors: The viewing of certain species by wildlife tourists can make that species more vulnerable to predators. Evidence of this phenomenon has been recorded in birds, reptiles and mammals.

DIRECT POSITIVE IMPACTS OF WILDLIFE ECOTOURISM

Although there are negative impacts in wildlife tourism, but there are several positive impacts also.

1) Habitat restoration by eco–lodges and other tourism operations: Many owners of eco–accommodation or wildlife attractions preserve and restore native habitats on their properties and possibly in other areas also.
2) Breeding conservation: Many parks like Chitwan National Park has established centres for breeding and restocking of endangered species like Gharial (*Gavialis gangeticus*) and Asian elephants (*Elephas maximus*) at Kasara and Khorsor respectively.
3) Financial donations: Many wildlife ecotourism contributes monetary donations to conservation efforts once they visit and know about the area very well.
4) Quality interpretation: A good and trained wildlife guide will impart a deeper understanding of the wildlife and its ecological needs, which will give visitors a more information on which to subsequently modify their behaviour and decide what code of ethics to support and follow.
5) Research and monitoring: Some wildlife ecotourism operations contribute to monitoring of wildlife numbers or general research relevant to conservation from time to time so that necessary measures are taken into account.
6) Anti–poaching: Bringing tourists regularly into some areas are likely make it more difficult for poachers of large animals or those who collect smaller species for the black market help in the anti–poaching activity.

This list of both negative and positive impacts could be highly extended with specific and clear concept wildlife ecotourism studies are carried out in protected areas of Nepal.

CONCLUSION

Finally, the government, tourism establishments and research and teaching organizations like universities should come forward to take actions in formulating

such studies so that a better and robust wildlife ecotourism can be devised for the long term conservation planning of our country.

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