

# Research Report



## Avifaunal Survey and Vegetation Analysis at Ghodaghodi Lake of Nepal

Focus on Threatened and Near-Threatened  
Species

*Gandhiv Kafle*



Oriental Bird Club (OBC), United Kingdom  
2005

The designation of geographical entities in this report, and the presentation of the material, do not imply the expression of any opinion whatsoever on the part of Oriental Bird Club (OBC) UK and Bird Conservation Nepal (BCN) Kathmandu, Nepal concerning the legal status of any territory or area or of its authorities or concerning the delimitation of its frontiers or boundaries.

The views expressed in this publication do not necessarily reflect those of OBC and BCN.

This report has been made possible by funding from the Oriental Bird Club (OBC), United Kingdom.

The materials from this report may be reproduced in whole, in part in any form for educational or non-profit purposes without special permission from the copy right holder, provided acknowledgement of the source made. Author would appreciate receiving a copy of any publication, which uses this publication as a source.

**Recommended Citation:** Kafle, G. 2005. Avifaunal Survey and Vegetation Analysis Focusing on Threatened and Near-Threatened Species on Ghodaghodi Lake of Nepal. A Report Submitted to Oriental Bird Club (OBC), United Kingdom.

**Cover photo:** Lesser Whistling Duck by Sumit 2005.

**Design and layout:** G. Kafle

**For copies of the report, write to:** [Gandhiv@msn.com](mailto:Gandhiv@msn.com)

## EXECUTIVE SUMMARY

Avifaunal survey and vegetation analysis was carried out in Jan.-Feb. 2005 and Sep.-Oct 2005 focusing on threatened and near-threatened species in Ghodaghodi Lake of Nepal. Ghodaghodi Lake (150 ha) is one of the 14 lakes of Ghodaghodi Lake Complex (2563 ha) – a Ramsar Site of Nepal. The main objective of the research was to count the population of six threatened and near-threatened bird species found in the lake area in two seasons – summer and winter. Direct field observation, key informants' survey, literature review and photography were the major tools used for data collection. Of the 193 wetland-dependent birds found in Nepal, Ghodaghodi Lake is inhabited by 60 (38 percent). Six species are of threatened and endangered status including two critical, three near-threatened and one vulnerable species. Oriental Darter was the most numerous near-threatened species and Indian Spotted Eagle was the least. Numbers of all species were higher in the winter. A total of 35 species of plants (trees, shrubs and herbs) were recorded at terrestrial forest. Sal (*Shorea robusta*) and Asna or Saj (*Terminalia alata*) were the dominant species all over the terrestrial forest around the lake. A total of 22 species of aquatic vegetation (submerged, floating and emergent) were identified from different wetland habitat types of Ghodaghodi Lake Area. Adjacent wet grassland formed a rich habitat comprising sedges (*Cyperus distans*, *C. esculentus*, *C. imbricatus*), Reed (*Phragmites karka*), and grasses *Alpinia nigra*, *Chrysopogon aciculatus*, *Cynodon dactylon*, *Imperata cylindrica*, and herbs such as *Desmodium triflorum*, *Dichanthium annulatum*, *Digitaria sp.*, *Centella asiatica*. The main threats to birds and wetland ecosystem were human disturbance, high grazing pressure, poaching, hunting and illegal forest products extraction, encroachment, eutrophication, siltation, much dependency of local people on forest and wetland resources, poisoning, reduced inflows into the lake, lack of waste disposal schemes, and pollution, invasive species, introduction of new alien species and drainage of water for irrigation and dredging. Conservation education programme on wetland conservation for birds among indigenous Tharu community and school children are highly recommended. Besides this, avifaunal survey on remaining 13 lakes and terrestrial forest land is highly recommended to have actual estimation of population of threatened and near-threatened bird species representative of whole Ghodaghodi Lake Complex (2563 ha).

## ACKNOWLEDGMENTS

I am grateful to the District Forest Office of Kailali District and Ghodaghodi Area Conservation and Awareness Forum (GACAF) for providing permits for this project, and just as importantly, their warm hospitality. This project was supported by the Oriental Bird Club (Small Grants Programme), United Kingdom. I thank Carol Inskipp and Dr. Hem Sagar Baral for their enduring patience with and support for this project. My especial thank goes to David Buckingham, OBC Conservation Officer for Nepal, for providing me the constructive comments at the report preparation stage. His comments greatly help me in enhancing the quality of report. For their skilled field guidance and wonderful company, I thank my field assistants Sujas Prasad Phuyal and Umesh Chaudhary. I want to acknowledge Jay P. Sah and Joel T. Heinen for providing advice and literatures during the report writing stage. I thank Ms. Sunita Chaudhary and Mr. Gopal Ghimire for helping me with Nepal Wetland Policy (2003) English version and Nepali version respectively. My special thanks go to Carol Inskipp for her untiring advice, direction, encouragement and literatures from the very beginning of the project. I also acknowledge the support of the Institute of Forestry, Pokhara, Bird Conservation Nepal (BCN), Pokhara Branch and Shelf Help Environment Awareness Camp (SHEAC) c/o Institute of Forestry, Pokhara who generously provide me the space for office work, library facility and volunteer contribution to the project. I am grateful to BCN staffs – Mr. Dev Ghimire and Ms. Ishana Thapa – for their help in administrative process of transfer the research grant.

I am grateful to the following officials of Institute of Forestry, Pokhara, who have provided assistance directly and/or indirectly to the project since its inception: Chiranjibi Prasad Upadhyaya, Reader and Campus Chief; Prof. Mohan K. Balla, Department of Watershed Management and Environmental Science; Raj Kumar Koirala, Head of Department of Parks, Recreation and Wildlife Management; Dr. Bimal Keshari Paudyal, Head of Department of Forest Management and Social Forestry, Faculty members Ram Prasad Sharma and Shree Prasad Dhoubhadel. I am very much grateful to my colleagues Narayan Prasad Gautam, Dharendra Kumar Pradhan, Laxman Prasad Paudel, Paras Vikram Singh, Suman Sharma, Suman Bhattarai, Som Bahadur G. C., Achyut Kafle, Anjana Shrestha, Sujas Prasad Phuyal, Bhupendra Yadav, Kedar Baral, Nagendra Prasad Regmi and Rabin Kadariya for their kind help and encouragement at different stages of the project.

I express my sincere thanks to Bharat G. C., Chairperson of Ghodaghodi Area Conservation and Awareness Forum (GACAF), and Gyan Chandra Upadhyaya (Pujari of Temple at Ghodaghodi Lake) for providing social and religious information at the lake area. Bipatram Chaudhary – watcher or guard of the lake area – is highly acknowledged for his untiring help in boating, transect walk, language translation, field guidance and key information provision. I heartily acknowledge the Publication Units of Ramsar, Iran and IUCN, Switzerland for providing the key literatures on wetland conservation for the project.

Last but never least, the heartily encouragement from family members is the backbone to continue every endeavours for ever. I am very much grateful to them.

**Gandhiv Kafle**

## ACRONYMS

BCN = Bird Conservation Nepal

BPP = Biodiversity Profile Project

CBD = Convention on Biological Diversity

CITES = Convention on International Trade in Endangered Species of Fauna and Flora

DFO = District Forest Office

DIO = District Irrigation Office

DOAD = Department of Agriculture Development

DOF = Department of Forest

FWDR = Far Western Development Region

GACAF = Ghodaghodi Area Conservation and Awareness Forum

HMGN = His Majesty's Government of Nepal

IBA = Important Bird Area

IUCN = International Union for Conservation of Nature and Natural Resources

MEA = Multilateral Environment Agreement

MFSC = Ministry of Forest and Soil Conservation

NBS = Nepal Biodiversity Strategy

NTFP = Non-Timber Forest Product

OBC = Oriental Bird Club

RSPB = The Royal Society for the Protection of Birds

VDC = Village Development Committee

WLWG = Wetland and Livelihood Working Group of Wetlands International

## GLOSSARY

**Avifauna:** It denotes birds.

**Biological diversity or biodiversity:** is the total variety of life on Earth. It encompasses the total number, variety, and variability of life forms, levels, and combinations existing within the living world. As such, biodiversity means the richness and variety of living beings from all sources including, *inter alia*, terrestrial, marine and freshwater ecosystems, and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems. Ecosystem diversity comprises the variety of habitats, the dynamic complexes of plant, animal and micro-organism communities and their non-living environment, which interact as a functional unit, and their change over time. Ecologists have identified 118 ecosystems in Nepal representing distinct biological communities with their associated flora and fauna.

**Fauna:** It is a collective term to denote all types of animals.

**Flora:** It is a collective term to denote all types of vegetation.

**Habitat:** Habitat means the place or type of site where an organism or population naturally occurs.

**Important Bird Areas (IBAs):** IBAs are places of international significance for the conservation of birds at the global level. They are identified using standardised, internationally agreed criteria. Sites must, wherever possible, be amenable to being conserved and to being delimited from surrounding areas, and be large enough to support viable populations of the species for which they are important.

**Protected Area:** Protected area means a geographically defined area that is regulated and managed to achieve specific conservation objectives.

**Species Diversity:** It refers to the frequency and variety of species (wild or domesticated) within a geographical area. The total number of species in the world has been estimated to range from 5 to 30 million, out of which approximately 1.7 million have been described (WCMC 1992). There are different ways to describe species diversity. One often used to measure species diversity is *species richness*, which gives the total number of species within a particular sample area or geographical area. *Species evenness*, also known as *taxonomic diversity*, is expressed as the relationship of the number of species in different taxa, and indicates the relative abundance of taxa. For example, an island with two bird species and one lizard species has greater taxonomic diversity than an island with three bird species but no lizards (Raven 1992). *Species dominance* refers to the most abundant species (Botkin & Keller 1995).

**Waterfowls:** Waterfowls refers to birds dependent on water and/or wetland for survival, growth and development

**Wetland:** Nepal's National Wetland Policy (2003) defines wetlands as "natural or artificially created areas, such as swamp, marsh, riverine floodplain, lake, water storage area and agricultural land containing water from underground water resource or atmospheric precipitation that may be permanent or temporary, static or flowing and freshwater or saline".

# TABLE OF CONTENTS

EXECUTIVE SUMMARY .....	III
ACKNOWLEDGMENTS .....	IV
ACRONYMS .....	V
GLOSSARY .....	VI
CHAPTER 1: INTRODUCTION.....	1
CHAPTER 2: LITERATURE REVIEW .....	2
2.1 BIODIVERSITY IN WETLANDS OF TERAI REGION OF NEPAL.....	2
2.1.1 Wetland-Dependent Birds .....	2
2.1.2 Wetland Flora .....	2
2.2 BRIEF DESCRIPTION OF THREATENED AND NEAR-THREATENED BIRD SPECIES ON GHODAGHODI LAKE .....	2
a) White-rumped Vulture <i>Gyps bengalensis</i> .....	2
b) Slender-billed Vulture <i>Gyps tenuirostris</i> .....	2
c) Lesser Adjutant <i>Leptoptilos javanicus</i> .....	3
d) Indian Spotted Eagle <i>Aquila hastate</i> .....	3
e) Oriental Darter <i>Anhinga melanogaster</i> .....	3
2.3 RAMSAR SITES OF NEPAL .....	4
2.4 IMPORTANT BIRD AREAS (IBAs) IN NEPAL .....	4
2.5 POLICY, LEGAL AND INSTITUTIONAL CONTEXT OF WETLAND MANAGEMENT IN NEPAL.....	4
2.6 LEGAL PROTECTION FOR WETLAND SPECIES.....	6
2.7 THREATS TO WETLAND BIRDS.....	6
CHAPTER 3: OBJECTIVES, RESEARCH QUESTIONS AND LIMITATIONS.....	7
3.1 Specific Objectives .....	7
3.2 Research Questions .....	7
3.3 Limitations of the study.....	7
CHAPTER 4: STUDY AREA .....	8
4.1 DESCRIPTION OF STUDY AREA .....	8
4.1.1 Kailali District: The Project District .....	8
4.1.2 Ghodaghodi Lake: The Project Site .....	8
4.1.2.1 Location and Habitat Description .....	8
4.1.2.2 Faunal Diversity .....	9
4.1.2.3 Floral Diversity .....	9
4.1.2.4 Socioeconomic Context .....	10
CHAPTER 5: METHODS .....	11
5.1 DATA COLLECTION .....	11
5.1.1 Direct field observation.....	11
5.1.1.1 Waterfowl Survey: Vantage Points Identification and Methods.....	11
5.1.1.2 Population Count: Season, Frequency and Methods.....	11
5.1.1.3 Threat Identification .....	12
5.1.1.4 Vegetation Survey .....	12
5.1.2 Key Informants Survey .....	12
5.1.3 Literature Review .....	12
5.1.4 Photography .....	12
5.2 INFORMATION AND DATA ANALYSIS.....	12
CHAPTER 6: RESULTS .....	13
6.1 WATERFOWL DIVERSITY .....	13
6.2 POPULATION OF THREATENED AND NEAR-THREATENED WATERFOWLS .....	13
6.3 VEGETATION DIVERSITY .....	14
6.3.1 Terrestrial Forest Vegetation .....	14
6.3.2 Aquatic Vegetation .....	14
6.3.3 Grassland Vegetation .....	14
6.4 MAJOR THREATS TO BIRDS.....	15
6.5 ROOT CAUSES OF DEGRADATION AND LOSS OF GHODAGHODI LAKE .....	16
6.6 GOOD PRACTICES .....	16
6.7 PHOTOGRAPHY .....	17
CHAPTER 7: DISCUSSION AND CONCLUSION.....	18
CHAPTER 8: RECOMENDATIONS AND PRACTICAL IMPLICATIONS .....	19
REFERENCES .....	20
ANNEXES.....	21
Annex 1: Checklist of Waterfowls Found on Ghodaghodi Lake of Nepal .....	21
Annex 2: Population Count (Winter) .....	22
Annex 3: Population Count (Summer) .....	22
Annex 4: Terrestrial Forest Vegetation Species around Ghodaghodi Lake .....	22
Annex 5: Aquatic Vegetation Species on Ghodaghodi Lake .....	23
Annex 6: Important Bird Areas (IBAs) in Nepal .....	234
Annex 7: Photo Essay .....	225
INDEX .....	36

CHAPTER 1

INTRODUCTION

Nepal's National Wetland Policy (2003) defines wetlands as "natural or artificially created areas, such as swamp, marsh, riverine floodplain, lake, water storage area and agricultural land containing water from underground water resource or atmospheric precipitation that may be permanent or temporary, static or flowing and freshwater or saline".

The Department of Agriculture Development (DOAD) 1992 has roughly estimated that wetlands occupy 743,500 ha or roughly five percent of Nepal's land area (Table 1). Lakes in Nepal are estimated to hold 3 percent of all available water in Nepal (Sharma 1997). However, the IUCN Nepal (1998) inventory of 19 Terai districts alone estimated that wetlands cover some 724,257 ha in these districts alone. Neither DOAD estimate nor the IUCN Terai wetland assessment takes into account all the diverse wetland types that occur in Nepal. The total extent and diversity of wetlands in Nepal is still unknown (IUCN Nepal 2004).

Table 1: Total Wetland Areas in Nepal

Wetland Type	Estimated Area (Ha)	Percent
Rivers	3, 95,000	53.0
Lakes	5,000	0.7
Reservoirs	1,380	0.2
Village ponds	5,183	0.7
Paddy fields	3, 25,000	43.6
Marshland	12,000	1.6
Total	7, 43,563	100.0

Source: DOAD, 1992, Fisheries Development Division

Nepal's Terai has several lakes and ponds. The IUCN (1998) inventory lists 46 lakes with area over 8 ha in the Nepal's Terai. The largest of these include Ghodaghodi (138 ha), Badhaiya (105 ha), Beeshazar (100 ha) and Nacrodi (70 ha). His Majesty's Government of Nepal (HMGN) has undertaken rapid assessments of the status of wetlands in the Terai (lowlands). In total, 51 sites were explored and 36 deemed of significant biodiversity importance (BPP 1995a) (Table 2).

Table 2: Wetland Sites in the Terai that Merit Legal Protection

Site	District (VDC)	Size (Ha)	Reasons For Listing
Bishazar Lake	Chitwan (Gitanagar)	180	Large complex of oxbow lakes set in a very scenic environment. Of major importance as a particularly good representative of an oxbow ecosystem, supporting an appreciable assemblage of rare, vulnerable and endangered wildlife species.
Gaindahawa Lake	Rupandehi (Bisnupura)	11	Oxbow lake supporting small resident and wintering populations of several species of waterfowl.
Jagadishpur Reservoir	Kapilbastu (Niglihawa)	156	Large irrigation reservoir supporting > 4% of the Asian population of Ferruginous Duck ( <i>Aythya nyroca</i> ), (whose 1% criterion = 100) with 405 recorded. The same site almost reached the 1% criterion for the Lesser Whistling Duck ( <i>Dendrocygna javanica</i> ).
Badahiya	Bardia (Chailahi)	100	Large marshy natural depression supporting a large number of resident and wintering populations of several species of waterfowl.
Ghodaghodi Lake	Kailali (Darkh Nidi)	150	Large complex of oxbow lakes set in a very scenic environment, surrounded by dense Sal forest. Of major importance as a particularly good example of an oxbow ecosystem supporting an appreciable assemblage of rare, vulnerable and endangered wildlife species. Important site for transient migratory species moving between Dudwa National Park (India), Royal Suklaphanta Wildlife Reserve and Royal Bardia National Park. The resident population of <i>Nettapus coromandelianus</i> makes up nearly 1% of the total Asian population.
Nacrodi Lake	Kailali (Sandepani)	100	Large complex of oxbow lake surrounded by dense Sal forest. Of major importance as a good example of an oxbow ecosystem supporting an appreciable assemblage of rare, vulnerable and endangered wildlife species.
Rampur Lake	Kailali (Urma)	20	Medium-sized complex of oxbow lakes set in a very scenic environment, surrounded by dense Sal forest. Of major importance as a particularly good representative of an oxbow ecosystem supporting an appreciable assemblage of rare, vulnerable and endangered wildlife species.
Deukhuria	Kailali (Dhangadi Municipality)	22	Large lake set in a very scenic environment. Of major importance as a particularly good example of an oxbow ecosystem supporting an appreciable assemblage of rare ( <i>Sarkidiornis melanotos</i> ), vulnerable and endangered wildlife species.
Patriyani	Kanchanpur (Krishnapur)	35	Large oxbow lake of major importance as a particularly good representative of an oxbow ecosystem supporting an appreciable assemblage of rare, vulnerable and endangered wildlife species.
Betkot	Kanchanpur (Daiji)	4	Very scenic lake of special value for maintaining genetic and ecological diversity.

Source: BPP (1995a)



CHAPTER 2

LITERATURE REVIEW

2.1 Biodiversity in Wetlands of Terai Region of Nepal

Wetlands of Terai Region of Nepal inhabit wide range of flora and faunal species. A brief overview of biodiversity in wetlands of Terai Region of Nepal is presented below:

2.1.1 Wetland-Dependent Birds

Of the 862 (the latest is Greater White-Fronted Goose) bird species found in Nepal, 193 (22.5 percent) are known to be dependent on wetlands. The IUCN Red List of 2003 lists 12 globally threatened species that are wetland dependent, including the **critically endangered** Pink-Headed Duck (*Rhodonessa caryophyllacea*); **endangered** Greater Adjutant (*Leptoptilos dubius*) and Lesser Florican (*Sypheotides indica*); and **vulnerable** Baikal Teal (*Anas formosa*), Swamp Francolin (*Francolinus gularis*), Baer's Pochard (*Aythya baeri*), Grey Pelican (*Pelecanus philippensis*), Sarus Crane (*Grus antigone*), Indian Skimmer (*Rynchops albicollis*), Black-Necked Crane (*Grus nigricollis*), Lesser Adjutant (*Leptoptilos javanicus*) and Band-Tailed Fish Eagle (*Haliaeetus leucoryphus*).

2.1.2 Wetland Flora

Terai wetlands host considerable floral diversity. At least 318 wetland dependent plant species have been recorded here (IUCN Nepal 2004). 26 of the 246 angiosperm species are wetland dependent (Shrestha and Joshi 1996) occurring in lakes, marshes and river/stream banks. Of the 91 nationally threatened plants found in Nepal, ten are dependent on wetlands including the **endangered** *Aconitum balangrense*, *Crateva unilocularis*, *Operculina turpethum*; and **vulnerable** *Alstonia scholaris*, *Butea monosperma*, *Neopicrorhiza scrophulariifolia*, *Valerina jatamansii*, *Piper longum*, *Panax pseudo-ginseng*, *Dalbergia latifolia*. Four wetland macrophytes – *Spiranthes sinensis*, *Cyathea spinulosa*, *Sphagnum nepalensis* and *Pandanus nepalensis* – are also considered **nationally endangered** (Joshi and Joshi 1991).

2.2 Brief Description of Threatened Bird Species Found on Ghodaghodi Lake

a) White-rumped Vulture *Gyps bengalensis*

**2005 IUCN Red List Category** (as evaluated by BirdLife International - the official Red List Authority for birds for IUCN): **Critically Endangered**

**Justification** This species qualifies as Critically Endangered because it has suffered an extremely rapid population decline, particularly across the Indian subcontinent, probably as a result of feeding on carcasses of animals treated with the veterinary drug diclofenac, perhaps in combination with other causes.

**Family/Sub-family** ACCIPITRIDAE

**Identification** 75-85 cm. Medium-sized, dark vulture. Adult has blackish plumage, white neck-ruff, rump and underwing-coverts, silvery panel on upper surface of secondaries, dark head and neck, and rather short, heavy, mostly silver bill. Juvenile dark brown with prominent white shaft-streaks, especially below. White down on head and neck and usually a brownish nape- patch. Sub-adult drabber brown. **Similar spp.** Long-billed Vulture *G. indicus* has pale brown lesser and median coverts, dark brown remiges and pale brown, almost unstreaked, under parts. **Voice** Croaks, grunts, hisses and squeals at nest colonies, roosts and carcasses.

Global population estimate is 2,500-9,999 in decreasing trend.



b) Slender-billed Vulture *Gyps tenuirostris*

**2005 IUCN Red List Category** (as evaluated by BirdLife International - the official Red List Authority for birds for IUCN): **Critically Endangered**

**Justification** This recently recognised species is classified as Critically Endangered because it has suffered an extremely rapid population decline, particularly across the Indian subcontinent, probably as a result of feeding on carcasses of animals treated with the veterinary drug diclofenac, perhaps in combination with other causes.



**Family/Sub-family** ACCIPITRIDAE

**Taxonomic note** *Gyps indicus* (Sibley and Monroe, 1990, 1993) has been split into *G. indicus* and *G. tenuirostris* following Rasmussen and Parry (2001).

**Identification** 80-95 cm. Thin, rather attenuated vulture. Perched adults have dark bill with pale culmen; black cere; a near-total lack of feathering on the black head and neck. Cold brown overall colouration and scruffy, ill-kempt appearance. Juveniles are very similar but have black head and necks with a hint of white down on the nape and upper neck. Underparts are pale streaked. In flight the white downy thigh patches are distinctive. **Similar spp.** Jizz is remarkably different from other *Gyps* vultures due to slender snake-like neck, thin elongated bill, angular crown and scruff appearance. Eye ring is dark and does not contrast with facial skin. Head and neck skin is bare and thickly creased and wrinkled.

Global population estimate is 2,500-9,999 in decreasing trend.

**c) Lesser Adjutant *Leptoptilos javanicus***

**2005 IUCN Red List Category** (as evaluated by BirdLife International - the official Red List Authority for birds for IUCN): **Vulnerable**

**Justification** This stork qualifies as Vulnerable because it has a small, declining population as a result of habitat loss and degradation, hunting and disturbance.

**Family/Sub-family** CICONIIDAE

**Identification** 122-129 cm. Very large stork, dark grey-black above, white below, with naked head and neck. Non-breeders have mostly yellowish head and neck skin with vinous-tinged head sides and contrastingly pale forehead. Breeding males show coppery spots on median coverts, narrow whitish edges to lower scapulars, tertials and inner greater coverts and redder head sides. Juvenile is duller and less glossy above, with more down on head and neck. **Similar spp.** Greater Adjutant *L. dubius* has more massive bill, paler head sides, pendulous neck-pouch, pale grey greater coverts and tertials. Global population estimate is 5,000 in decreasing trend.



**d) Indian Spotted Eagle *Aquila hastata***

**2005 IUCN Red List Category** (as evaluated by BirdLife International - the official Red List Authority for birds for IUCN): **Vulnerable**

**Justification** This recently split and poorly known species is inferred to have a population below 10,000 individuals that is declining rapidly. It therefore qualifies as Vulnerable.

**Family/Sub-family** ACCIPITRIDAE

**Taxonomic note** *Aquila pomarina* (Sibley and Monroe 1990, 1993) has been split into *A. pomarina* and *A. hastata* following Parry *et al.* (2002).

**Identification** 65 cm. A stocky, medium-sized eagle with short, broad wings and a rather short tail. Adults are essentially brown and successfully identifying this species requires good views. The gape has 'lips' that are extensive and fleshy and extend to the middle of the eye. The nostril is round. The legs appear longer and thinner due to the tarsii being less thickly feathered. In adults the brown of the plumage is paler, and as a result there is a more obvious contrast between the paler wing-coverts and flight feathers, both above and below. The head is large in relation to body size. **Similar spp.** In flight it shows rounder wings and is lighter, slimmer and less bulky than the Greater Spotted Eagle *A. clanga*. It is however very similar to this species and not all individuals can be reliably identified. **Voice** High pitched cackling laugh.

Global population estimate is 2,500-9,999 in decreasing trend.

**e) Oriental Darter *Anhinga melanogaster***

**2005 IUCN Red List Category** (as evaluated by BirdLife International - the official Red List Authority for birds for IUCN): **Near Threatened**

**Family/Sub-family** ANHINGIDAE

**Summary** *Anhinga melanogaster* occurs in **Pakistan** (fairly widespread irregular year-round visitor to Sind and Punjab, locally resident), **India** (widespread resident, locally common in Assam, current status poorly known but apparently declining), **Nepal**



(uncommon resident and non-breeding visitor), **Sri Lanka** (common resident in dry lowlands, scarce visitor elsewhere), **Bangladesh** (local resident in northern and coastal regions), **Myanmar** (previously a widespread resident, now scarce to locally fairly common in south, status uncertain elsewhere), **Thailand** (formerly widespread, now very rare and possibly no longer breeds), **Laos** (previously widespread and numerous but numbers have plummeted with only a few sporadic recent records), **Vietnam** (previously widespread breeder, once locally common but now almost extinct), Cambodia (scarce visitor, probably still breeds), **Cambodia** (abundant in early 1960s with flocks reported to be totalling several thousand observed on the Mekong; currently a local resident in small numbers), Peninsular **Malaysia** (vagrant in west, possibly former resident), **Singapore**, **Brunei** (widespread), **Indonesia** (locally common breeder on Borneo, Java and Sulawesi, vagrant to other islands in the Lesser Sundas and Moluccas). The species is generally uncommon and declining throughout Asia, although an estimate of 4,000 for South Asia is probably too low. It inhabits shallow inland wetlands including lakes, rivers, swamps and reservoirs, as well as estuaries, tidal inlets, mangroves and coastal lagoons, ascending to 1,400 m, at least in India and Java. In common with many other Asian waterbirds, it is primarily threatened by habitat loss, disturbance (at feeding grounds and colonies), hunting and pollution.

*Source:* BirdLife International (2005)

### 2.3 Ramsar Sites of Nepal

Four wetlands of Nepal have been included in Ramsar list of wetlands of international significance covering 23,488 hectares. They are Koshi Tappu Ramsar Site (17,500 hectares, 26°39'N 086°59'E), Beeshazar and Associated Lakes (3,200 hectares, 27°37'N 084°26'E), Ghodaghodi Lake Area (2,563 ha, 28°41'N 080°57'E) and Jagadishpur Reservoir (225 ha, 27°35'N 083°05'E) (Ramsar 2004) (Fig. 1)

### 2.4 Important Bird Areas (IBAs) in Nepal

The IBA programme in Nepal was coordinated by Bird Conservation Nepal (BCN), the BirdLife International Affiliate for the Kingdom of Nepal with support from the Royal Society for the Protection of Birds (RSPB), UK. A report entitled 'Important Bird Areas (IBAs) in Nepal' was published in 2001 which identifies 27 IBAs (Annex 2) and four potential IBAs in Nepal. Ghodaghodi Lake is one of the IBAs in Nepal. IBAs are places of international significance for the conservation of birds at the global level under certain internationally agreed criteria. Further details can be obtained from Baral and Inskipp (2001). The complete checklist of IBAs in Nepal is presented in annex 6.

### 2.5 Policy, Legal and Institutional Context of Wetland Management in Nepal

Nepal is signatory to several Multilateral Environment Agreements (MEAs) of which three can be considered the most important for wetland biodiversity conservation – Convention on Wetlands (Ramsar 1971), Convention on Biodiversity Conservation (CBD 1992) and Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES 1973). The Nepal Biodiversity Strategy (NBS) 2002 lays down Nepal's strategy for biodiversity conservation and has clearly identified the need for conservation and sustainable use of wetlands and specifically the need for the following key actions:



Figure 1: Map Showing Ramsar Sites of Nepal

- Formulation of comprehensive national wetland policy and wetland legislation;
- Review of institutional arrangements to ensure clarity in tenure wise-use and conservation;
- Research on wetland resources to provide scientific data and information;
- Identification of critical wetland habitats and their protection and directory and database on wetlands;
- Promotion of collaborative management of wetland resources;
- Implementation of demonstration projects to apply and promote wise use of wetlands and their resources and
- Promotion of awareness and capacity programmes on the importance, use, function and management of wetlands and their resources.

Nepal became signatory to the Convention on Wetlands of International Importance especially as habitat of waterfowls (Ramsar 1971) in 1987. In order to meet its obligations under Article 3 of the Ramsar Convention, to develop a national wetland policy and under Recommendation 6.3 of the Conference of the Parties 1996, to manage wetlands in participation with local people and communities, Nepal Wetland Policy (2003) was recently formulated. The policy addresses the need for a coordinated approach to wetland management and includes the following objectives:

- To conserve, manage and promote wise use of national wetlands particularly through the collaboration of communities;
- To recognize the importance of the knowledge, innovations and practices of indigenous people and local communities in relation to wetlands and to promote the wider use of such for conservation and sustainable use of wetlands;
- To manage wetlands in an ecologically sustainable way;
- To achieve community participation in the management and decision-making processes of wetlands;
- To raise public awareness, especially of women, about the conservation values and benefits and wise-use of wetlands; and
- To ensure a sound scientific and technological basis for conservation, management and wise use.

The Water Resources Strategy (2002) outlined by the Government is aimed at setting guidelines for the sustainable use of water, while providing for hazard mitigation, environmental protection, economic growth and constructive methods of resolving water use conflicts. Section 6.3 focuses on the management of watersheds and aquatic ecosystems and is a landmark for Nepal in that it is the first legal or policy document related to water resources that acknowledges environmental conservation and ecosystem maintenance as a priority during water resource planning. The strategy emphasizes the need to strengthen institutional capacity for this purpose and includes the following activities:

- Enhance institutional capacity and coordination;
- Improve environmental database system;
- Map important, critical and priority watersheds and aquatic ecosystems;
- Implement watershed and aquatic ecosystem protection, rehabilitation and management programmes;
- Develop and implement Strategic Environmental Assessment in water resources management;
- Implement a water conservation education programme;
- Develop water and wastewater quality standards and regulations and
- Promote community participation.

Nepal has several legal and institutional arrangements relevant to wetland management. Several of them are related to overall biodiversity conservation and are thus also relevant to wetlands, whilst some are specific to wetland conservation. Nepal Wetland Policy (2003) mentions that though several legal instruments such as the Constitution of Nepal, Nepal Treaty Act, Local Self Governance Act, Forest Act, Water Resources Act, Electricity Act, National Parks and Wildlife Conservation Act, Aquatic Life Conservation Act, Soil and Watershed Management Act, Environment Protection Act and their related rules are relevant to wetlands, they do not define wetlands nor do they mention wetland management particularly community participation in protection, management or wise use, hence the need for a wetland policy. In terms of national policies that preceded the Nepal Wetland Policy (2003), only the Nepal Biodiversity Strategy (2002) had identified wetlands as a distinct ecosystem. Therefore, the use of the term 'wetland' and its definition is a recent event (IUCN Nepal 2004).



## 2.6 Legal Protection for Wetland Species

The main legal instruments that protect some of the wetland dependent species across the country inside and outside protected areas are the National Parks and Wildlife Conservation Act 1973 (amended five times) for fauna, the Forest Act 1993 for flora and the Aquatic Life Protection Act 1961 for some specific aquatic species. Out of the nine nationally protected species of birds under the National Parks and Wildlife Conservation Act 1973, White Stork (*Ciconia ciconia*), Black Stork (*Ciconia nigra*) and Sarus Crane (*Grus antigone*) are wetland dependent birds.

Very few wetland plants species are legally protected in Nepal. Under the Forest Act 1993 (amended 2001), one wetland dependent species Jatamansi (*Valeriana jatamansi*) is banned for export and three timber trees – Khair (*Acacia catechu*), Simal (*Bombax ceiba*) and Bijaya Sal (*Dalbergia latifolia*) – banned for felling, transportation and export.

Of the 15 species of plants in Nepal that fall under the various CITES Annexes (HMG/N/MFSC 2002), only three ferns (*Cyatheaceae spp.*) are wetland dependent.

## 2.7 Threats to Wetland Birds

Nepal's wetlands face threats from drainage, diversion, abstraction, siltation, over-enrichment, pollution and poisons used to kill fish. Many observers have noted a decline in wetland birds, although data are currently lacking to illustrate trends on a national level. Figures available over a ten-year period from 1989 to 1999 for three wetlands in Royal Chitwan National Park reveal a decline in wetland dependent birds (Baral 1999).

No protection is afforded to the Ghodaghodi Lake Area, despite the surveys and conservation work done by Bird Conservation Nepal and IUCN-Nepal. The lake's close proximity to the East-West Highway becomes a major environmental problem to the lake and its wildlife unless carefully managed. The current situation and building of several temples and other structures also threaten the lake. Practical conservation programmes that benefit the community and help to maintain the biological diversity of the lake are necessary (Baral and Inskipp 2001). Details on threats of wetland can be obtained from IUCN Nepal (2004).

## CHAPTER 3

### OBJECTIVES, RESEARCH QUESTIONS AND LIMITATIONS

#### 3.1 Specific Objectives

The specific objectives of this study are as follows:

1. To estimate the population of threatened and near threatened species of birds at Ghodaghodi Lake
2. To analyze the vegetation at and around the Ghodaghodi Lake
3. To identify the threats to the birds at the lake area
4. To provide management recommendations for future course of actions

#### 3.2 Research Questions

This study attempts to answer the following research questions:

1. How many waterfowl species are present on Ghodaghodi Lake (150 ha), (i.e. species richness)?
2. What are the waterfowl species found in the Ghodaghodi Lake?
3. What is the population of threatened and near-threatened species of birds at Ghodaghodi Lake?
4. What are the aquatic and terrestrial vegetation found at the Ghodaghodi Lake?
5. What is the habitat condition in reference to vegetation of the lake?
6. What are the threats to the birds at the lake area?
7. What further steps can be undertaken to conserve the biodiversity of the Ghodaghodi Lake Area and enhance livelihood of the local indigenous community?

#### 3.3 Limitations of the Study

Some identified constraints limit the study to some extent as follows:

1. The increasing eutrophication made some portions of the lake inaccessible for boating for aquatic vegetation specimen collection.
2. Ghodaghodi Lake Complex (2563ha) is made of 14 small and large lakes with deciduous subtropical forests. This study was only focussed on Ghodaghodi Lake (138 ha) – one of the largest lake of the whole lake complex. So to obtain the avifaunal diversity representative of the whole lake complex, detail avifaunal survey will be needed in remaining 13 lakes as soon as possible.
3. The increasing conflict and insurgency at Far Western Development Region affected the schedule of study at the project area. That's why the study period was postponed for some months to neutralize the impacts of conflict.

## CHAPTER 4

### STUDY AREA

#### 4.1 Description of Study Area

The study was confined only at Ghodaghodi Lake – one of the 14 lakes of Ghodaghodi Lake Complex – which is 138 hectares large. The lake system is connected with extensive forests along the Siwalik (Churia) Hills to the north and falls between two of the Terai's Protected Areas—the Royal Bardia National park and the Royal Suklaphanta Wildlife Reserve—and functions as an important corridor for the movement of wildlife.

##### 4.1.1 Kailali District: The Project District

Ghodaghodi Lake is a natural lake that lies along the east west highway in Kailali district of Far-western Development Region (FWDR) of Nepal. Kailali is the second largest district of the FWDR with an area of 3235 sq. km. The district lies between 28°24'-29°18'N latitude and 80°30'-81°15'E longitude and is an extension of the Indo-Gangetic flat plain locally known as Terai and goes up to the Siwalik Mountain Range of the Western Nepal Himalaya. The upper part of the district mostly lies in the Bhabar Zone from 100 to 300 m characterized with gravel, boulders and deep water table. Kailali is rich in wetlands like Ghodaghodi Lake and a number of seasonal lakes with the high coverage of forest area (62 percent). The district has a tropical climate with tropical Sal (*Shorea robusta*) forest as dominant vegetation. The Karnali flows in the east making narrow valleys bordering between Kailali, Surkhet and Bardia districts. The district is a corridor for the Royal Shukla Phanta Wildlife Reserve and Royal Bardia National Park. A number of micro watersheds fall in Karnali. The rivers cause devastating floods each year during monsoon; rivers like Kandra cut hundreds of hectares of cultivated lands and destroy nearby settlements. Most of the population who have migrated from different parts of the country, as well as Tharu indigenous community occupies significant position among different caste classes.

##### 4.1.2 Ghodaghodi Lake: The Project Site

###### 4.1.2.1 Location and Habitat Description

The Ghodaghodi Lake complex is situated in Kailali district of FWDR at an altitude of 205 metres from the sea level. Its latitude and longitude are 28°41'03"N and 80°56'43"E respectively with an area of 2563 ha. It circumscribes three Village Development Committees (VDCs) of Kailali district namely Darakh, Sandepani and Ramshikharjhala VDCs (Fig. 2). Ghodaghodi Lake Complex has been included in Ramsar Site of International Importance under the Wetlands Convention in 13/08/2003. The basis for the listing was that the area includes examples of a specific type of wetlands that are rare and vulnerable in the western Terai bio-geographical region; supports an appreciable assemblage of rare, vulnerable, or endangered species; and, regularly supports 1 percent of the Asian population of the Asian Pygmy-goose (*Nettapus coromandelianus*). The area remains outside of the Protected Area system. The lake complex comprises 14 natural, permanent or seasonal lakes ranging from 2 to 138 ha. It was connected with the rest of the

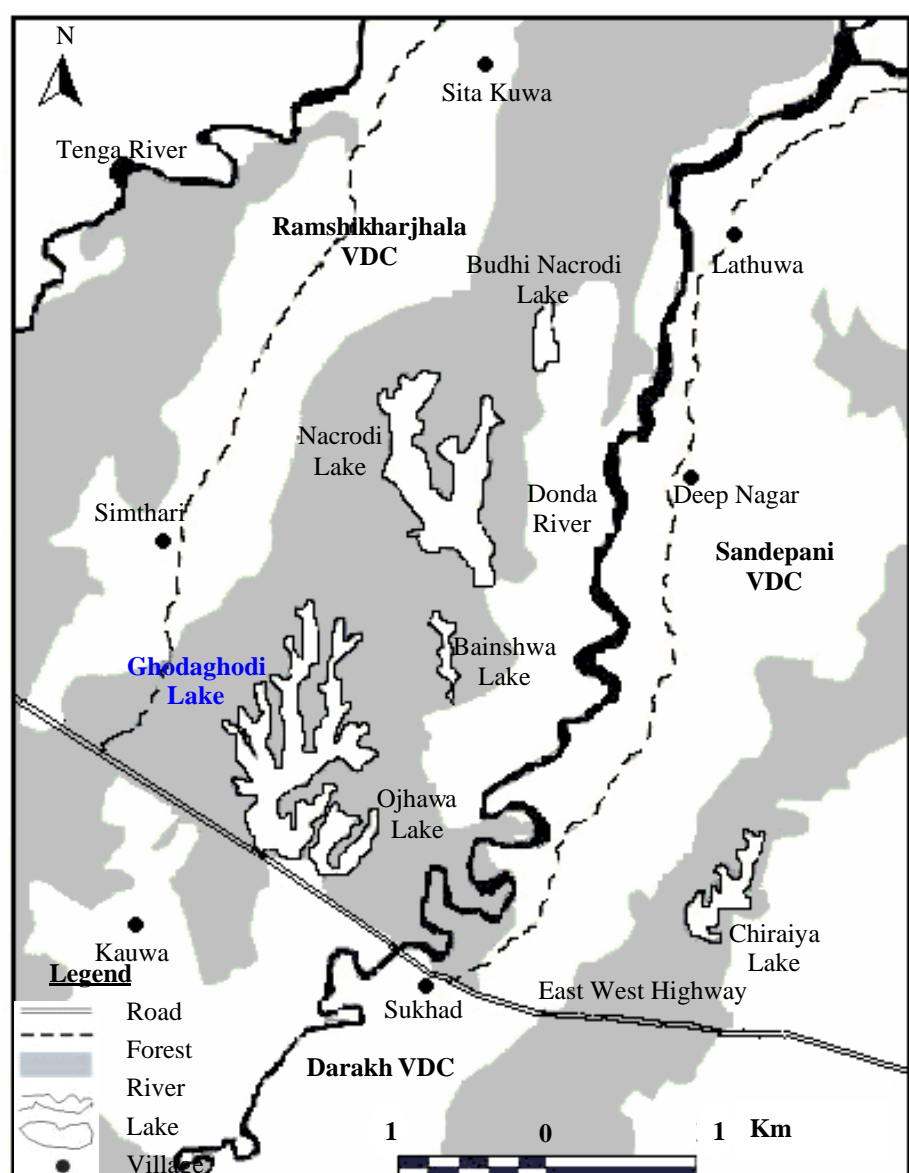


Figure 2: Map Showing Ghodaghodi Lake of Nepal

country by road only in 1993, when the bridge over the Karnali River was completed. Since then it has undergone much socio-economic change. The lake complex is characterised by three types of wetland habitats: 1. Riverine: a) Perennial rivers b) River flood plain; 2. Lacustrine (oxbow lakes and ponds); and 3. Palustrine (marshes and swamps). Marshy areas on the fringes of the lakes are subject to periodic inundation. Only Ghodaghodi Lake and Nacrodi Lake are perennial; the others are seasonal, and turn marshy for varying periods during the dry season. It has three types of forest habitat namely 1. Sal (*Shorea robusta*) forest, 2. Asna or Saj (*Terminalia alata*) forest and 3. Mixed deciduous riverine forest.

#### 4.1.2.2 Faunal Diversity

##### Birds

A total of 140 species of birds, representing over 16% of the nation's avifauna (Bhandari 1998a) has been recorded in the lake area, including the globally threatened Darter and Lesser adjutant (Baral 1992).

##### Mammals

A total of 34 species of mammals have been recorded in the lake area including endangered and threatened species. Globally endangered and threatened species (IUCN, 2002) include: Endangered: Tiger (*Panthera tigris*), Hispid Hare (*Caprolagus hispidus*) Vulnerable: Smooth-coated Otter (*Lutra perspicillata*), Common Otter (*Lutra lutra*), Dhole (*Cuon alpinus*), Swamp deer (*Cervus duvaucelli*), Clouded Leopard (*Neofelis nebulosa*), Sloth Bear (*Melampus ursinus*) Least Risk : Rhesus macaque (*Macaca mulatta*), Hanuman Langur (*Semnopithecus entellus*) Data Deficient: Bengal Fox (*Vulpes bengalensis*). Other significant species include Leopard (*Panthera pardus*), Jackal (*Canis aureus*), Wild Boar (*Sus scrofa*), Jungle Cat (*Felis chaus*), Fishing Cat (*Prionailurus viverrinus*), Mongoose (*Herpestes edwardii*); Spotted Deer (*Axis axis*), Hog Deer (*Axis porcinus*), Barking Deer (*Muntiacus muntjak*) (IUCN 1998).

##### Reptiles

A total of 10 species of reptiles have been recorded in the lake area including endangered and threatened species. Globally-threatened species (IUCN, 2002) includes Critically endangered: Red-crowned Roofed Turtle (*Kachuga kachuga*) Endangered: Three-striped Roof Turtle (*Kachuga dhongka*); Vulnerable: Marsh Crocodile (*Crocodylus palustris*) Least Risk: Asiatic Rock Python (*Python molurus*). Three other species are listed in CITES Appendix I: Indian Roofed Turtle (*Kachuga tecta*), Golden Monitor Lizard (*Varanus Flavescens*), Indian Python (*Python molurus*) (IUCN 1998).

##### Fish, Amphibians and Invertebrates

A total of 27 fish species have been recorded in the lake area including nationally threatened and endangered species. The status of globally threatened species is still unknown. National Red Data Book for Nepal (1995) lists Endangered: *Tor tor*; Vulnerable: *Tor putitora*, *Acrossochilus hexagonolepis*. No surveys of amphibians have been carried out yet. In case of invertebrates, no survey has been carried out yet except for butterflies – 32 species identified (IUCN 1998).

#### 4.1.2.3 Floral Diversity

It comprises a series of inter-related, but not surface-connected, lakes surrounded by subtropical deciduous forest largely of Sal (*Shorea robusta*), Asna or Saj (*Terminalia alata*) and mixed riverine forests in which Jamun (*Syzygium cumini*) and Pani Bet or rattan (*Calamus tenuis*) are dominant. The lake ecosystem and its adjoining river system provide important habitats for the globally-threatened Marsh Crocodile (*Crocodylus palustris*) and Smooth-coated Otter (*Lutra perspicillata*) as well as various turtles. The aquatic vegetation of the lake includes varieties of Water-Lily (*Nymphaea spp.*), Lotus (*Nelumbo spp.*), Singada (*Trapa quadrispinosa*), *Pistia spp.* etc. (Baral 1992). Adjacent wet grassland forms a rich habitat comprising sedges (*Cyperus distans*, *C. esculentus*, *C. imbricatus*), Reed (*Phragmites karka*), and grasses *Alpinia nigra*, *Chrysopogon aciculatus*, *Cynodon dactylon*, *Imperata cylindrica*, and herbs such as *Desmodium triflorum*, *Dichanthium annulatum*, *Digitaria sp.*, *Centella asiatica*. Permanent freshwater swamp forest: is dominated by the Willow (*Salix tetrasperma*) and Jamun (*Syzygium cumini* and *S. jambos*) these occur in particular around Nacrodi Lake and other lakeshores. This habitat forms one of the most important breeding sites for the globally near-threatened Grey headed Fishing Eagle (*Ichthyophaga ichthyaetus*) and the nationally-threatened Comb Duck (*Sarkidiornis melanotus*) (IUCN 1998).



#### 4.1.2.4 Socio-economic Context

The Ghodaghodi Lake Area lies in Darakh Village Development Committee (VDC) ward no. 5 in Kailali District of Seti Zone of Nepal. The whole area falls within the administrative boundary of far western development region. In the east and north Sadepani VDC, in the west Ram Shikar Jhala VDC and in the south Mahendra Highway borders the area (Baral 1992).

The total population of the Project district is estimated to be 6, 16,697 settled in 94,430 households (2001 Census). The district supports 28.1 percent of the total population of the FWDR and 2.7 percent of the national population. Population density of the area is 191 persons/km<sup>2</sup>, which is slightly higher than the national (157 persons/km<sup>2</sup>) and regional average (112 persons/km<sup>2</sup>), but lower than the average for the Terai as a whole (330 persons/km<sup>2</sup>). The population growth rate of Kailali district during the 1991-2001 census is estimated at 4.8 percent per annum, over twice that of the national average of 2.24 percent and much higher than the Terai average of 3.0 percent. Average family size is 6.53, also above the national (5.44) and regional averages (5.96).

The major inhabitants of this place are the Tharus, one of the most underprivileged tribes in the lowland Nepal; the rest are migrants from the mountains. Acharya and Sah (2002) found that the total population of three Village Development Committees (VDCs) surrounding the area comprises of 24,286 individuals from 3,442 households. Some 51% speak Tharu (an indigenous ethnic group) language. Population composition shows that 51.3% are Tharu, 47% are hill migrants and 1% is other caste groups of the Terai plain. Most Tharu families are dependent on extraction from wetlands; all groups use forests for fuel wood but mountain migrants/settlers use forests for fodder more than did Tharus (Sah and Heinen 2001). About 88% of the population is dependent on agriculture, forestry and fishing, with others involved in community services, government services and business (Acharya and Sah 2002). However, the indigenous Tharus are mostly involved in fishing and agriculture. Those households that cannot produce enough food for annual subsistence are involved in wage earning (mostly agricultural or forestry), sharecropping, fishing, and collection and sale of Non-Timber Forest Products (NTFPs). The people of wetland-dependent communities are struggling for basic survival. Women in the Project area are mainly involved in domestic work and agricultural activities, but are also engaged in collecting fuel wood, fodder and other forest resources. Tharu women, who are shy and avoid outsiders, are involved in collecting snails, fish and other wetland resources.

In the catchment area of Ghodaghodi Lake, more than 400 ha of forest have been converted into agricultural land since 1978, due to the increasing number of migrants from the hills (IUCN 1998). The latest DFO study (DFO Kailali 2002) notes that about 90 households have settled within the Ghodaghodi area and encroached about 131 ha of land.

## CHAPTER 5

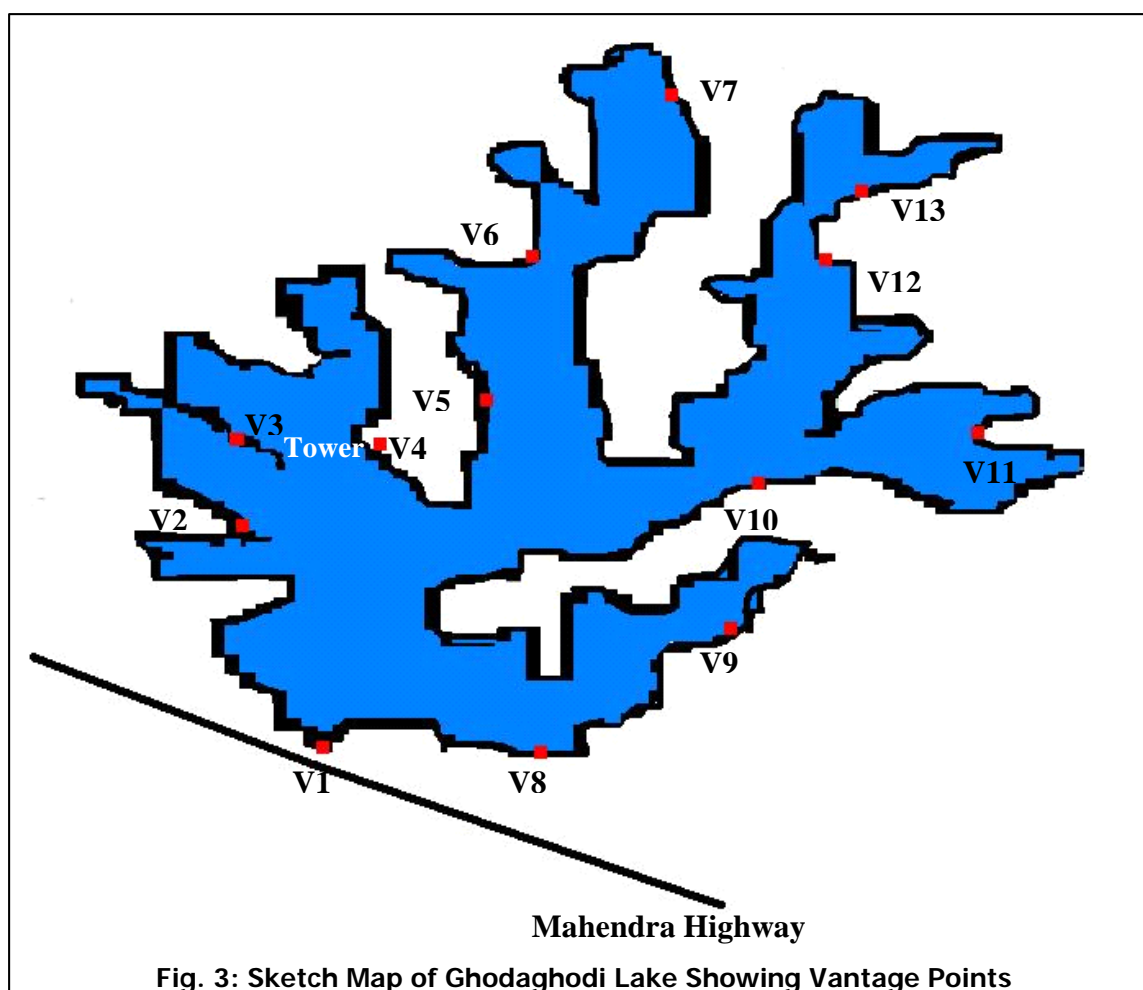
### METHODS

#### 5.1 Data Collection

Both primary and secondary data of qualitative as well as quantitative nature were collected from different sources. The following tools were used for data collection.

##### 5.1.1 Direct Field Observation

##### 5.1.1.1 Waterfowl Survey: Vantage Points Identification and Methods



Waterfowl survey was conducted in January 2005 to identify the water bird species present on the lake area and make a checklist. Survey was carried out in the morning and evening for the best chance of seeing all species inhabiting the wetland. Site locations were identified by cycling and walking around the perimeter of the wetland and vantage points (fallen log, stump, open water, large uniform areas of vegetation) were identified that covered large sections of the wetland and where birds were disturbed the least and where the chances of visibility or sighting is higher than other

locations around the lake. Altogether 13 vantage points were identified which is shown in the figure 3. Vantage point 4 (V4) is the two-storied watching tower.

Each of the designated survey sites was approached quietly to limit bird disturbance. The water birds that can be identified were recorded in a data record form. It took 15 days to complete the bird survey through these vantage points. Finally, a checklist of waterfowls on the Ghodaghodi Lake was prepared with the help of field guide book 'Birds of Nepal' published by Helm Publishers, which is presented in annex 1.

##### 5.1.1.2 Population Count: Season, Frequency and Methods

The checklist was analyzed and a list of threatened and near-threatened species (based on BirdLife's International Criteria) was again extracted from it. A total of six species were identified as threatened including two critical, one vulnerable and three near-threatened species.

Population count was carried out in two seasons – winter (January – February) and summer (September-October). In winter, checklist was prepared as mentioned above in section 5.1.1.1 and population count was started. But in the summer, previous checklist was used as reference and the team direct start the population count of these species.

The population count was conducted from the vantage points which were already identified in section 5.1.1.1. For the vultures, oriental darter and eagle, the roosting sites were identified and counting was started. For the duck and stork, the count was done on the water body and shallow deposits in the lake covered with short grasses.

Two repetitive counts were conducted in each season. The data were recorded in a data record sheet. If the birds were accidentally flushed, a note was made of the direction they flew and tried not to count them at the next location. If birds fly into the area when we were surveying they were included in the count. It took altogether 45 days to complete the counts of six species of birds in the lake area.

#### **5.1.1.3 Threat Identification**

The day to day activities of the local people (women, indigenous Tharus, religious persons, children, herders, etc.) were observed and recorded. Each activity was related to its impact on the waterfowls and wetland ecosystem condition. The details of the identified threats are presented in 6.4 section of this report.

#### **5.1.1.4 Vegetation Survey**

Specimens of wetland vegetation were collected from edge and middle of the lake through transect walk and boating respectively. Help of different experts was taken to identify the collected specimens. Attempts were made to verify the already existing list of vegetation both terrestrial and aquatic prepared by IUCN (1998). The details of the description are presented in section 6.3 of this report.

#### **5.1.2 Key Informants Survey**

Key informants such as religious gurus, local stakeholder representatives and elder persons were interviewed informally to find out the strategic information which can hardly be obtained from hard effort technically.

#### **5.1.3 Literature Review**

The previous research reports, project documents, articles (hard copy and digital version from internet), management plan, local journals and personal communication records were extensively reviewed to enhance the knowledge on wetland and biodiversity conservation. The main documents reviewed were as follows: IUCN 1998, Ramsar 2004, Baral 1992, IUCN 2004, HMG/N/MFSC 2002, Baral and Inskipp 2001 and Bhandari 1998. These reviews prevented the duplication and recollection of already verified data and to some extent promoted the means of verification of data collected during this study.

#### **5.1.4 Photography**

Photographs of the lake were taken at different conditions such as dead trees for roosting by birds, siltation, forest condition, fishing by Tharus, lotus seed collection, grazing, drainage of lake water, swimming, religious activities, succession, native wild rice etc. The detail of location of photographs is shown in the sketch map below. The photographs have been arranged in another file with brief description.

These photographs are expected valuable records of the state of the habitat when I visited. These can be compared with how the habitat develops in the future. This technique - known as photo-monitoring - is a very good way of identifying changes that may go un-noticed at the time.

### **5.2 Information and Data Analysis**

The qualitative data were analyzed and described in text. The quantitative data were analyzed and interpreted in text, tables and charts. Simple statistical tools such as tallying, tabulation, addition and bar diagrams were used for quantitative data analysis.

CHAPTER 6

RESULTS

6.1 Waterfowl Diversity

A total of 60 species of waterfowls was recorded from Ghodaghodi Lake (138 ha). Among them, six species were of threatened and endangered status including two critical, three near-threatened and one vulnerable species. These species include: **Critical:** White-rumped vulture (*Gyps bengalensis*), Slender-billed vulture (*Gyps tenuirostris*); **Vulnerable:** Lesser Adjutant Stork (*Leptoptilos javanicus*) and **Near-threatened:** Ferruginous Duck (*Aythya nyroca*), Oriental Darter (*Anhinga melanogaster*) and Indian Spotted Eagle (*Aquila hastate*). The most common waterfowl in summer season was Common Moorhen.

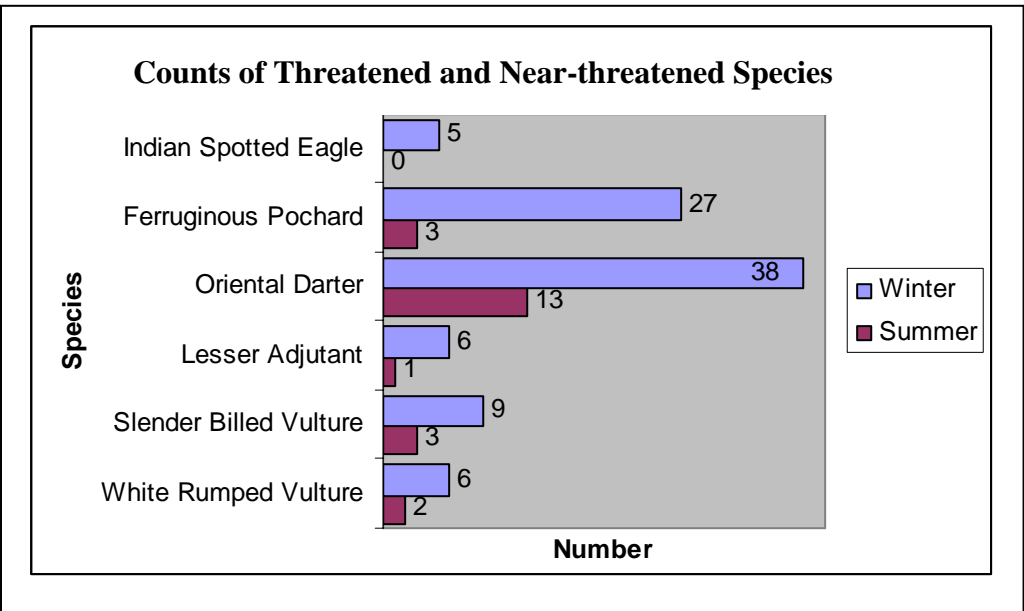
6.2 Population of Threatened and Near-Threatened Waterfowls

The counts of threatened and near-threatened waterfowls varied in two seasons (winter and summer). Detail is presented in the following table.

Table 3: Counts of Threatened and Near-Threatened Waterfowls on Ghodaghodi Lake

S. N.	Common Name	Scientific Name	Status	Counts	
				Winter	Summer
a)	White-rumped vulture	<i>Gyps bengalensis</i>	CR	6	2
b)	Slender-billed Vulture	<i>G. tenuirostris</i>	CR	9	3
c)	Lesser Adjutant Stork	<i>Leptotilos javanicus</i>	VU	6	1
d)	Ferruginous Duck	<i>Aythya nyroca</i>	NT	27	3
e)	Oriental Darter	<i>Anhinga melanogaster</i>	NT	38	13
f)	Indian Spotted Eagle	<i>Aquila hastate</i>	NT	5	0

Note: CR=Critical, VU = Vulnerable, NT = Near-threatened, Summer = September, Winter = January



The comparison of population of these bird species is presented in the following chart:

Figure 1: Comparison of Counts of threatened and near-threatened bird species on Ghodaghodi Lake in winter and summer season

This study was solely concentrated on Ghodaghodi Lake (150 hectares). So the above population figures apply to this lake only – not to the remaining 13 associated lakes and adjacent forest. The complete checklist of waterfowls observed on the Ghodaghodi Lake is presented in annex 1.

Roosting Sites

The dead and drying trees of Sal (*Shorea robusta*), Asna (*Terminalia tomentosa*) and Simal (*Bombax ceiba*) around the edge of lake provide good roosting sites to vultures, eagles and darters. The small islands in the lake made through eutrophication, sitation and succession provides the roosting and nesting places for most of the waterfowls. The roosting sites are shown in the photographs in annex 7.

### 6.3 Vegetation Diversity

The vegetation on and around the Ghodaghodi Lake was of three types: 1. Terrestrial forest vegetation, 2. Aquatic vegetation and 3. Grassland vegetation.

#### 6.3.1 Terrestrial Forest Vegetation

A total of 35 species of plants (trees, shrubs and herbs) were identified from terrestrial forest of Ghodaghodi Lake Area.

The terrestrial forest is dominated by Sal (*Shorea robusta*) and Asna or Saj (*Terminalia alata*) which is present around the Ghodaghodi Lake. Asna or Saj Forest is dominant along the lakes' eastern shores with Sindure being the second dominant species and other main species as in Sal forest. Other major tree species are as follows:

Amala (*Phyllanthus emblica*),

Kyamun (*Cleistocalyx operculata*),

Bel (*Aegle marmelos*),

Kusum (*Schleichera oleosa*), and

Karma (*Adina cordifolia*).

The forest was dense with secondary layer of vegetation. The main tree species in the secondary layer were Bhalayo (*Semecarpus anacardium*), Bhogate (*Maesa macrophylla*), and Sindure (*Mallotus philippensis*). Dhanyero (*Woodfordia fruticosa*) – a shrub inhabited the forests of northern shores of the lake. Trees of *Eugenia kurzii* and *Syzigium cumini* were common along the lakeshores and in depressions while the secondary layer was composed of a number of trees including Bayer (*Ziziphus mauritiana*), Bhogate, Dhanyero, Piyar (*Buchanania latifolia*) and Kalikath (*Aporosa octandra*). Riverine Forest was relatively open, dominated by Khair (*Acacia catechu*) and Simal (*Bambax ceiba*) with a secondary layer of Bhogate, Kalikath, and Murraya (*Murraya koenigii*). Sissoo (*Dalbergia sissoo*), a common and important component of Terai riverine forests, was rare here. The rare spiny shrubs of *Gardenia turgida* and *G. campanulata*, were also recorded in the forests of shores of the lake.

A systematic list of the identified terrestrial plant species are presented in annex 4.

#### 6.3.2 Aquatic Vegetation

A total of 22 species of aquatic vegetation (submerged, floating and emergent) was identified from different wetland habitat types of Ghodaghodi Lake Area.

Ghodaghodi Lake, Nacrodi Lake, Bainshawa Lake and Ojhuwa Lake were permanent with water all over the year. Lotus (*Nelumbo nucifera*), Water Primrose (*Ludwigia adscendens*) water lilies (*Nymphaea nouchali*, *Nymphoides hydrophyllum* and *N. indicum*) and pondweed (*Potamogeton natans*) were the dominant anchored leaf-floating species at Ghodaghodi Lake. Hydrilla (*Hydrilla verticillata*), Starworts (*Chara* spp.), Hornwort (*Ceratophyllum demersum*) and pondweeds (*Potamogeton* spp.) were dominant submerged species. *Azolla imbricata*, *Lemna minor* and *Wolffia globosa* were free-floating species.

Permanent marshes were only observed around the fringes and edges of the rivers Tengwa, Kauwa, Kandra, Donda, and Suktikanda. The remaining were seasonal marshes fed by the monsoon rains dominated by emergent species dominated by *Cyperus esculentus*, *Polygonum hydropiper*, *Limnophila indica*, *Monochoria vaginalis*, and *P. glabrum*, *Paspalidium flavidum*, reed (*Phragmites karka*), Reed-mace (*Typha angustifolia*), sedges (*Cyperus difformis*, *C. diffuses*, *C. iria*), Buttercup (*Ranunculus sceleratus*), *Schoenoplectus articulatus* and *S. juncoides*, and *Acorus calamus*. The swamps and marshes are important for many water birds including the Lesser Adjutant Stork (*Leptoptilos javanicus*).

A systematic list of the identified aquatic plant species are presented in annex 5.

#### 6.3.3 Grassland Vegetation

Wet grasslands were observed around the lake area especially on southern and eastern shores of the lake. These grasslands comprised *Alpinia nigra*, *Chrysopogon aciculatus*, *Cynodon dactylon*, *Imperata cylindrica*, sedges (*Cyperus distans*, *C. esculentus*, *C. imbricatus*), reed (*Phragmites karka*), and herbs such as *Digitaria sp.* *Centella asiatica*,

*Desmodium triflorum* and *Dichanthium annulatum*. Livestock grazing was observed heaviest in the southern and eastern parts of Ghodaghodi Lake and the eastern part of Nacrodi Lake because of their proximity to villages and the abundance of *I. cylindrica*; in the less disturbed areas, *C. dactylon* and *C. asiatica* were dominant.

#### 6.4 Major Threats to Birds

Main threats to the wetland biodiversity in the Ghodaghodi Lake area are as follows:

- a) **Human disturbance:** The religious activities of people were observed on south-west shore of the lake. Temples and small houses were observed there. People used to throw the materials such as cut hair, plastic and fruits on the water. Local people informed us that different groups of people, even from the other districts, usually come there for picnic and recreation purpose. Swimming on south-west shore of the lake was commonly observed activity. Precisely indicating, heavy highway traffic, picnicking, swimming and increasing human activities around the lake have disturbed the habitats of birds and other wildlife.
- b) **High Grazing Pressure:** Grazing pressure was higher in the north and south-eastern parts of Ghodaghodi Lake and the eastern part of Nacrodi Lake. The proliferation of the unpalatable *Imperata cylindrica* over the native vegetation was observed. Rearing of improved varieties of livestock and stall-feeding practices were very limited. Over grazing and browsing of palatable species had created very sparse vegetation cover especially on southern part of the lake area impairing the regeneration capacity of vegetation. Local people and herdsmen informed us that they sometimes found the damaged nest of the ground-dwelling species due to disturbance by overgrazing.
- c) **Poaching, hunting and illegal forest produce extraction:** Wildfowl and bird trapping and egg collection had been reported in the area. Young persons used to kill the birds using the round stone hit by elastic rubber rope. Illegal tree felling and smuggling of Sal (*Shorea robusta*) and Khair (*Acacia catechu*) timber was prevalent according to key informants.
- d) **Encroachment:** Human encroachment along the lakes' shores and adjoining forests has been increased by continue inflow of migrants from the hill districts (Dadeldhura, Baitadi and Doti) since 1978. The migrants converted more than 500 ha parts of government managed forests and wetlands to agricultural lands.  
The encroachment problem was severe in the south-eastern part of Nacrodi Lake, the eastern part of Sunpokhari and Budhi Nacrodi, and the south-eastern and north-western part of Ghodaghodi Lake.
- e) **Eutrophication:** The Ghodaghodi Lake Complex was severely affected by natural eutrophication although agricultural runoff was also affecting Nacrodi Lake. Increasing human activities such as bathing, washing, disposals from religio-cultural practices and buffalo wallowing and grazing around the area, have accelerated the process of eutrophication.  
The vegetation died and contributed to the organic material on the lake bottom raising it and accelerating seral succession towards dry land. The excessive growth of aquatic macrophytes such as *Ceratophyllum demersum*, *Nelumbo nucifera*, *Naja minor*, *Hydrilla verticillata* on the water surface of Ghodaghodi Lake made it difficult to observe the bottom of the lake. A number of marshy floating islands dominated with fern (*Thelypteris interrupta*), sedge (*Cyperus* spp., *Schoenoplectus* sp.) and reed (*Phragmites karka*) were observed to be profusely growing in the Ghodaghodi Lake.
- f) **Siltation:** Heavy siltation with more decaying organic materials and some soil was observed in all parts of the lake nearer to the shores of the lake. However, the middle parts of the lake still consists crystal water. The representatives of a local NGO at Ghodaghodi Lake Area informed me that if the lake was cleaned by removing the deposits, the lake condition improves but the diversity of the birds would decline. If not, diversity of birds would increase at the cost of sedimentation in the lake.
- g) **Dependency on forest and wetland resources:** There is a high dependence on forest and wetland resources since roughly 88 percent of the population is engaged in agriculture and fishing. The local community extracts fish, snails, lotus leaves and rhizome, leaves of trees, wild fruits, green vegetables, grass, fodder, firewood and timber for use. Fishing was year-round practice of the indigenous Tharu people for subsistence living, not for selling. They were very poor and they had no alternative living options.

- h) **Poisoning:** Use of poisons e.g. pesticides (particularly Thiodine and Phoret), household bleach and other chemicals derived from local plants was widespread in the Ghodaghodi Lake Area to catch fish, either indiscriminately or introduced into bait.
- i) **Reduced inflows into the lakes:** Due to silting up of the existing but inadequate canal system there was a decrease in water flows into the lakes leading to stagnation and succession. The northern Betin Siwalik Watershed, where a number of water springs ooze out from the ground, was the major source of water for the Lake Complex. But due to rapid deforestation and encroachment in the area the water sources were gradually drying up.
- j) **Lack of waste disposal schemes and pollution:** Religio-cultural practices such as marriage ceremony, worshipping and local festivals generated more pollution by waste in Ghodaghodi Lake. It was highest during *Margha Panchmi*, a special occasion for worshipping the Ghodaghodi deity during which the indigenous Tharu community used to sacrifice pigs, goats, chickens, and pigeons. In addition, washing, bathing and buffalo wallowing also polluted the lake waters.
- k) **Invasive species:** *Ipomoea carnea* was the major invasive alien species in the area. The species was rapidly colonizing marshes/swamps, canals and ditches. Water Hyacinth (*Eichhornia crassipes*) had been spreading in small lakes and marshes.
- l) **Introduction of new alien species:** Department of Irrigation, Village Development Committee and District Development Committee encouraged exotic fish farming mostly carps in the Ghodaghodi Lake Area. This practice was believed to reduce the yield of native fish species.
- m) **Drainage of water for irrigation and dredging:** About 500 ha of rice fields were currently irrigated by water from the Ghodaghodi Lake. IUCN Nepal, with a local NGO called GACAF built two small dams and canals for irrigation in the south-west shores of the lake.

## 6.5 Root Causes of Degradation and Loss of Ghodaghodi Lake

The threats identified above have largely three root/underlying causes as follows (IUCN Nepal 2004):

- a) Poor integration of wetland biodiversity conservation into sectoral, legal and policy frameworks and poorly co-ordinated implementation of plans between sectors;
- b) Inadequate technical and institutional capacity, information base, and awareness for wetland biodiversity conservation planning and management decisions; and
- c) High local community dependence on wetland resources but low involvement in their management.

## 6.6 Good practices

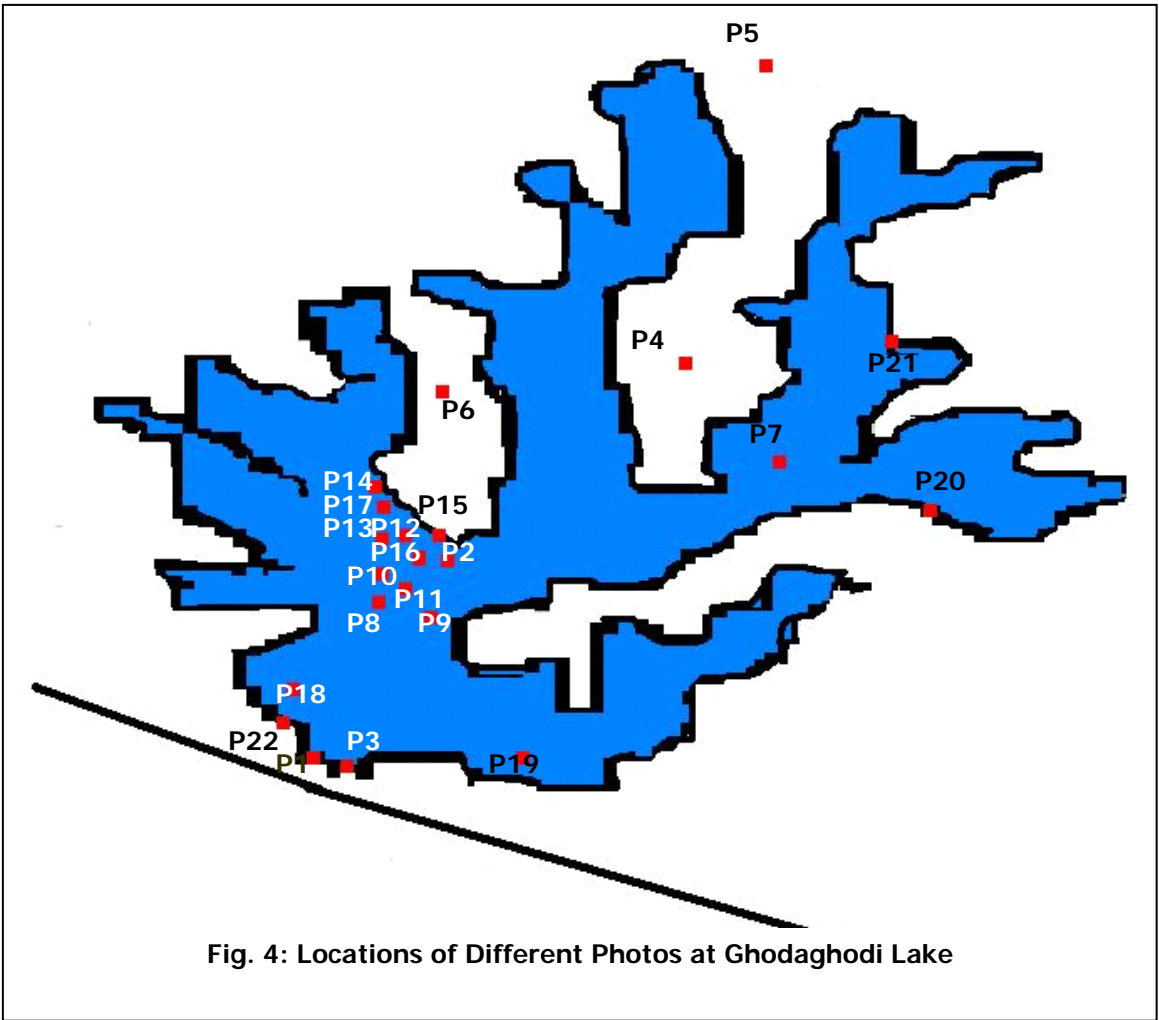
- a) The southern edge of the lake is managed by women users groups. The plantation of Sissoo (*Dalbergia sissoo*) is in good condition at sapling stage with grass coverage at ground level which is used for forage to livestock by users. The area seems a well-managed area with grass and saplings which serve dual purposes to local people. The first is forage production for livestock and the second is soil and water conservation. There is a nursery with the seedlings of Sissoo (*Dalbergia sissoo*), Khair (*Acacia catechu*) and some fodder trees but its condition is very poor now and needs support for its management.
- b) Ghodaghodi Area Conservation and Awareness Forum (GACAF) in coordination with District Forest Office (DFO) of Kailali and support from IUCN Nepal has facilitated the handing over of the adjacent forest to local community especially women only forest users groups. It has also facilitated the formation of eco-clubs at the schools around the Ghodaghodi Lake. A watch man or guard is recruited to look the activities on and around the lake area in favour of the lake conservation.
- c) The lake is very important for religious purpose also. Many visitors were observed coming at Ghodaghodi Temple Area for religious purpose such as marriage, worshipping, etc. A religious library has been established and a visitor centre, though unmanaged, is kept adjacent to the temples.
- d) Two cement concrete dams and irrigation canals have been built at the south-west edge of the lake for regulation of water drainage for irrigation. However, people construct the temporary water control structures using the wooden poles, brushwood and wire in other lakes for drainage. The water drained from the lake is used by the farmers on the farmland to irrigate the agricultural crops.

**Key sightings**

The most common activity observed in the field is the fishing by indigenous Tharu community, from children to adult, for subsistence living not for selling. They use different techniques for fish capture such as net, hook, traps and biological and chemical poison but the most common method is by using the net. The majority of the fish collectors are Tharu people because their poverty, high population and limited land drive them to do this for subsistence living. Their lives are indeed hard and risk-proned. Fishing from the lake area is prohibited. When we reach the site of fishing, they were afraid of us. They began to pack the trapping materials such as nets, hooks etc. hurriedly to escape from there covering the mouth with clothes when we attempted to take some photographs. They feel that they will be punished from the exact identification of their face. But our local guide – one of the Tharu People- assured them about our intention of taking photographs on their native Tharu language. Tharu women use the lake area for lotus seed collection for subsistence living. They use to uproot the lotus from the lake area and extract the seeds from within the flower. They informed that lotus seeds are highly nutritious and tasty.

**6.7 Photography**

Photographs representing different condition of the lake area were taken. The detail of locations of photographs taken (P1, P2...) is presented in figure 4. The photographs according to caption in this figure are presented in annex 5.





## CHAPTER 7

### DISCUSSION AND CONCLUSION

Sixty species of water birds have been recorded in Ghodaghodi Lake (150 ha). Of the 193 wetland-dependent birds found in Nepal, Ghodaghodi Lake is inhabited by 60 (38 percent) of these species. Among sixty species of water birds, six species are of threatened and endangered status including two critical, three near-threatened and one vulnerable species. These species include: Critical: White-rumped vulture (*Gyps bengalensis*), Slender-billed vulture (*Gyps tenuirostris*); Vulnerable: Lesser Adjutant Stork (*Leptoptilos javanicus*) and Near-threatened: Ferruginous Duck (*Aythya nyroca*), Oriental Darter (*Anhinga melanogaster*) and Grey-headed Fishing Eagle (*Ichthyophaga ichthyaetus*).

Baral (1992) listed 140 species of birds at Ghodaghodi and Nachrodi Lakes together. That list included water birds as well as terrestrial birds. This study identifies 60 species of water birds inhabiting the Ghodaghodi Lake (150 ha). The count of water birds had never been conducted at Ghodaghodi Lake. The total counts of the threatened and near-threatened bird species have been carried out through this study. The population of white rumped vulture, slender billed vulture, lesser adjutant stork, ferruginous duck and Indian spotted eagle is 6, 9, 6, 27, 38 and 5 respectively in winter and 2, 3, 1, 3, 13 and 0 respectively in summer. Oriental Darter is the most abundant bird species among threatened species in Ghodaghodi Lake.

The terrestrial forest is dominated by Sal (*Shorea robusta*) and Asna or Saj (*Terminalia alata*) which is present around the north and west of the Ghodaghodi and Nacrodi Lakes. A total of 35 species of plants (trees, shrubs and herbs) have been recorded at terrestrial forest of Ghodaghodi Lake Area. A total of 22 species of aquatic vegetation (submerged, floating and emergent) have been identified from different wetland habitat types of Ghodaghodi Lake Area. Adjacent wet grassland forms a rich habitat comprising sedges (*Cyperus distans*, *C. esculentus*, *C. imbricatus*), Reed (*Phragmites karka*), and grasses *Alpinia nigra*, *Chrysopogon aciculatus*, *Cynodon dactylon*, *Imperata cylindrica*, and herbs such as *Desmodium triflorum*, *Dichanthium annulatum*, *Digitaria sp.*, *Centella asiatica*.

The main threats to birds and wetland ecosystem are human disturbance, high grazing pressure, poaching, hunting and illegal forest products extraction, encroachment, eutrophication, siltation, much dependency of local people on forest and wetland resources, poisoning, reduced inflows into the lake, lack of waste disposal schemes, and pollution, invasive species, introduction of new alien species and drainage of water for irrigation and dredging. The latest DFO study (DFO 2002) notes that about 90 households have settled within the Ghodaghodi area and encroached about 131 ha of land. Extensive proliferation of macrophytes causes a shift in the balance of bird species, favouring egrets, storks and jacanas at the expense of those migratory waterfowl that require some open water for feeding. IUCN Nepal (2004) indicated that fishing practice by pumping was prevalent in Ghodaghodi Lake but this practice was not found at Ghodaghodi Lake Area from the present study. It was the effect of the management efforts put forth by the Ghodaghodi Area Conservation and Awareness Forum (GACAF) with support from IUCN Nepal in forming the forest user groups and setting certain rules for extraction of products from the area. Recently the District Irrigation Office (DIO), Kailali completed the pre-feasibility study for using Ghodaghodi Lake to provide irrigation facilities for up to 45 hectares of land. A more detailed study is planned. While the DIO is concerned mainly with the use of surplus or overflow/over-drained water from the lake basin, a full EIA is necessary to conserve and manage the lake basin for irrigation while maintaining aquatic biodiversity.

The root causes of degradation and loss of Ghodaghodi Lake Area are poor integration of wetland biodiversity conservation into sectoral, legal and policy frameworks and poorly co-ordinated implementation of plans between sectors; inadequate technical and institutional capacity, information base, and awareness for wetland biodiversity conservation planning and management decisions and high local community dependence on wetland resources but low involvement in their management.

## CHAPTER 8

### RECOMENDATIONS AND PRACTICAL IMPLICATIONS

Based on the results, the following recommendations have been made:

1. The anthropogenic factors are the root cause of the deterioration and degradation of the lake and its resources. So, conservation education programme on wetland conservation for birds among local community and school children are highly recommended. Education and awareness programs should focus on indigenous and lower caste mountain residents to increase participation in conservation and management activities and to improve attitudes.
2. This study estimates the population of threatened and near threatened species of birds on Ghodaghodi Lake (150 ha) – one of the 14 lakes of Ghodaghodi Lake Complex. So, avifaunal survey on remaining 13 lakes and terrestrial forest land is highly recommended to have actual estimation of population of threatened and near-threatened bird species representative of whole Ghodaghodi Lake Complex (2563 ha).
3. Tourism and localized fish farming should be promoted to increase off-farm income so that dependency on forest and wetland resources can be reduced. Establishment of resource centre is proposed to enhance the tourism.
4. The Tharu community members are mostly illiterate and they have not yet known importance of wetlands to biodiversity conservation. They have weak, undiversified and insecure local livelihoods, based mostly on direct exploitation of natural resources. They have little or no option in their patterns of exploitation. Their illiteracy becomes a major factor to fuel the activities that threaten the forest and wetland ecosystem. It is their local indigenous system of resource exploitation. So, effective conservation can be achieved only when conservation and development are integrated into a local indigenous system of resource management which is possible only if local norms and values are taken into consideration right from planning stage.

## REFERENCES

- Acharya, P. and Sah, J. P. 2002. Wetland Vegetation and Their Traditional Uses in Ghodaghodi Lake System of Far Western Nepal. Abstract presented in Society of Wetland Scientists (SWS), 23<sup>rd</sup> Annual Meeting, June 2-7, 2002, Lake Placid, New York.
- Baral, H. and Inskipp, T. 2001. Important Bird Areas in Nepal. A Report Submitted to the Royal Society for the Protection of Birds (RSPB), UK.
- Baral, H. S. 1992. Ghodaghodi Lake System: A National Treasure. Nepal Bird Watching Club, Kathmandu, Nepal.
- Bhandari, B. (Ed.). 1998. An Inventory of Nepal's Terai Wetlands. IUCN- The World Conservation Union, Nepal. Kathmandu.
- Bhandari, B. 1998a. Wise Use of Wetland Resources: Lessons Drawn from Selected Wetland Sites of Nepal's Terai Region. Case study No: 13. In *Community Participation in Wetland Management: Lessons from the Field*. On-line Publication. [http://www.wetlands.org/pubs&/proc\\_pub.html#download](http://www.wetlands.org/pubs&/proc_pub.html#download) on 01/15/2004
- BirdLife International 2005. Species Factsheet: *Anhinga melanogaster*. Downloaded from <http://www.birdlife.org> on 8/10/2005
- BirdLife International 2005. Species Factsheet: *Aquila hastata*. Downloaded from <http://www.birdlife.org> on 8/10/2005
- BirdLife International 2005. Species Factsheet: *Gyps bengalensis*. Downloaded from <http://www.birdlife.org> on 8/10/2005
- BirdLife International 2005. Species Factsheet: *Gyps tenuirostris*. Downloaded from <http://www.birdlife.org> on 8/10/2005
- BirdLife International 2005. Species Factsheet: *Leptoptilos javanicus*. Downloaded from <http://www.birdlife.org> on 8/10/2005
- BirdLife International 2005. Species Factsheet: *Lesser adjutant*. Downloaded from <http://www.birdlife.org> on 8/10/2005
- Botkin, D. & Keller, E. 1995. Environmental Science: Earth as a Living Planet. John Wiley & Sons, Inc., New York.
- BPP 1995a. Enumeration of the Amphibians and Reptiles of Nepal. Biodiversity Profile Project Publication No. 2. Department of National Parks and Wildlife Conservation, Kathmandu , Nepal.
- DOAD 1992. National Fisheries Development Plan. 1992/93. Fisheries Development Division, Department of Agriculture Development HMGN, Kathmandu, Nepal.
- HMG/WECS 2002. Water Resources Strategy Nepal. Kathmandu, Nepal.
- HMGN/MFSC 2002. Nepal Biodiversity Strategy. His Majesty's Government of Nepal, Kathmandu.
- HMGN/MFSC 2003. Nepal Wetland Policy. Kathmandu, Nepal.
- Inskipp, C., Inskipp, T. and Grimmett, R. 2001. Birds of Nepal. Helm Field Guide, Prakash Books, New Delhi.
- IUCN 1998. The Ghodaghodi Tal Conservation Area: A Community Centered Management Plan. IUCN Nepal, Kathmandu.
- IUCN Nepal 2004. A Review of the Status and Threats to Wetlands in Nepal. IUCN Nepal, Kathmandu.
- Ramsar 2004. List of Wetlands of International Importance Designated by the Contracting Parties. Ramsar Iran.
- Raven, P. H. 1992. The Nature and Value of Biodiversity. In Courrier, K. (ed) *Global Biodiversity Strategy*, pp 1-5. WRI, USA; IUCN, Switzerland; UNEP, Kenya.
- Sah, J. P. and Heinen, J. T. 2001. Wetland Resource Use and Conservation Attitudes among Indigenous and Migrant Peoples in Ghodaghodi Lake Area, Nepal. *Environmental conservation* **28**(4): 345-356.
- Sharma, C. K. 1997. A Treatise on Water Resources in Nepal. Kathmandu.
- Swar, D. B. and Gurung, T. B. 1988. Introduction and Cage Culture of Exotic Carps and their Impact on Fish Harvested in Lake Begnas. *Hydrobiologia* 166:277- 283pp.
- WCMC. 1992. World Conservation Monitoring Centre: Global Biodiversity – Status of the Earth's Living Resources (ed: Groombridge, B.) Chapman and Hall, London.

ANNEXES

Annex 1: Checklist of Waterfowls found on Ghodaghodi Lake of Nepal

S. N.	Scientific Name	Common Name
1.	<i>Tachybaptus ruficollis</i>	Little grebe
2.	<i>Phalacrocorax niger</i>	Little cormorant
3.	<i>Anhinga melanogaster</i>	Oriental darter
4.	<i>Ardeola grayii</i>	Indian pond heron
5.	<i>Bubulcus ibis</i>	Cattle egret
6.	<i>Egretta garzetta</i>	Little egret
7.	<i>Egretta intermedia</i>	Intermediate egret
8.	<i>Egretta alba</i>	Great white egret
9.	<i>Ardea cinerea</i>	Grey heron
10.	<i>Ardea purpurea</i>	Purple heron
11.	<i>Ciconia episcopus</i>	Wolly necked stork
12.	<i>Leptoptilos javanicus</i>	Lesser adjutant
13.	<i>Pseudibis papillosa</i>	Red naped black ibis
14.	<i>Dendrocygna javanica</i>	Lesser whistling duck
15.	<i>Sarkidiornis melanotos</i>	Comb duck
16.	<i>Nettapus coromandelianus</i>	Cotton pigmy goose
17.	<i>Anas penelope</i>	Eurasian wigeon
18.	<i>Anas strepera</i>	Gadwall
19.	<i>Anas crecca</i>	Common teal
20.	<i>Anas platyrhynchos</i>	Mallard
21.	<i>Anas acuta</i>	Northern pintail
22.	<i>Anas querquedula</i>	Garganey
23.	<i>Anas clypeata</i>	Northern shoveler
24.	<i>Aythya ferina</i>	Common pochard
25.	<i>Aythya nyroca</i>	Ferruginous duck
26.	<i>Elanus caeruleus</i>	Black shouldered kite
27.	<i>Milvus migrans</i>	Pariah kite
28.	<i>Ichthyophaga ichthyaetus</i>	Grey headed fishing eagle
29.	<i>Neophron percnopterus</i>	Egyptian vulture
30.	<i>Gyps bengalensis</i>	Oriental white back vulture
31.	<i>Gyps indicus</i>	Long billed vulture
32.	<i>Gyps fulvus</i>	Eurasian griffon vulture
33.	<i>Spilornis cheela</i>	Crested serpent eagle
34.	<i>Circus aeruginosus</i>	Eurasian marsh harrier
35.	<i>Circus melanoleucus</i>	Pied harrier
36.	<i>Aquila pomarina</i>	Lesser spotted eagle
37.	<i>Spizaetus nipalensis</i>	Mountain hawk eagle
38.	<i>Falco tinnunculus</i>	Common kestrel
39.	<i>Porzana fusca</i>	Ruddy breasted crake
40.	<i>Amauromis akool</i>	Brown crake
41.	<i>Amauromis phoenicurus</i>	White breasted waterhen
42.	<i>Gallinula chloropus</i>	Common moorhen
43.	<i>Porphyrio porphyrio</i>	Purple gallinule
44.	<i>Fulica atra</i>	Common coot
45.	<i>Hydrophasianus chirurgus</i>	Pheasant tailed jacana
46.	<i>Metopidius indicus</i>	Bronze winged jacana
47.	<i>Rostratula benghalensis</i>	Painted snipe
48.	<i>Charadrius dubius</i>	Little ringed plover
49.	<i>Hoplopterus duvaucelli</i>	River plover
50.	<i>Hoplopterus malabaricus</i>	Yellow wattled plover
51.	<i>Hoplopterus cinereus</i>	Grey headed plover
52.	<i>Hoplopterus indicus</i>	Red wattled plover
53.	<i>Gallinago sternura</i>	Pintail snipe
54.	<i>Tringa nebularia</i>	Common greenshank
55.	<i>Tringa ochropus</i>	Green sandpiper
56.	<i>Actitis hypoleucos</i>	Common sandpiper
57.	<i>Sternura aurantia</i>	River ten
58.	<i>Halcyon smyrnensis</i>	White throated kingfisher
59.	<i>Pelargopsis capensis</i>	Stork billed kingfisher
60.	<i>Alcedo atthis</i>	Common kingfisher

Annex 2: Population Count (Winter)

S.N.	White-rumped vulture	Slender-billed vulture	Oriental darter	Lesser adjutant	Indian spotted eagle	Ferruginous duck
V1	×	1	3	1	1	2
V2	×	×	3	1	1	1
V3	×	2	5	×	×	×
V4	×	×	6	×	×	4
V5	×	×	4	×	1	3
V6	×	1	×	×	×	1
V7	×	×	×	2	1	2
V8	1	2	4	×	1	×
V9	3	2	3	1	×	5
V10	×	×	3	1	×	3
V11		×	2	×	×	1
V12	2	1	3	×	×	4
V13	×	×	2	×	×	1
Total	6	9	38	6	5	27

Note: The average values of counts of two repetitive surveys are presented in the table. V1, V2,... = Vantage Points

Annex 3: Population Count (Summer)

S.N.	White-rumped vulture	Slender-billed vulture	Oriental darter	Lesser adjutant	Indian spotted eagle	Ferruginous duck
V1	×	×	×	×	×	×
V2	×	×	×	×	×	1
V3	×	×	3	×	×	×
V4	×	×	1	×	×	×
V5	×	×	2	×	×	×
V6	×	1	×	×	×	×
V7	×	×	1	×	×	×
V8	×	2	2	×	×	×
V9	2	×	3	1	×	1
V10	×	×	×	×	×	×
V11	×	×	1	×	×	×
V12	×	×	×	×	×	1
V13	×	×	×	×	×	×
Total	2	3	13	1	0	3

Note: The average values of counts of two repetitive surveys are presented in the table. V1, V2,... = Vantage Points

Annex 4: Terrestrial Forest Vegetation Species around Ghodaghodi Lake

S. N.	Botanical Name	Common Name	Type
1.	<i>Acacia catechu</i>	Khair	Tree
2.	<i>Adina cordifolia</i>	Karma	Tree
3.	<i>Aegle marmelos</i>	Bel	Tree
4.	<i>Albizzia spp.</i>	Siris	Tree
5.	<i>Aporosa octandra</i>	Kalikath	Tree
6.	<i>Bombax ceiba</i>	Simal	Tree
7.	<i>Buchanania latifolia</i>	Piyar	Tree
8.	<i>Calamus tenuis</i>	Rattan	Herb
9.	<i>Cassia fistula</i>	Raj Briksha	Tree
10.	<i>Cassia tora</i>	Tapre	Herb
11.	<i>Cleistocalyx operculata</i>	Kyamun	Tree
12.	<i>Clerodendron viscosum</i>	Bhanti	Shrub
13.	<i>Dalbergia latifolia</i>	Bijaya Sal	Tree
14.	<i>Dalbergia sissoo</i>	Sissoo	Tree

15.	<i>Dillenia pentagyna</i>	Tantari	Tree
16.	<i>Dryopteris spp.</i>	Unyu	Herb
17.	<i>Eugenia kurzii</i>		Tree
18.	<i>Gardenia spp.</i>		Shrub
19.	<i>Ipomea carnea</i>	Besarma	Tree
20.	<i>Madhuca latifolia</i>	Mahuwa	Tree
21.	<i>Maesa macrophylla</i>	Bhogate	Tree
22.	<i>Mallotus philippensis</i>	Sindure	Tree
23.	<i>Michellia champaca</i>	Champ	Tree
24.	<i>Mimosa pudica</i>	Buhari Jhar	Herb
25.	<i>Murraya koenigii</i>	Mitho Neem	Tree
26.	<i>Phyllanthus emblica</i>	Amala	Tree
27.	<i>Salix tetrasperma</i>	Willow	Tree
28.	<i>Schleichera olelsa</i>	Kusum	Tree
29.	<i>Semecarpus anacardium</i>	Bhalayo	Tree
30.	<i>Shorea robusta</i>	Sal	Tree
31.	<i>Solanum indicum</i>	Kantakari	Herb
32.	<i>Syzygium cumini</i>	Jamun	Tree
33.	<i>Terminalia tomentosa</i>	Asna or Saj	Tree
34.	<i>Woodfordia fruticosa</i>	Dhanyero	Shrub
35.	<i>Ziziphus mauritiana</i>	Bayer	Shrub

**Annex 5: Aquatic vegetation Species on Ghodaghodi Lake**

S. N.	Local Name	Botanical Name
Submerged Species		
1.	Hydrilla	<i>Hydrilla verticillata</i>
2.	Starworts	<i>Chara spp.</i>
3.	Hornwort	<i>Ceratophyllum demersum</i>
4.	pondweeds	<i>Potamogeton spp.</i>
Floating Species		
5.		<i>Azolla imbricata</i>
6.	duckweeds	<i>Lemna minor</i>
7.		<i>Wolffia globosa</i>
8.	water lilies	<i>Nymphaea nouchali</i> , <i>N. hydrophyllum</i> and <i>N. indicum</i>
9.	Lotus	<i>Nelumbo nucifera</i>
Emergent Species		
10.		<i>Limnophila indica</i>
11.		<i>Monochoria vaginalis</i>
12.		<i>Cyperus esculentus</i>
13.		<i>Polygonium hydropiper</i>
14.		<i>P. glabrum</i>
15.		<i>Paspalidium flavidium</i>
16.	Reed-mace	<i>Typha angustifolia</i>
17.	Sedges	<i>Cyperus difformis</i> , <i>C. diffuses</i> , <i>C. iria</i>
18.	Buttercup	<i>Ranunculus sceleratus</i>
19.		<i>Schoenoplectus articulatus</i>
20.		<i>S. juncoides</i> ,
21.		<i>Acorus calamus</i>
22.		<i>Ipomoea fistulosa</i>

*Note: The source of these species is direct field observation and literature review.*



Annex 6: Important Bird Areas (IBAs) in Nepal

S. N.	International Name	IBA Code	Criteria
1.	Annapurna Conservation Area	NP012	A1, A2, A3
2.	Barandabhar forests and wetlands	NP015	A1, A3, A4i
3.	Dang Deukhuri foothill forests and west Rapti wetlands	NP008	A1, A3
4.	Dharan forests	NP023	A1, A2, A3, A4i
5.	Dhorpatan Hunting Reserve	NP007	A1, A2, A3
6.	Farmlands in Lumbini area	NP011	A1, A3, A4i
7.	Ghodaghodi Lake	NP002	A1, A3, A4i
8.	Jagdishpur Reservoir	NP009	A1
9.	Kanchenjunga Conservation Area	NP026	A1, A2, A3
10.	Khaptad National Park	NP004	A1, A2, A3
11.	Koshi Tappu Wildlife Reserve and Koshi Barrage	NP024	A1, A3, A4i, A4iii
12.	Langtang National Park	NP017	A1, A2, A3
13.	Mai Valley forests	NP027	A1, A2, A3
14.	Makalu Barun National Park	NP021	A1, A2, A3
15.	Nawalparasi forests	NP010	A1
16.	Parsa Wildlife Reserve	NP014	A1, A3
17.	Phulchowki Mountain forests	NP019	A2, A3
18.	Rampur valley	NP013	A1
19.	Rara National Park	NP005	A1, A2, A3
20.	Royal Bardia National Park	NP003	A1, A3, A4i
21.	Royal Chitwan National Park	NP016	A1, A3, A4i
22.	Royal Sukla Phanta Wildlife Reserve	NP001	A1, A3, A4i
23.	Sagarmatha National Park	NP020	A1, A3
24.	Shey-Phoksundo National Park	NP006	A1, A2, A3
25.	Shivapuri National Park	NP018	A2, A3
26.	Tamur valley	NP022	A2, A3
27.	Urlabari forest groves	NP025	A1



P11: Decayed organic matter in the lake

INDEX

- adjutant, 9, 18, 20
- agriculture, 10, 15
- alien, iii, 16, 18
- amphibians, 9
- Anhinga, 3, 13, 18, 20
- anthropogenic, 19
- aquatic, iii, 5, 6, 7, 9, 12, 14, 18
- Aquila, 3, 20
- avifauna, 9
- avifaunal, iii, 7, 19
- awareness, 5, 16, 18, 19
- biodiversity, 1, 4, 5, 12, 15, 16, 18, 19
- BirdLife, 2, 3, 4, 20
- birds, iii, vi, 2, 3, 4, 6, 7, 9, 11, 12, 15, 18, 19
- buffalo, 15, 16
- butterflies, 9
- children, iii, 19
- collaborative, 5
- communities, 5, 10
- conflict, 7
- conservation, iii, vi, 4, 5, 6, 12, 16, 18, 19, 20
- Conservation, ii, iii, iv, v, 4, 5, 6, 20, 24
- Convention, v, 8
- Darter, iii, 9, 13, 18
- demonstration, 5
- disturbance, iii, 4, 11, 15, 18
- drainage, iii, 6, 18
- dredging, iii, 16, 18
- duck, 11, 18
- eagle, 3, 11, 18
- ecosystem, iii, 1, 5, 9, 12, 18, 19
- education, iii, 5, 19
- Education, 19
- emergent, iii, 14, 18
- encroachment, iii, 15, 16, 18
- Environment, iv, v, 4, 5
- eutrophication, iii, 7, 13, 15, 18
- fauna, 4, 6
- fish, 6, 9, 10, 15, 16, 19
- fishing, 10, 15
- floating, iii, 14, 15, 18
- flora, 4, 6
- forest, iii, 1, 8, 9, 10, 13, 14, 15, 18, 19, 24
- forestry, 10
- freshwater, vi, 1, 9
- Ghodaghodi, ii, iii, iv, v, 1, 2, 4, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 18, 19, 20, 24
- Governance, 5
- Government, v, 1, 5, 20
- grasses, iii, 9, 11, 18
- grassland, iii, 9, 18
- grazing, iii, 15, 18
- Gyps, 2, 3, 13, 18, 20
- habitat, iii, 4, 9, 14, 18
- herbs, iii, 9, 14, 18
- hunting, iii, 4, 15, 18
- IBA, v, 4, 24
- indigenous, iii, 5, 8, 10, 12, 16, 19
- insurgency, 7
- invasive, iii, 16, 18
- invertebrates, 9
- irrigation, iii, 1, 16, 18
- Kailali, iv, 1, 8, 10, 18
- Lake, ii, iii, iv, 2, 4, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 18, 19, 20, 24
- lands, 8
- legislation, 5
- Leptoptilos, 2, 3, 13, 18, 20
- livestock, 15
- mammals, 9
- management, 5, 7, 12, 16, 18, 19
- marshes, 9, 14, 16
- migrants, 10, 15
- near-threatened, iii, 11, 13, 18, 19
- Nepal, ii, iii, iv, v, vi, 1, 2, 3, 4, 5, 6, 8, 9, 10, 16, 18, 20
- NTFPs, 10
- organic, 15
- Parks, iv, 5, 6, 20
- people, iii, 5, 10, 12, 18
- plan, 12
- poaching, iii, 18
- policy, 5, 16, 18
- Policy, iv, vi, 1, 4, 5, 20
- pollution, iii, 4, 6, 16, 18
- Population, 10, 11, 13
- projects, 5
- proliferation, 15, 18
- Ramsar, iv, 5, 8, 12
- reptiles, 9
- school, iii, 19
- sedges, iii, 9, 14, 18
- shallow, 4, 11
- Shorea, iii, 8, 9, 13, 14, 15, 18, 23
- shrubs, iii, 14, 18
- siltation, iii, 6, 18
- Soil, v
- species, iii, vi, 1, 2, 3, 4, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 18, 19, 23
- stakeholder, 12
- stork, 3, 11, 18
- Strategy, v, 4, 5, 20
- submerged, iii, 14, 18
- subtropical, 9
- succession, 13, 15, 16
- sustainable, 4, 5
- swamps, 4, 9, 14, 16
- Terai, 1, 2, 8, 20
- Terminalia, iii, 9, 13, 14, 18, 23
- terrestrial, iii, 12, 14, 18, 19
- Tharu, iii, 8, 10, 16, 19
- Tharus, 10, 12
- threatened, iii, 2, 4, 7, 9, 11, 13, 18, 19
- threats, iii, 6, 7, 12, 15, 16, 18
- trees, iii, 6, 13, 14, 15, 18
- tribes, 10
- vantage, 11
- vegetation, iii, 7, 8, 9, 11, 12, 14, 18
- vulture, 2, 3, 13, 18
- wallowing, 15, 16
- waste, iii, 16, 18
- water, iii, vi, 1, 5, 8, 11, 16, 18, 23
- Water, 5, 9, 14, 16, 20
- waterfowl, 1, 18
- Waterfowl, 11, 13
- waterfowls, 5, 11, 12, 13
- Watershed, iv, 5, 16
- wetland, iii, 1, 2, 4, 5, 6, 9, 10, 11, 12, 14, 15, 16, 18, 19
- wetlands, vi, 1, 2, 4, 5, 6, 8, 10, 19, 24
- Wildlife, iv, 1, 5, 6, 8, 20, 24