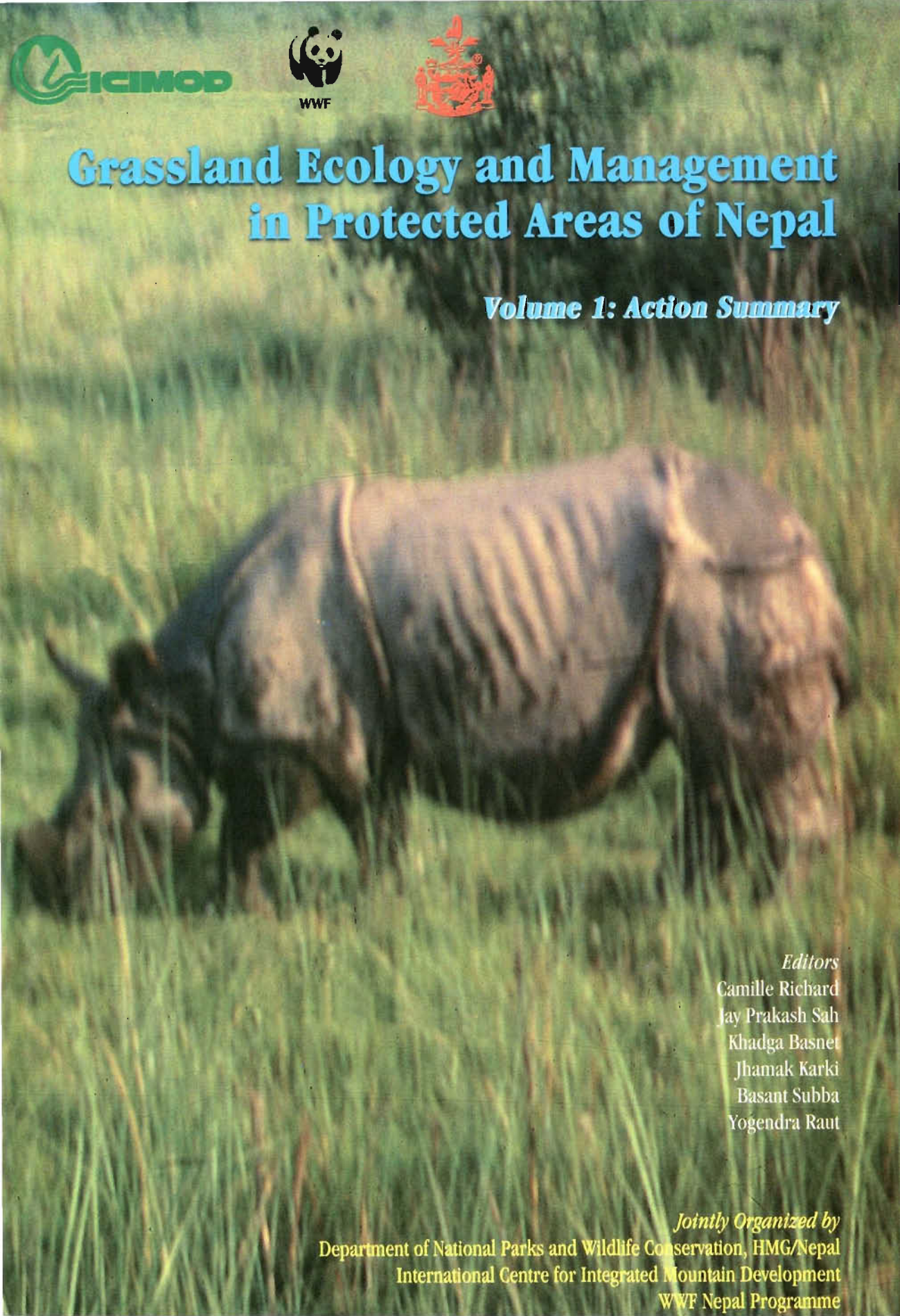

Grassland Ecology and Management in Protected Areas of Nepal

Volume 1: Action Summary

Editors

Camille Richard

Jay Prakash Sah

Khadga Basnet

Jhamak Karki

Basant Subba

Yogendra Raut

Jointly Organized by

Department of National Parks and Wildlife Conservation, HMG/Nepal

International Centre for Integrated Mountain Development

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Grassland Ecology and Management in Protected Areas of Nepal

Proceedings of a Workshop

Royal Bardia National Park
Thakurdwara, Bardia, Nepal
March 15-19, 1999

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Credits:
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Back cover - Blue Sheep in Shey Phoksundo National Park (*D. Miller*)
Elephant at Rest, Royal Chitwan National Park (*C. Richard*)

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Foreword

Globally, grasslands and rangelands occur in polar, temperate, sub-tropical, and tropical latitudes, from low to high elevations. In total, they cover 45 million square kilometres or one quarter of the earth's surface. In the Hindu Kush-Himalayan Tibet-Qinghai Plateau, rangelands and pastures cover some 60 per cent of the total area. They vary from sub-tropical savannas to alpine meadows in the eastern, central, and western Himalayas and steppe formations on the Plateau. As such, they contain a wide diversity of grasses and other plant species on which a number of endangered wildlife species depend. This diversity is matched by the cultural diversity of the people who have adapted their lifestyles to the harsh environment.

It is ICIMOD's, World Wide Fund for Nature's (WWF), and the Department of National Parks and Wildlife Conservation's (DNPWC) concern about the relationship between the people and their rangelands, between environment and development, and between nature and culture, that has brought together the scientists and managers represented here in these volumes. These proceedings provide valuable information on grassland ecology and management, not only for protected area managers here in Nepal, but also for scientists and managers working in other countries with similar ecological conditions.

It was only in 1995, when the first four-year Regional Collaborative Programme for the Sustainable Development of the Hindu Kush-Himalayas started, that ICIMOD could appoint its first rangeland management specialist and allocate some modest resources to a programme addressing rangeland issues. In ICIMOD's Second Regional Collaborative Programme (RCP-II), which covers the period from 1999-2002, rangelands have become an important focus of work on the mountain commons. We are very fortunate that the Government of Austria is funding the three-year Regional Rangeland Programme that allows us to carry out a comprehensive programme of research, capacity building, and extension, continuing until the end of 2001. The primary focus of the programme is to develop approaches that involve the local custodians of the rangeland resource – the communities themselves – in conservation and development of the rangelands upon which they so heavily depend. It is vital that collaborative management be the focus of future conservation efforts, both in Nepal and abroad, to ensure sustainable and equitable management of biological resources during this period of rapid change. This has been the approach of both WWF Nepal Programme and the DNPWC, who have pioneered work in collaborative management in the region.

Important issues that affect the grasslands and rangelands in protected areas of the Hindu Kush-Himalayas are the following:

- how to maintain biological diversity and multiple use of rangelands to promote co-existence of domestic and wild grazing ungulates and predators within and outside protected areas;

- how to find technical and institutional mechanisms to accommodate the needs of local communities to continue to access protected area resources while simultaneously promoting conservation;
- how to save and use the indigenous knowledge regarding use and management of rangeland resources; and,
- how do changing patterns of rangeland use and conservation affect the local communities, considering differential effects among diverse ethnic groups, on gender relations, and eventually on policy.

This compilation of working group outputs and research is a vital step in beginning to answer these important questions and provides working guidelines for protected area managers to help them prioritise future activities. The grasslands of the Himalayas are not only vital to the livelihood of many poor mountain families but to the sustainability of the varied and beautiful ecosystems that our in our trust. This work, and the innovative and committed people who have contributed to it as authors and editors, will help to conserve our mountain future.

J. Gabriel Campbell PhD.
Director General, ICIMOD

Acknowledgements

First we would like to offer our thanks to the Department of National Parks and Wildlife Conservation (DNPWC), the International Centre for Integrated Mountain Development (ICIMOD), and WWF NEPAL Programme for the support provided for organizing and conducting this workshop on "Grassland Ecology and Management in Protected Areas of Nepal.' Staff from the organizations working in the Royal Bardia National Park (RBNP), the Bardia Integrated Conservation Project (BICP), WWF Nepal Programme, Care Nepal, and The King Mahendra Trust for Nature Conservation KMTNC) - were instrumental in making this workshop successful on the ground. In particular we would like to thank Mr. Shiva Raj Bhatta (Chief Warden and BICP manager) for taking on all the responsibility for local management and facilities; Dr. Shanta Raj Jnawali (Director, KMTNC, Bardia) for supporting local management; Ms. Sushila Nepali (Assistant Manager, BICP) for her active role in public relations and logistics; Mrs. Sarita Jnawali for her management of food and beverages; Mr. C. P. Bhandari (Finance and Administration Assistant, BICP) for financial matters and logistics; Mr. Ramesh Thapa (Ranger, RBNP) for taking care of the workshop complex; Mr. Bhusal (Health Assistant) for providing first aid services; Mr. Ramji Shivakoti (RBNP/CARE Nepal), Mr. Naresh Subedi (Park and People Project) Ashok Bhandari, and the senior game Scouts for their logistical support, and the drivers of RBNP for their invaluable assistance transporting participants.

We are also grateful to the following people for their direct and indirect support in helping to make the workshop run effectively: Mr. Sushil Bhattarai, Joint Secretary, Ministry of Forest and Soil Conservation (MoFSC) for inaugurating the workshop; Mr. D. D. Bhatta (Director, Regional Forest Directorate), Mr. Shyam Bajimaya (Conservation Officer, DNPWC), Mr. Sawarkar (Scientist, Wildlife Institute of India), and Mr. Krishna Man Shrestha (former Chief warden of RBNP) for chairing various sessions of the workshop; and Basant Subba for serving as rapporteur. Special thanks are due to the editorial committee for their hard work in bringing this document to its present shape.

Finally, we would like to thank Dr. T.M. Maskey (Director General, DNPWC), Dr. U.R.Sharma (Joint Secretary, MoFSC), Mr. Egbert Pelinck (ex-Director General, ICIMOD), and Mr. Mingma N. Sherpa (Country Representative, WWF Nepal Programme) for their continuing support to conservation efforts in Nepal.

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Abbreviations and Acronyms

ACA	Annapurna Conservation Area
ACAP	Annapurna Conservation Area Project
AGB	above ground biomass
APPA	appreciative participatory planning and action
BZ	Buffer Zone
CAMC	Conservation Area Management Committee
DHR	Dhorpatan Hunting Reserve
DNP	Dudwa National Park
DNPWC	Department of National Parks and Wildlife Conservation
ERBC	ecoregion-based conservation
GIS	geographical information system
HKH	Hindu Kush-Himalayas/Himalayan
HMG/N	His Majesty's Government of Nepal
ICIMOD	International Centre for Integrated Mountain Development
KCA	Kanchenjunga Conservation Area
KMTNC	King Mahendra Trust for Nature Conservation
KNP	Khaptad National Park
KWR	Koshi Tappu Wildlife Reserve
LNP	Langtang National Park
masl	metres above sea level
MBNP	Makalu Barun National Park
MCA	Manaslu Conservation Area
NGO	non-government organization
PA	protected area
PAN	Protected Area Network
PAR	participatory action research
PPP	Plants and People Project (WWF)
PRA	participatory rural appraisal
PWR	Parsa Wildlife Reserve
RBNP	Royal Bardia National Park
RCNP	Royal Chitwan National Park
RNP	Rara National Park
RRA	rapid rural appraisal
RS	remote sensing
RSWR	Royal Shukla Phanta Wildlife Reserve

SNP	Sagarmatha National Park
SPNP	Shey Phoksundo National Park
SRV	species richness value
UNDP	United Nations Development Programme
WWF	Worldwide Fund for Nature

Glossary

Physiographic Regions of Nepal (Carson 1992)

- ***Terai*** — Alluvial piedmont plain occurring at the base of the Himalayan range, from 60-300masl. This is an extension of the broad Gangetic plains including Bhabar region and alluvial fans of the Siwaliks. The region is heavily traversed by the major river systems of Nepal. It exhibits a tropical type of climate. *Dalbergia sissoo, Shorea robusta,* and *Eucalyptus* are the major vegetation types of forest, interspersed with riverine savanna grassland. Much of the forests and savannas of the *Terai* have been converted to agriculture.

- ***Churia Hills (Siwaliks)***— The outermost Himalayan foothills are classified as the Siwaliks, ranging from 300-1,000m, and they represent the most recent zone of uplift. The soils are shallow, erodible, and drought prone, originating primarily from highly erodible sedimentary rock composed of previous piedmont plain alluvial sediments. The climate and vegetation of this region are mainly sub-tropical depending on the elevation, but forests are dominated by *sal* (*Shorea robusta*). Due to the fragility of the landscape, land-use pressures are not severe.

- ***Middle Hills*** — Landscape between 1,000-2,000m occurs throughout the Mahabharat range. Slopes are more gentle than in the Siwaliks and a significant portion of the sloping hills is cultivated under relatively sophisticated terrace systems in the form of low (irrigated) and upland (dry). The forests of the Middle Mountain are heavily exploited for fodder, firewood, litter, and timber collection.

- ***High Mountains*** — Landscape ranges between 2,000-3,000m, however, a range of sub-tropical to cool temperate conditions can occur within the same valley. Bedrock is predominantly highly metamorphosed sedimentary rocks, thus landscapes are steeper than in the Middle Hills because rocks are relatively more resistant to weathering. Deep 'V'-shaped valleys are common throughout the region. Forests in the High Mountains tend to be in better condition than in the Middle Hills due to lower population densities.

- ***High Himalayas*** — Landscapes are usually >3,000m in altitude. Most of the area below 4,300m is natural forest with alpine above. Bedrock is predominantly more competent and forms very steep and rugged terrain. Dry forest types and grassland steppes occur in the rainshadow behind the main mountain ranges. The area has a very low population density because of lack of cultivable land and cold winter conditions.

Seral — Early to mid-stage in ecological succession.

Climax —Final stage of a succession where a given assemblage of species is in equilibrium with the prevailing natural environment.

Phanta(s) — Grasslands dominated by short perennial grasses, such as *Imperata cylindrica*, which have originated following human intervention (forest clearing, burning, domestic stock grazing, and cultivation); they occur on more or less stabilised soils.

Tall (riverine) grassland — Riverine grassland dominated by tall grass species' assemblages maintained by inundation during the monsoon and/or by fire and grazing. These grass species range from *Typha elephantina, Phragmites karka,* and *Saccharum spontaneum* assemblages that colonise new alluvial deposits in flood plains to assemblages on drier and better developed soils dominated by *Narenga porphyrocoma, Saccharum bengalense,* and *Themeda arundinacea*. These herbaceous species eventually give way to dominance by non-flooded climax deciduous forest which is predominantly composed of *sal* (*Shorea robusta*).

Himalayan Alpine Shrub/Meadow — Mesic herbaceous and scrubby meadows that occur above the treeline on the south facing Himalayan range, dominated by herbaceous grassy genera such as *Kobresia, Poa, Deyeuxia, Agrostis,* and *Festuca* and shrubby species such as *Rhododendron, Juniperus,* etc. These regions contain a rich floral and faunal diversity.

Trans-Himalayan Rangelands — Vegetation communities dominated by desert steppe vegetation such as *Caragana, Lonicera,* and xeriphitic grass genera such as *Stipa*. Although relatively low in floral species' diversity, these rangelands support large herds of ungulates and wild predators.

Buffer Zone — Areas adjacent to or within a PA in which land use is partially restricted and managed to give an added layer of protection to the PA itself while providing valued benefits to the neighbouring rural communities (MacKinnon *et al.* 1986).

Eco-development — A site-specific package of measures, developed through peoples' participation, with the objective of promoting sustainable use of land and other resources, as well as farm and off-farm income generating activities not deleterious to protected area values (Panwar 1992).

Eco-development area — (as used in India, similar to a Buffer Zone in Nepal) – a conservation designation in the Indian Wildlife Act for areas adjacent to core Protected Areas. The area is managed so as to reduce or eliminate human pressure on core protected areas using eco-development measures.

Workshop Summary

Natural grasslands cover approximately 14 per cent of Nepal and are important areas in terms of biodiversity and sources of forage for wild ungulates and domestic livestock. In the plains of Nepal (the *Terai*), natural grasslands occur along flood plains and terraces. As a result of increasing population pressures in this region, these grasslands only exist in their natural state within protected areas (PAs) as neighbouring grassland and sub-tropical forest habitats have been rapidly converted into agricultural land and grazing commons. At higher altitudes, trans-Himalayan and alpine rangelands are home to a diverse array of wildlife and are grazed by livestock, which are an integral part of the livelihood of several different ethnic groups. While there is a general assumption that these high elevation areas are being overgrazed, little is known about the ecology and sustainability of prevailing land-use practices.

To address these issues, a workshop on Grassland Ecology and Management in Protected Areas of Nepal was organized jointly by HMG/N's Department of National Parks and Wildlife Conservation (DNPWC), the International Centre for Integrated Mountain Development (ICIMOD), and WWF Nepal Programme, from March 15-19, 1999, at Royal Bardia National Park, Nepal. The idea for the workshop arose from discussions on protected area (PA) management during the Wardens' Seminar in 1998 in the Annapurna Conservation Area. The DNPWC endorsed the recommendation of the Wardens' Seminar, and ICIMOD and WWF pledged financial and technical support. The goal of the workshop was to summarise the major grassland ecological research work conducted to date and devise effective research and management strategies for grasslands in PAs in the mountain and *Terai* areas of Nepal. Participants included representatives from the Ministry of Forest and Soil Conservation, protected area managers from Nepal, independent researchers from Nepal and abroad, and guest scientists from India who have worked in similar environments in their own country. Some papers invited from research workers who were unable to attend the workshop were included in the background papers (and will be published in the proceedings) to ensure completeness in the coverage of technical information.

A series of technical and status papers was presented summarising research for both *Terai* and Himalayan grassland ecosystems. Working groups were formed to prioritise issues, to identify research and management gaps, and to devise research and management guidelines for both grassland ecosystems. The *Terai* working group sessions revealed that, whereas much research on grasslands has been conducted to date, the results have not been incorporated into grassland management practice. The participants of the *Terai* working group outlined a number of management strategies to address these gaps, primarily focussing on maintenance of grassland habitats for key wildlife species. The mountain group sessions indicated a significant absence of research related to high elevation rangelands. Thus these participants focussed on developing research strategies to address the high priority issues of wildlife-livestock competition, crop and livestock depredation, medicinal plant extraction, stakeholder involvement, and transboundary protection. Research and management committees have been

recommended to follow up and refine these guidelines. The proceedings from the 'Workshop on Grassland Ecology and Management in Protected Areas of Nepal' are divided into three volumes. Volume I is the Workshop Action Summary and contains a brief summary of the papers presented in Volumes II and III, as well as a summary and synthesis of the workshop findings and recommendations; Volume II presents the status and research papers from the *Terai* protected areas of Nepal and India; and Volume III presents the status and research papers from protected areas in the mountains.

Volume I. Action Summary

Volume II. Technical and Status Papers on Grasslands of *Terai* Protected Areas

Volume III. Technical and Status Papers on Grasslands of Mountain Protected Areas

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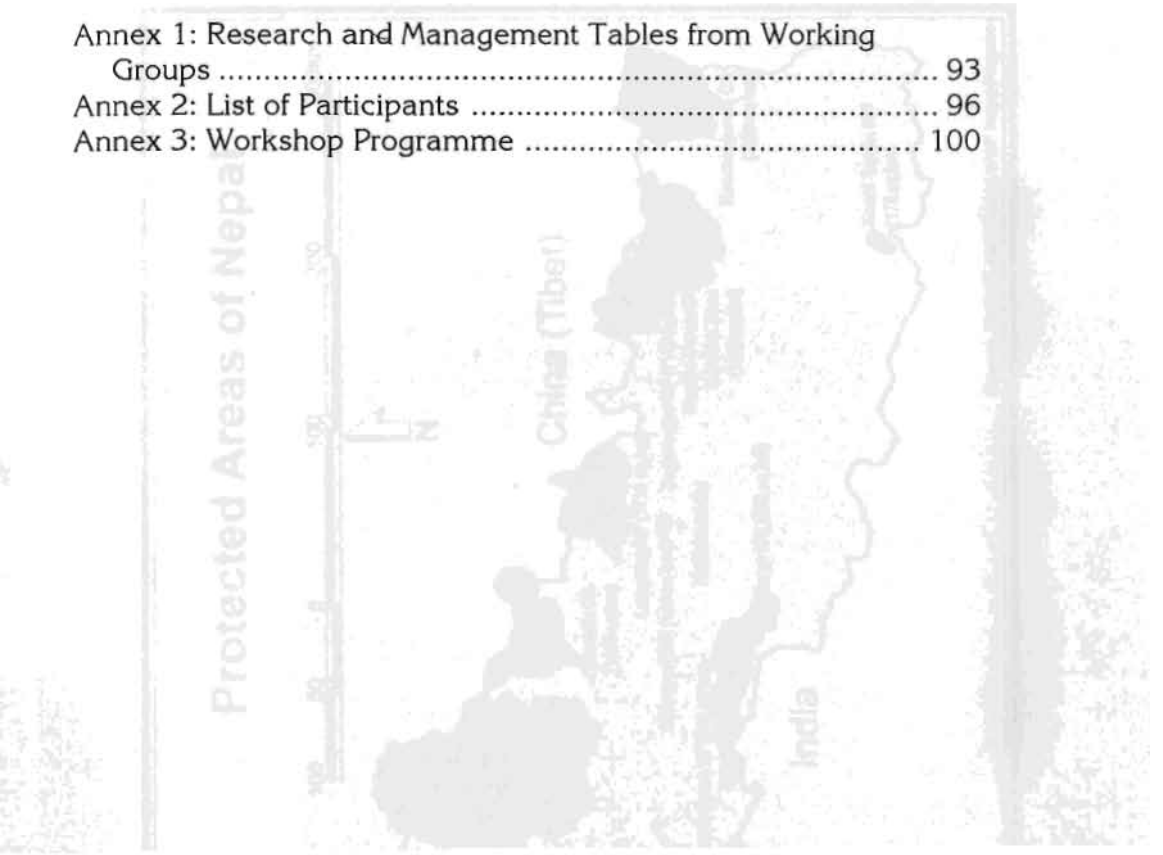
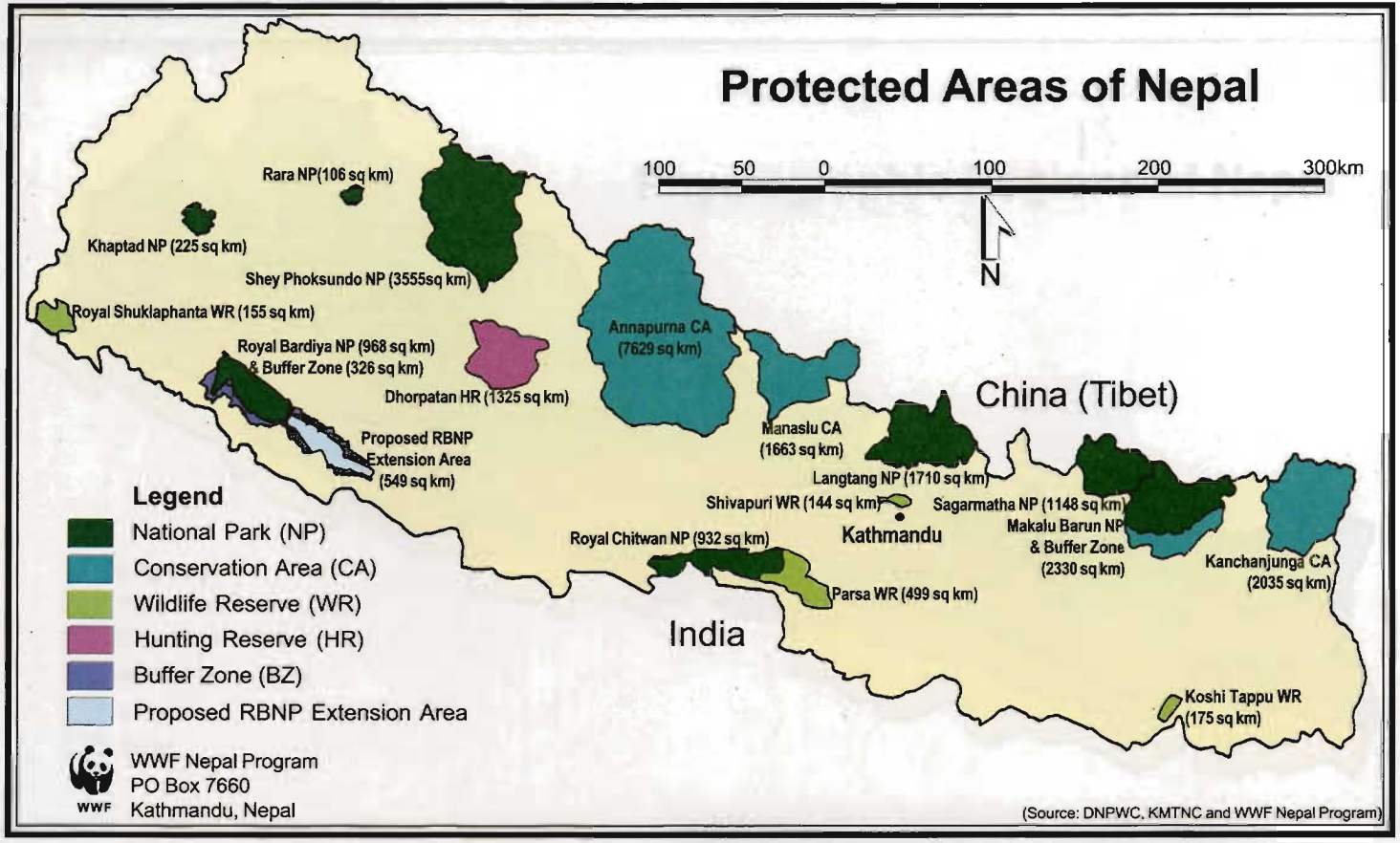
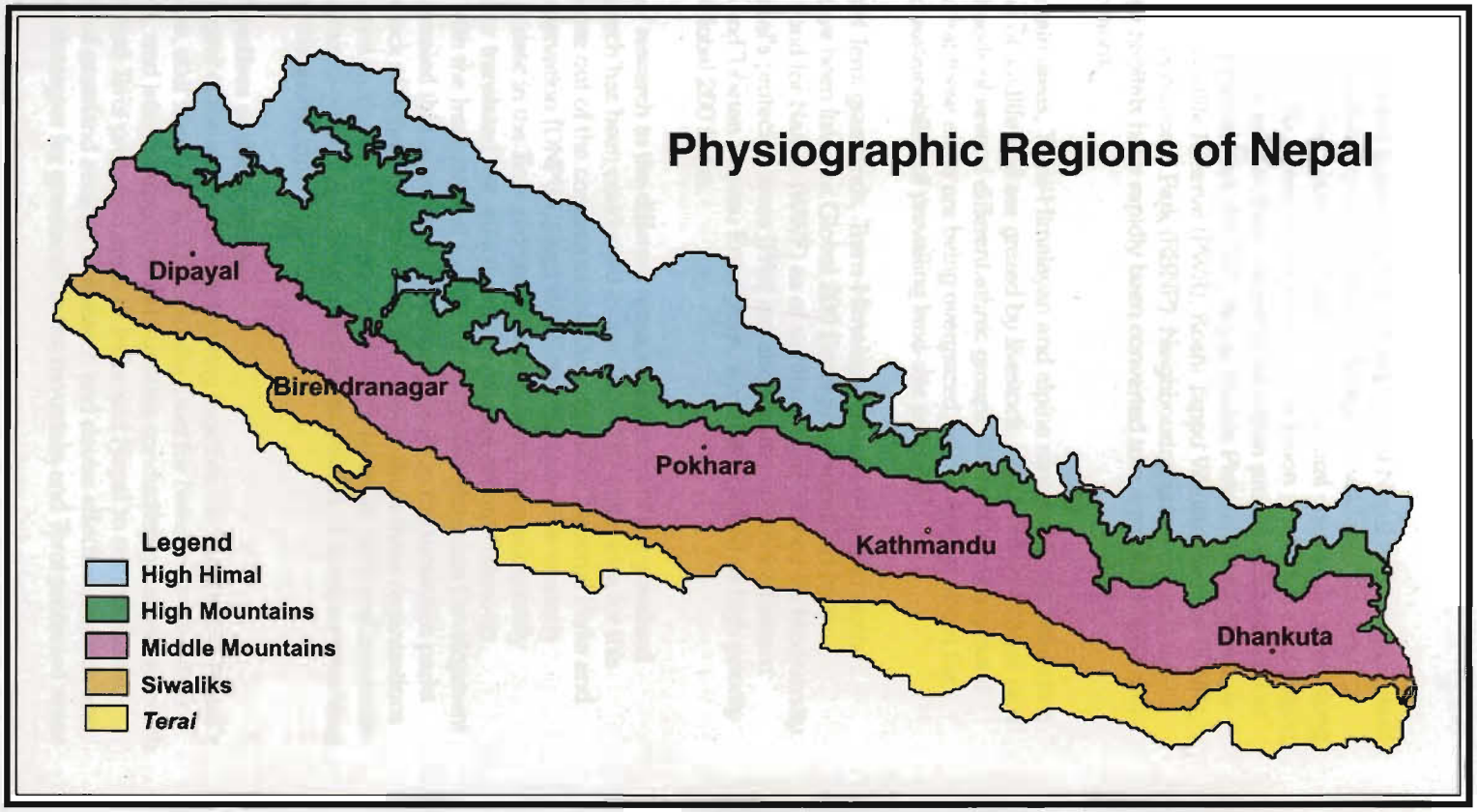



Protected Areas of Nepal
100 50 0 100 200 300km
N
Rara NP(106 sq km)
Khaptad NP (225 sq km)
Shey Phoksundo NP (3555sq km)
Royal Shuklaphanta WR (155 sq km)
Royal Bardiya NP (968 sq km)
& Buffer Zone (326 sq km)
Dhorpatan HR (1325 sq km)
Proposed RBNP
Extension Area
(549 sq km)
Annapurna CA
(7629 sq km)
Manaslu CA
(1663 sq km)
China (Tibet)
Langtang NP (1710 sq km)
Shivapuri WR (144 sq km)
Kathmandu
Sagarmatha NP (1148 sq km)
Makalu Barun NP
& Buffer Zone
(2330 sq km)
Kanchanjunga CA
(2035 sq km)
Royal Chitwan NP (932 sq km)
Parsa WR (499 sq km)
India
Koshi Tappu WR
(175 sq km)
Legend
National Park (NP)
Conservation Area (CA)
Wildlife Reserve (WR)
Hunting Reserve (HR)
Buffer Zone (BZ)
Proposed RBNP Extension Area
WWF Nepal Program
PO Box 7660
Kathmandu, Nepal
WWF
(Source: DNPWC, KMTNC and WWF Nepal Program)


Physiographic Regions of Nepal
Dipayal
Birendranagar
Pokhara
Kathmandu
Dhankuta
Legend
High Himal
High Mountains
Middle Mountains
Siwaliks
Terai

Workshop Background

Natural grasslands cover approximately 14 per cent of Nepal and are important areas in terms of biodiversity and sources of forage for wild ungulate and domestic livestock. In the plains of Nepal (*Terai*), natural grasslands occur along riverine flood plains. As a result of increasing population pressures in this region, these grasslands only exist in their natural state within protected areas such as Royal Chitwan National Park (RCNP), Royal Shukla Phanta Wildlife Reserve (RSWR), Parsa Wildlife Reserve (PWR), Koshi Tappu Wildlife Reserve (KWR), and Royal Bardia National Park (RBNP). Neighbouring grassland and sub-tropical forest habitats have rapidly been converted into agricultural land and grazing commons.

In the mountain areas, Trans-Himalayan and alpine rangelands are home to a diverse array of wildlife and are grazed by livestock, which are an integral part of the livelihoods of several different ethnic groups. While there is a general assumption that these areas are being overgrazed, little is known about the ecology and sustainability of prevailing land-use practices.

These alluvial *Terai* grasslands, Trans-Himalayan rangelands, and alpine meadows have been listed as Global 200 Ecoregions. identified by the Worldwide Fund for Nature (WWF) as of significant importance for biodiversity. Many of Nepal's protected areas (PAs) are also located within the Eastern Himalayan and Tibetan Plateau Ecoregions, which are ranked as high priority sites in the Global 200 Index.

The extent of research in the different areas varies; most of the grassland ecology research has been conducted in the *Terai*. The initial idea for this workshop arose out of the concern of the Department of National Parks and Wildlife Conservation (DNPWC) and WWF that the extensive research conducted to date in the *Terai* protected areas has not been adequately summarised or translated into effective management action. Follow-up discussions with the International Centre for Integrated Mountain Development (ICIMOD) revealed that in contrast the primary issues in the mountain parks arise from a lack of appropriate research. As a result, these three organizations proposed a joint workshop to address the research issues in *Terai* and mountain regions simultaneously. This publication is the first volume of three summarising the results of this workshop.

Goals and Objectives of the Workshop

The primary goal of the workshop was to bring together the Wardens of Nepal's National Parks, staff from The King Mahendra Trust for Nature Conservation (KMTNC) PA, and international/regional scientists conducting grassland research in mountain and *Terai* protected areas of India and Nepal to summarise the major results of grassland ecological research and devise effective research and management strategies for grasslands in the mountain and *Terai* protected areas of Nepal.

Objectives

- Document the history of grassland management and its impact on biodiversity in protected areas of Nepal (*Terai* and mountain areas)
- Summarise the major grassland ecological research conducted in protected areas of Nepal
- Gain perspectives from scientists working in similar ecological zones of Nepal and India
- Gain information on recent development and future directions of grassland ecology from regional/global perspectives

Output

- Research and management guidelines for protected area managers
- Research, Management, and Policy groups formed to address grassland issues in the protected areas of Nepal

Workshop Participants

- Wardens of Nepal's Protected Areas
- KMTNC Protected Area staff
- Key policy-makers
- International/regional scientists conducting grassland research in Nepal and India
- (Technical papers were included from research workers who were unable to attend the workshop to ensure completeness in the coverage of technical information.)

Workshop Agenda

The Workshop was organized in the following manner.

I. General Overview

Introduction to the Workshop and Working Definitions

Ecology of the Grasslands of the *Terai*

- General overview of *Terai* protected areas – ecology and management
- Grassland research in the *Terai* of Nepal and India

Ecology of the Grasslands of the Mountain Areas

- General overview of mountain protected areas – ecology and management
- Grassland research in the mountains of Nepal and India

II. Working Group Sessions (Concurrent)

Ecology of the Grasslands of the *Terai*

- Individual *Terai* park reports (summary of research work, management issues faced in each PA)
- Working group sessions to define data gaps, identify future research needs, and define management strategies for *Terai* protected areas with sufficient data

Ecology of the Grasslands of the Mountain Areas

- Individual mountain park reports (summary of research work, management issues faced in each PA)

- Working group sessions to define data gaps, identify future research needs, and define management strategies for mountain protected areas with sufficient data

Workshop Inaugural Session

The inaugural session of the workshop on 'Grassland Ecology and Management in Protected Areas of Nepal' was held on the morning of 16 March 1999 at Lalmati, Royal Bardia National Park. Mr. Sushil Bhattarai, Joint Secretary, Ministry of Forests and Soil Conservation, was the chief guest. Mr. Dibya Dev Bhatta, Director, Mid-western Regional Forest Office chaired the session.

Chief Warden Mr. Shiva Raj Bhatta welcomed the participants to Royal Bardia National Park and said that the presence of researchers, park managers, and conservationists from both India and Nepal was very encouraging. He also hoped the ensuing interaction would help in making appropriate recommendations for the effective management of protected areas.

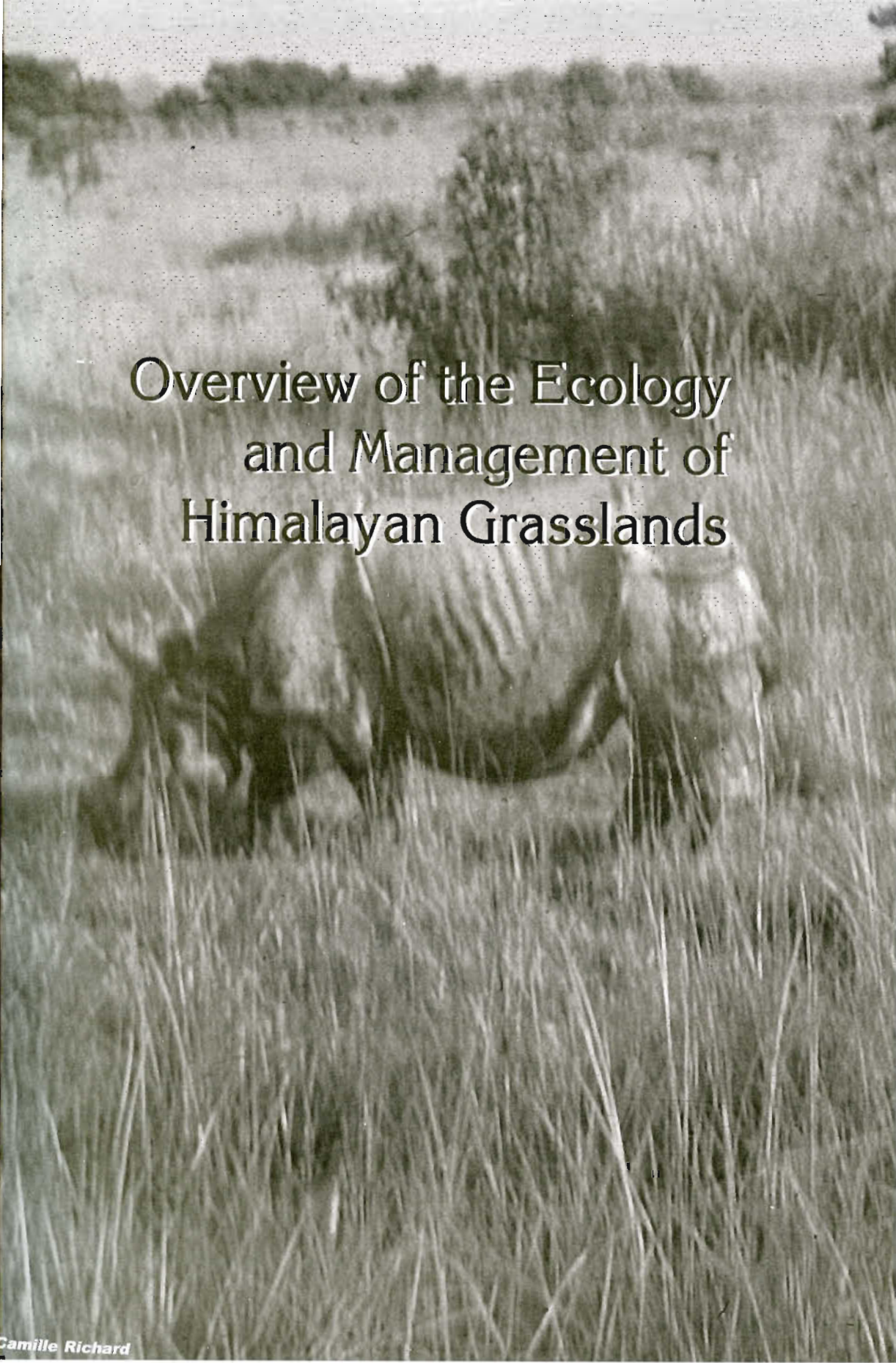
Following the welcome address, the chief guest, Mr. Sushil Bhattarai, formally inaugurated the workshop by lighting up the *Panas*.

On behalf of the Department of National Parks and Wildlife Conservation, the Management Officer Mr. Shyam Bajimaya welcomed the participants and hoped that the deliberations would have far-reaching effects on the management of grasslands and rangelands that would ultimately lead to sustainable conservation of natural resources. He stressed that the issues relating to grasslands need to be addressed immediately. He also shed light on Nepal's conservation efforts in the last twenty-five years and added that, despite great conservation challenges, Nepal has set aside more than 16 per cent of the country's land as protected areas. Concluding his address, Mr. Bajimaya remarked that the interaction was aimed to be instrumental in reaching a consensus on preparing guidelines for the effective management of grassland resources.

The chief guest Mr. Sushil Bhattarai expressed his pleasure at participating in the workshop. He emphasised that grasslands were of prime concern because both wildlife and local people depended on them. He also added that grass cutting was permitted for a few days during winter in the *Terai* parks. Likewise, local people traditionally use grasslands for grazing livestock in the mountain parks. He hoped that the workshop would come up with prescriptions for His Majesty's Government and guidelines for protected area managers for the sustainable management of these grassland ecosystems.

The presiding chairperson, Mr. Dibya Dev Bhatta, concluded the session and said that grasslands outside protected areas were equally important and also needed immediate attention. He hoped that the interaction would help in preparing guidelines for protected areas and wished for the success of the workshop on behalf of the Ministry of Forest and Soil Conservation.

Overview of the Ecology and Management of Himalayan Grasslands



Camille Richard

Representation of Grassland Ecosystems in the Himalayan Ecoregions

Khadga Basnet, Tribhuvan University/WWF-Nepal

Natural grasslands are complex ecosystems. 'Grassland' means an area covered by herbaceous plants, mainly grasses and sedges, but is also used in the following to denote rangelands, which include tropical and sub-tropical alluvial grasslands, alpine meadows, shrublands, steppes, and deserts. Natural grasslands once occupied at least one-third of the land surface of the earth (Olson and Dinerstein 1998, WCMC 1992, Whitaker and Likens 1973). As a result of their extent, diversity, and use, grassland ecosystems have drawn the attention of rangeland, forest, and wildlife managers and conservationists for many decades (Lehmkuhl 1989, Peet *et al.* 1997, Tilman and Downing 1994). Understanding their biodiversity (species' composition and richness), regional distribution patterns, and ecosystem functioning, is important for their long-term management and conservation.

The main objectives of this overview are to:

- review the representation of grassland ecosystems in the Himalayan ecoregions, particularly in the Eastern Himalayan ecoregion of the Global 200 Ecoregions (Box 1) and Table 1;
- highlight grassland biodiversity and its importance for conservation; and
- examine the challenges and opportunities in managing the grasslands of Nepal.

The Himalayan Ecoregions and Grasslands

The Himalayas, the highest mountain chain on Earth, stretches about 3,200 km from Northern Pakistan in the west to the subtropical forests of Myanmar in the east (Figure 1). Parts of several countries like Bhutan, China (S.E. Tibet), India

Box 1: The Global 200 Ecoregions

An ecoregion is defined as a relatively large parcel of land or water that shares a large majority of its species, dynamics, and environmental conditions. It is a new and emerging concept in biodiversity conservation and is used as the unit for analysis, conservation planning, and action. WWF scientists have identified a list of more than 200 biological regions that are crucial to conservation of global biodiversity (Olson and Dinerstein 1998). The 'Global 200 Ecoregions' initiative identifies the most outstanding terrestrial, fresh water, and marine ecoregions on Earth. The concept of the Global 200 is based on the conservation of the broadest variety of the world's species and ecological and evolutionary processes by conserving the broadest variety of the world's habitats. The ultimate objective is to conserve the biodiversity linking specifically genes, species, communities, and ecological phenomenon within the ecoregion.

At present, there are 240 ecoregions on the list - more than 136 terrestrial, 36 fresh water, and 65 marine ecoregions. These ecoregions can be divided into 3 categories (Wikramanayake *et al.* 1998) depending upon their protection status (included or not included in the protected area network or PAN). They are: a) areas with extensive coverage by the PAN, b) areas with inadequate coverage by the PAN, c) areas with poor or no coverage by the PAN. Most of the Himalayan ecoregions are not/or poorly covered by the PAN system.

TABLE 1. COVERAGE OF THE HIMALAYAN ECOREGIONS BY THE PROTECTED AREA NETWORK (PAN)

No/poor coverage by PAN	Inadequate coverage by PAN	Extensive coverage by PAN
1. Western Himalayan Broadleaf Forests	1. Himalayan Subtropical Broadleaf Forests	1. Himalayan Subtropical Pine Forests
2. *Terai*-Duar Savannas and Grasslands	2. Eastern Himalayan Broadleaf Forests	2. Western Himalayan Alpine Shrub/ Meadow
3. Northern Triangle Subtropical	3. Western Himalayan Subtropical Conifer Forests	3. Eastern Himalayan Alpine Shrub/ Meadow
4. Northern Triangle Temperate Forests	4. Northern Himalayan Alpine Shrub/Meadow	4. Eastern Himalayan Subalpine Conifer Forests
5. Trans-Himalayan Alpine Shrub/ Meadow	5. The Tibetan Plateau	
6. Trans-Himalayan Subalpine Conifer Forests		
7. High Altitude Cold Steppe		

Source: Wikramanayake *et al.* 1998

(Sikkim and Arunachal Pradesh), Myanmar, Nepal, and Pakistan, belong to the range. The Eastern Himalayas, which cover Bhutan, S.E.Tibet (China), Sikkim and Arunachal Pradesh (India), the north-eastern part of Myanmar, and Nepal (east of Kaligandaki), are recognised globally as hotspots of biodiversity (Wikramanayake *et al.* 1998). WWF has identified 16 Himalayan ecoregions for the Global 200 which are the conservation targets in the Himalayas (Olson and Dinerstein 1998, Wikramanayake *et al.* 1998). They include:

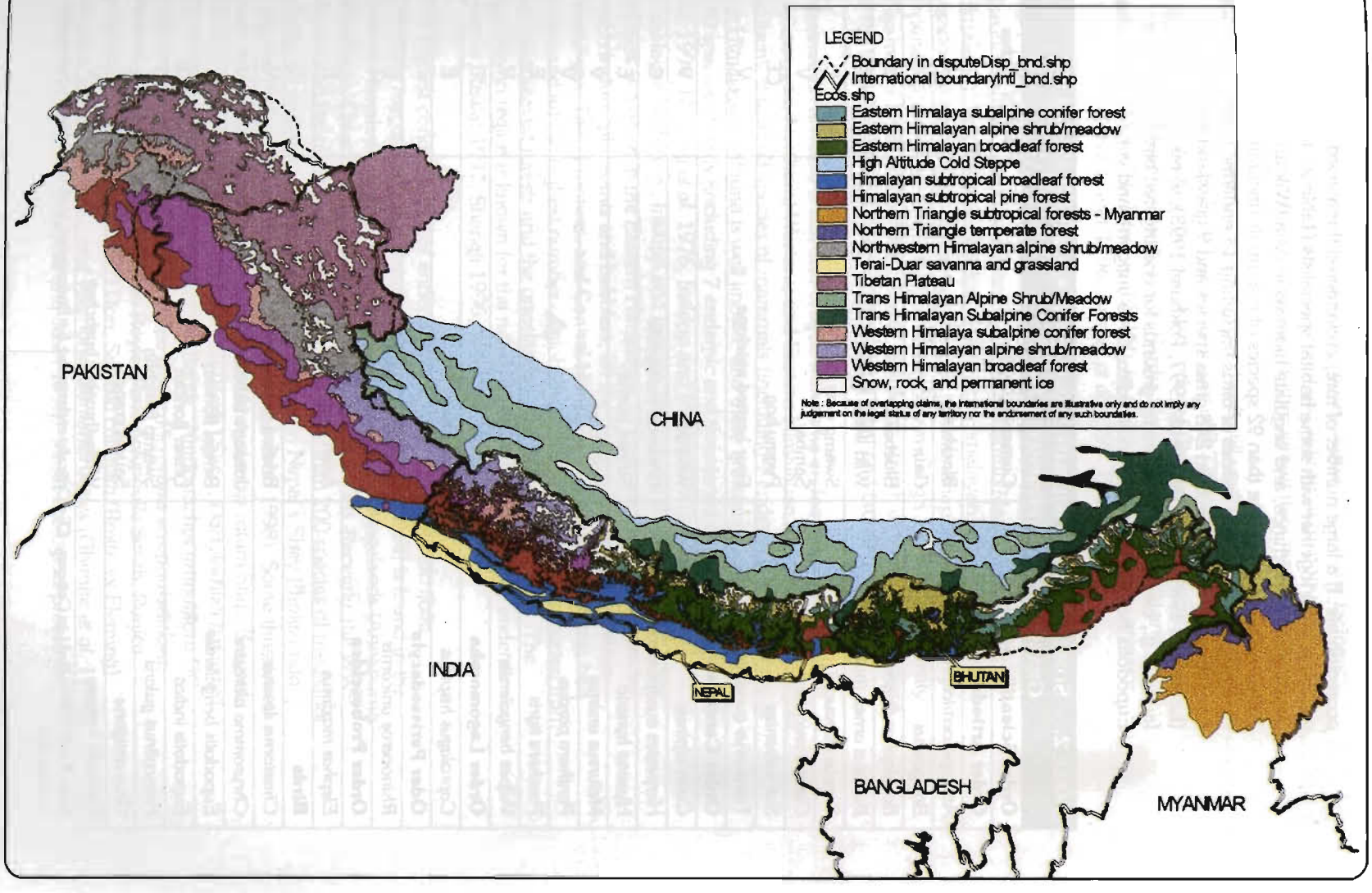
- distinct communities, habitats, and biological assemblages (e.g., *Terai*-Duar Savanna);
- large intact habitats and biotas (Northern Triangle Temperate Forests of Myanmar);
- keystone ecosystems and habitats (e.g., rivers and lakes/ponds like Ajingara tal); and
- distinct large-scale ecological phenomena (e.g., long-route migration of birds and elephants).

The Himalayan Ecoregions include two main types of grassland ecoregion: i) *Terai*-Duar Savannas and Grasslands (lowland alluvial grasslands); and ii) The Himalayan Alpine Shrub/Meadow and Trans-Himalayan Rangelands.

***Terai*-Duar Savanna and Grasslands**

The sub-tropical alluvial grasslands found in the lowlands of Nepal and Assam (India) are the last remnant of a once extensive ecosystem in southern Nepal and northern India (Lehmkuhl 1989, Peet *et al.*1997, Wikramanyake *et al.* 1998). These ecosystems (known as *charkose jhadi* in Nepal) are the tallest grasslands (up to 6-metre tall grasses) in the world and are confined mainly to protected areas (Bell and Oliver 1992; Figure 1). These grasslands are rich in biodiversity and contain complex ecological processes (Basnet 1996, Peet *et al.* 1997, Lehmkuhl 1989). Some of the distinguishing characteristics of the

Figure 1. Himalayan Ecoregions



ecoregion are: i) a large number of rare, endangered/threatened, and endemic wildlife species together with some habitat specialists (Table 2); ii) the highest densities of tigers, rhinos, and ungulate biomass in Asia (Wikramanyake *et al.* 1998); iii) records of more than 92 species of mammals (including 3 endemic species), and about 500 species of birds (including 18 endemic species); iv) high floral diversity with more than 248 grass species and 9 grassland assemblages (Lehmkuhl 1989, 1994, Peet *et al.* 1997, Pokharel 1993); v) migration of mega fauna (e.g., elephants); vi) breeding grounds for endangered bird species (e.g., *Eupodotis bengalensis, Eupodotis indica, Grus antigon*); and vii) a large number

TABLE 2. SOME IMPORTANT WILDLIFE SPECIES IN *TERAI* SAVANNAS AND GRASSLANDS AND PERIPHERAL AREAS

Order/Scientific name	Common name	IUCN status
Order Artiodactyla		
Antilope cervicapra	Blackbuck	V
Bos gaurus	Gaur	V
Boselaphus tragocamelus	Bluebull	S
Bubalus arnee (bubalis)	Wild water buffalo	E
Cervus duvauceli	Swamp deer	E
Cervus unicolor	Sambar	V
Sus salvanius	Pygmy hog	CE
Tetracerus quadricornis	Four-horned antelope	V
Order Carnivora		
Cuon alpinus	Wild dog	V
Herpestes auropunctatus	Common mongoose	C
Hyaena hyaena	Striped hyena	E
Melursus ursinus	Sloth bear	V
Panthera pardus	Leopard	V
Panthera tigris	Tiger	E
Vulpes bengalensis	Indian fox	V
Order Lagomorpha		
Caprolagus hispidus	Hispid hare	E
Oder Perissodacyla		
Rhinoceros unicornis	One horned rhino	E
Order Proboscidea		
Elephas maximus	Asian elephant	E
Birds		
Chaetornis striatus	Bristled grass-warbler	V
Chrysomma altirostre	Jordon's babbler	V
Eupodotis bengalensis	Bengal florican	E
Eupodotis indica	Lesser florican	CE
Francolinus gularis	Swamp francolin	V
Grus antigone	Saurus crane	E
Saxicola insignis	White-throated bushchat	V

Note: IUCN (1996) Red List Category: CE=Critically endangered; E=Endangered; V=Vulnerable; S=Susceptible or lower risk

of human settlements and disturbances. These unique habitats are facing several direct (e.g., clearing for agriculture) and indirect (e.g., population growth) threats and ecological degradation throughout their range (Table 4).

In Nepal, *Terai*-Duar Savannas and Grasslands still cover a significant portion of the *Terai* protected areas (>1,684 sq.km. out of 3,779 sq.km.), which include the Koshi Tappu Wildlife Reserve (KWR), Royal Chitwan National Park (RCNP), Parsa Wildlife Reserve (PWR), Royal Bardia National Park (RBNP), and Royal Shukla Phanta Wildlife Reserve (RSWR), in addition to their linkage areas or possible corridors (Basnet 1996, Basnet *et al.* 1998, BPP 1995).

The Himalayan Alpine Shrub/Meadow and Trans-Himalayan Rangelands
The Himalayan alpine grasslands are classified as: a) Trans Himalayan Alpine Shrub/Meadow, b) Northern Himalayan Alpine Shrub/Meadow, c) Western Himalayan Alpine Shrub/Meadow, d) Eastern Himalayan Alpine Shrub/Meadow, and e) High Altitude Cold Steppe (Wikramanayake *et al.*1998), depending upon their location, type of vegetation (Singh 1989), and diversity (Gyamtsho 1996, Miller 1998). These grasslands stretch along the high regions of the Himalayas and support an enormous floral and faunal diversity.

Mammalian diversity is rich and unique with some endemic species (Table 3). For example, Northern, Western, and Eastern Himalayan Alpine Shrub/Meadow contains at least 63 species of mammals (including 7 endemic). The diversity of the Himalayan avifauna is well known, and these grasslands support at least 180 species of birds (including 7 endemic and threatened e.g., *Grus nigricollis*) (Ali 1994, Fleming *et al.* 1976, Inskipp and Inskipp 1997). Studies of the Himalayan birds (e.g., Inskipp and Inskipp 1997) have shown that: i) species' richness is highest in the Eastern Himalayas; ii) there are 15 endemic species, which include pheasants and babblers; iii) the Eastern Himalayas, Western Himalayas, Tirap Frontiers, and Central Himalayas are the four endemic bird areas; and iv) the highest number of globally threatened species is reported from the broadleaved forests and the grasslands in the eastern Himalayas. The Himalayan region is known for the richest alpine flora, particularly endemic species (Rawat 1997, Shengji 1996, Shrestha and Joshi 1996).

The highest concentration of endemic plants (e.g., *Berberis mucrifolia*, *Corydalis megacalyx*, *Delphinium himalayai*, *Heracleum lallii*) is found in the Eastern Himalayan region, alpine shrub/meadows, and rangelands (Annapurna/Dhaulagiri, Chumbi Valley) (Wikramanayake *et al.* 1998). Recently, the WWF 'Plants and People Project' (PPP) identified more than 200 species of medicinal plants, 48 endemic, and 25 threatened species in Nepal's Shey Phoksumdo National Park only (Ghimire *et al.*1998 Shrestha *et al.* 1998). Some threatened plant species with economic value include: *Aconitum spicatum* Stap, *Bergenia ciliata* (Haw.) Sternb. *Cordyceps sinensis* (Berk.) Sacc., *Dactylorhiza hatagirea* (D.Don) Soo, *Megacarpaea polyandra* Benth., *Nardostachys grandiflora* DC, *Olea ferruginea* Royle, *Olea ferruginea* Royle, *Picrorhiza scrophulariiflora* Pennell, *Podophyllum hexandrum* Royle, *Paris polyphylla* Smith, *Punica granatum* L., *Rheum australe* D.Don, *Swertia chirayita* (Roxb. ex Fleming) Karsten, *Taxus baccata* L., and *Valeriana jatamansii* Jones (Ghimire *et al.* 1998), Shrestha *et al.* 1998, Shrestha and Joshi 1996). Major ecological processes

TABLE 3. SOME IMPORTANT WILDLIFE SPECIES OF ALPINE SHRUB/MEADOW AND PERIPHERAL AREAS

Order/Scientific name	Common name	IUCN status
Mammals: **Order Artiodactyla**		
Bos grunniens	Wild yak	S
Budorcas taxicolor	Takin	Rare
Capricornis sumatraensis	Serow	V
Hemitragus jemlahicus	Thar	S
Moschus chrysogaster	Musk deer	E
Moschus fuscus	Musk deer	E
Nemorhaedus goral	Goral	S
Ovis ammon	Great Tibetan sheep	V
Pantholops hodgsoni	Tibetan antelope	V
Pseudois nayaur	Blue sheep	S
Order Carnivora		
Canis lupus	Grey wolf	V
Cuon alpinus	Wild dog	V
Panthera pardus	Leopard	V
Uncia uncia	Snow leopard	E
Vulpes vulpes	Fox	S
Order Perissodactyla		
Equus kiang	Tibetan wild ass	E

Note: IUCN (1996) Red List Category:-E=Endangered; V=Vulnerable; S=Susceptible or lower risk

TABLE 4. MAJOR MANAGEMENT ISSUES ASSOCIATED WITH THE HIMALAYAN GRASSLAND ECOREGIONS

Major issues	Savanna	Alpine Meadow
Human population growth	High	Medium
Poverty and lack of opportunities	High	High
Lack of education and awareness	High	High
Clearing for agriculture	High	Low
Livestock grazing (and wildlife competition)	High	High
Encroachment and fragmentation	High	Low
Highways and development projects	High	Medium
Illegal hunting and poaching	High	High
Illegal collection of plants	High	High
Transboundary protection issues	High	High
Migration of wildlife populations	Medium	Medium
Annual burning	High	Medium
Hydropower and irrigation canals	High	Low
Increasing tourism	Medium	Medium
Park-people conflicts	High	High
Lack of research and adequate information	High	High

Note: Potential threats are indicated in terms of high, medium, and low.

include horizontal and vertical migration of wildlife (e.g., takin, migratory birds) and wildlife-livestock interaction (Basnet 1998).

The protected areas of the mountain region of Nepal are: the Kanchenjunga Conservation Area (KCA), Makalu-Barun National Park (MBNP), Sagarmatha National Park (SNP), Langtang National Park (LNP), Manaslu Conservation Area (MCA), Annapurna Conservation Area (ACA), Dhorpatan Hunting Reserve (DHR), Shey Phoksumdo National Park (SPNP), Rara National Park (RNP), and Khaptad National Park (KNP). Combined, they cover an area of about 21,241 sq.km. (16% of Nepal's land mass), which includes 2,954 sq.km. of alpine rangelands (BPP 1995).

Grassland Management Issues

Management of the Himalayan grasslands is essential for balanced biodiversity conservation and sustainable community development. However, these grasslands are largely neglected from a management point of view and are in a degraded condition in places (Peet *et al.* 1997, Wikramanayake *et al.* 1998). The Himalayan grasslands are challenging to manage because of: i) the diverse flora and fauna and associated habitats they possess (Shengji 1996, UNDP 1998; ii) high human population growth and associated disturbances such as forest clearing and grazing; and iii) the complex socioeconomic and political conditions of the region. The major management issues across the Himalayan grasslands include: i) human population growth and encroachment; ii) over-exploitation of resources; iii) poaching and hunting; iv) habitat degradation, fragmentation, and loss; v) loss of biodiversity; vi) transboundary problems and lack of coordination; and vii) lack of adequate information and a proper management plan (Table 4). However, the precise management issues are specific to the country, grassland type, and protected area, as has been highlighted in the working group sessions of this workshop.

Conclusion

Management priorities may differ considerably among different grasslands (see Basnet *et al.* 1996, DNPWC/WWF 1996, KMTNC 1998) because they are guided by different management issues. Considering the biodiversity of these areas, their protection status and the issues they face, priorities for the Himalayan Ecoregions, particularly for Nepal, should be to:

- identify research and management gaps and priorities;
- promote collaboration and cooperation at the local, national, and international level;
- include under-represented areas in the protected area network system;
- restore critical habitats; and
- develop effective research and monitoring strategies.

The Himalayan Ecoregions, particularly the Eastern Himalayas, are a focal point of the Global 200 Ecoregion Initiative (Olson and Dinerstein 1998). The grassland ecoregions discussed here are unique habitats harbouring endemic, rare, and endangered plant and wildlife species. But these important habitats are facing direct and indirect threats, including some spanning national borders, which can be addressed by the ecoregion-based conservation (ERBC) approach

that WWF is now promoting. Thus, an intergovernmental agreement among the Himalayan range states for the protection and conservation of the Himalayan grasslands is a high priority. WWF and UNDP (United Nations Development Programme), in collaboration with ICIMOD, have taken this initiative (UNDP 1998). Long-term research addressing questions using a holistic approach is essential for strong management prescriptions and sustainable management of these complex systems.

An Agro-ecological Perspective on Grassland Management in the *Terai* and Mountain Protected Areas

Camille Richard, ICIMOD

Grasslands of the Hindu Kush-Himalayan region are vast, ranging from the low-lying *Terai* savanna grasslands, to the forest grazing lands of the sub-tropical and temperate regions, to the high alpine and desert steppe rangelands of the Tibetan Plateau. They encompass approximately two million sq.km. or over 60 per cent of the region. These grasslands are important for a variety of reasons; they are the headwaters of the major river systems of Asia; they provide important habitat for many wildlife and plant species, thus much of the region is designated as protected areas; and they provide forage for grazing livestock, which make up a significant percentage of cash income in many areas (Miller 1995). The primary land use is livestock grazing on rangeland, forest, and anthropogenic shrubland and grassy pastures, which are managed as common property resources by millions of farmers and pastoralists reliant on their bounty.

Functional Definitions for Grasslands and Rangelands

When talking about protecting these ecosystems, it is important to realise that grasslands and their use do not exist in isolation from surrounding forest lands, agricultural lands, nor even distant urban centres, therefore our conservation goal should be to promote a 'biodiversity friendly' landscape beyond the PA. Protected area managers do not primarily manage biological resources, they manage people and their use of biological resources and should be concerned with the flows of goods and services derived from those resources. Therefore, when speaking of grasslands and rangelands, we must speak a common language and have functional definitions that focus on use of the resource. These distinctions in definition are important to make because of the management implications for maintaining particular types of vegetation communities.

The following definitions were put forth for use in this workshop.

Pasture – land used for grazing (synonymous with grazing land)

Forage – the portion of vegetation that is potential food for animals

Fodder – vegetation that is cut and carried to penned livestock (like tree leaves, grasses, and crop residues)

Grassland – a vegetation community in which the dominant component is comprised of herbaceous graminoid species such as grasses and sedges (generally but not always). Three types of grassland are distinguished.

> Artificial Grassland — Artificial grassland refers to artificial cultivation of annual or perennial grasses and forbs to meet the fodder needs of ruminant animals. These are generally cut and carry systems but also include improved pasture for grazing. *Semi-artificial* grassland means native vegetation communities that are over-sown with exotic fodder

species. Intensive pasture/hay meadow management requires high inputs such as: 1) species maintenance, 2) fertility and irrigation; and 3) protection. It is only practised where benefits in terms of livestock production exceed the cost of inputs, thus it is typically market driven.

Semi-natural Grassland — Semi-natural grasslands are composed of seral (successional) vegetation communities that are dominated by herbaceous species (usually native) resulting from anthropogenic disturbance in forest ecosystems, such as fire or grazing, or ploughing and subsequent abandonment of agricultural land. This definition would also include the *phantas* (previously cultivated and re-vegetated short grassland) of the *Terai* which, without grazing or fire, would convert to forest vegetation.

Natural Grassland — Natural grassland comprises a vegetation community dominated by graminoids as a result of some natural bio-physical limitation that precludes the growth of trees or shrubs. This would include native alpine grassland, maintained by a cold, high elevation climate, and alluvial tall grass communities of the *Terai*, maintained as grassland by natural hydrological processes.

Shrubland — Shrubland covers a vegetation community dominated by shrubs, such as a seral shrub community resulting from anthropogenic use of forests, or native shrubs in desert steppe and alpine environments.

Rangelands — Rangelands are "those areas of the world which, by reason of physical limitations, low and erratic precipitation, rough topography, poor drainage, or cold temperatures, are unsuitable for cultivation and which are a source of forage for free-ranging native and domestic animals, as well as a source of wood products, water, and forest wildlife" (Stoddart *et al.* 1975). Thus **rangeland** is an ecological definition. It denotes natural shrub or natural grassland and is not synonymous with *pasture* or grazing land, terms used to denote a use of rangeland, forest, or agricultural vegetation types.

Rangeland management — Rangeland management is "*the science and art of optimising the returns from rangelands in those combinations most desired by and suitable to society through the manipulation of the range ecosystem*" (Stoddart *et al.* 1975). These definitions for **rangelands** and **rangeland management** generally refer to areas characterised by cold temperatures, arid conditions, or some other bio-physical parameter that naturally precludes the growth of trees, and excludes forage resources from sub-tropical and temperate forest areas and cultivated lands. The term 'rangeland' covers a particular group of ecosystems in the Himalayas, principally alpine rangeland, Trans-Himalayan desert steppe rangeland, and *Terai* riverine/savanna grassland.

The focus of this workshop is primarily on the broad types of grasslands and pastures that are found in Nepal's protected areas. These include semi-natural grassland (seral grasslands found in the forest zones of the *Terai* and mountain areas), seral shrub and forest grazing lands, and native rangeland (native grassland or shrubland). Given the broad types of native and semi-natural grasslands prevalent in Nepal, we need a broader management definition for

these lands, beyond the classic definition for **rangeland management**. That is a functional definition that includes native rangeland as well as forest areas (often converted to shrubland, grassland, and cultivated fields). Considering that the primary use of 'grasslands' in Nepal is for grazing of domestic livestock and wild ungulates, we need a definition that focusses on sustained forage production. This leads to the concept of integrated forage management.

Integrated Forage Management - the sustainable use and maintenance of forage resources (native rangeland, forest, pasture, and agricultural lands), incorporating both scientific and indigenous systems of management,to meet the optimal needs and desires of households and the community (increased livestock and/or crop production, water availability, and forest products) without disrupting the integrity of the ecosystem (maintaining the ecological integrity of watersheds and biodiversity).

An Agro-ecosystem Perspective on Grassland and Rangeland Management in Protected Areas[1]

Given the inter-disciplinary nature of the above definitions, protected area managers should adopt an agro-ecosystem framework for analysis when addressing conservation issues in countries such as Nepal where humans reside within or use protected area resources. A well-designed assessment programme needs to shed insight into the complexities of indigenous land management systems and the manner in which outside intervention positively or negatively alters the ebb of village life, especially local institutional authority. Conflicts arise between local people and park authorities because protected area designations and policies are often formulated and implemented before the environmental and socioeconomic realities of the area are understood and appreciated. This information is vital to designate a protected area effectively, or devise realistic strategies for buffer zone management. This is because the environment first and foremost dictates production of plant biomass, and thus the potential for land-use intensification in associated farming systems (barring socioeconomic constraints for the sake of simplification in this discussion).

Farming systems are defined by the ecosystem in which they evolved. In this discussion, land-use systems of the Himalayan region are placed into three broad categories of agro-ecosystems, depending on the environment and their livestock use patterns, although it should be emphasised that these are generalisations

Agriculturalists — Agriculturalists are those communities who rely primarily on cultivation and in which livestock serve as an integral part of the mountain farming system. Animals are generally stall-fed, or grazed off the farm in localised grazing lands within neighbouring forest areas. Livestock usually provide negligible income and are kept mainly to promote crop fertility, but they also provide dairy products, meat, hides, and draught power. These cropping systems generally occur in sub-tropical and lower temperate mountain forests.

Agro-pastoralists — Agro-pastoralists are sedentary cultivators who graze

[1] Adapted from Richard (1999).

most of their livestock far from their homes (transhumance) in an effort to exploit micro-niches at different altitudes or latitudes to secure adequate forage throughout the year. This system is typically practised by communities who reside at higher altitude, where adequate precipitation or irrigation allows cultivation, but where crop production is generally insufficient to meet requirements. Consequently, these communities have developed elaborate herding and trading systems to procure the goods necessary for survival. In these systems, livestock are also kept for food, clothing, draught power, and crop fertility. In addition, they are used for transport in trading economies.

Pastoralists — Pastoralists reside in the most extreme environments of the Hindu Kush-Himalayan (HKH) region, in the high elevation, cold desert steppe rangelands of the Tibetan Plateau and the Hindu Kush mountains, areas which are too cold and dry to support agriculture. Livestock serve as their chief source of income as well as transport for traded goods. Surplus livestock products beyond subsistence needs are used as commodities in intricate trading systems, often with remote communities, to procure agricultural and other products that they can not otherwise acquire in their harsh environment. Grazing systems are very extensive in an effort to acquire the necessary forage.

Despite the diversity in the region, it is possible to view these broad land use systems and their associated landscapes along an ecological gradient in the Himalayas, for example a cross-section of Nepal from south to north. One moves from sub-tropical forests and riverine grasslands at low elevation in the Gangetic Plains up to the High Himalayas, characterised by alpine meadow, and on to the Tibetan Plateau, characterised by alpine desert steppes. Figure 2 illustrates a series of gradients that reflect the relationship between agro-ecosystems and their potential to produce biomass, and the ecological basis by which the gradients are designed. The potential to produce biomass is related to the potential for intensification, which is the basis for buffer zone management given the objective of reducing pressure on neighbouring protected areas. An ecosystem capable of producing a good amount of biomass is referred to as 'resource rich' in this discussion.

Grimes (1979) has provided plant ecologists with a simplistic but often applicable model to conceptualise plant species and their adaptability to various types of environments, termed **life history strategies**. These life history strategies, like the farming systems prevalent in each ecosystem, reflect the environmental conditions under which the plants evolved. In resource rich habitats characterised by low stress, like drought or nutrient stress, and low to moderate disturbance, such as fire or other activities that remove plant biomass, plant communities are dominated by highly productive **competitive** *(C)* species. When these habitats are highly disturbed, fast growing, weedy **ruderal** *(R)* species assume dominance. An example of this type of environment would be the sub-tropical forests or the riverine tall grasslands of the *Terai*. In resource poor environments, characterised by high stress such as aridity or cold temperatures, plant communities are dominated by **stress tolerant** *(S)* species that are naturally low in productivity. When these environments are subjected to high levels of disturbance, ruderal species cannot adapt well, and thus rarely come to dominate a large area (although they can dominate areas receiving

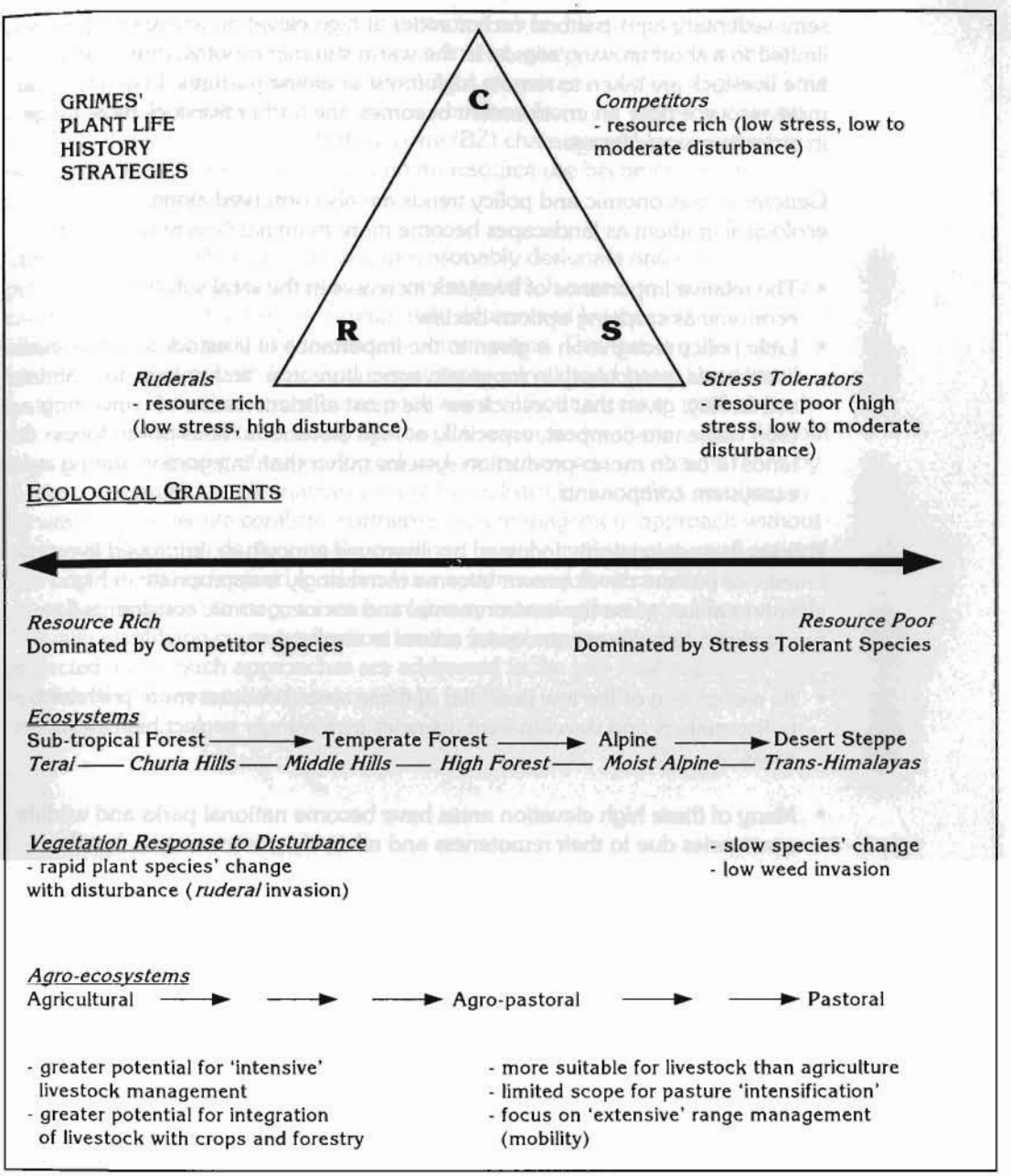


Figure 2. The relationship between agro-ecosystems and their potential for intensification along an ecological gradient in the Himalayas of Nepal

high nitrogen inputs such as grazing camps). Thus these areas can sustain higher grazing pressures without undergoing rapid species' change (although they are subject to erosion if highly disturbed). The Trans-Himalayan desert steppe is a prime example of this type of environment.

The associated farming systems change along the ecological gradient as well, from crop-based agricultural communities in sub-tropical climes to nomadic pastoral communities on the high elevation Tibetan Plateau. In between are

semi-sedentary agro-pastoral communities at high elevation where cropping is limited to a short growing season in the warm summer months, during which time livestock are taken to remote high forest or alpine pastures. In general, the more resource poor an environment becomes, the further livestock must range in order to procure forage.

General socioeconomic and policy trends are also observed along this ecological gradient as landscapes become more marginal (less resource rich).

- The relative importance of livestock increases in the local subsistence economy as cropping options decline.
- Little policy recognition is given to the importance of livestock in subsistence livelihoods, particularly in mountain agriculture as a 'technology' to maintain soil fertility, given that livestock are the most efficient means of converting crop waste into compost, especially at high elevations. Thus policy focus tends to be on mono-production systems rather than integration among agro-ecosystem components.

Policies that are primarily focussed on improved agriculture, improved livestock breeds, or pasture development become increasingly inappropriate in high elevation areas, given the environmental and socioeconomic constraints (low productivity, remoteness, and poor access to markets).

- As recognition of the low potential of these areas becomes more prevalent, policy-makers and development agencies increasingly neglect high elevation areas.

- Many of these high elevation areas have become national parks and wildlife sanctuaries due to their remoteness and relatively pristine nature, but the approach is often based on lower elevation models, where human access has been (and is capable of being) more restricted. Restricted access to resources has thus marginalised mountain communities who find themselves with few livelihood options, compared to lowland groups.

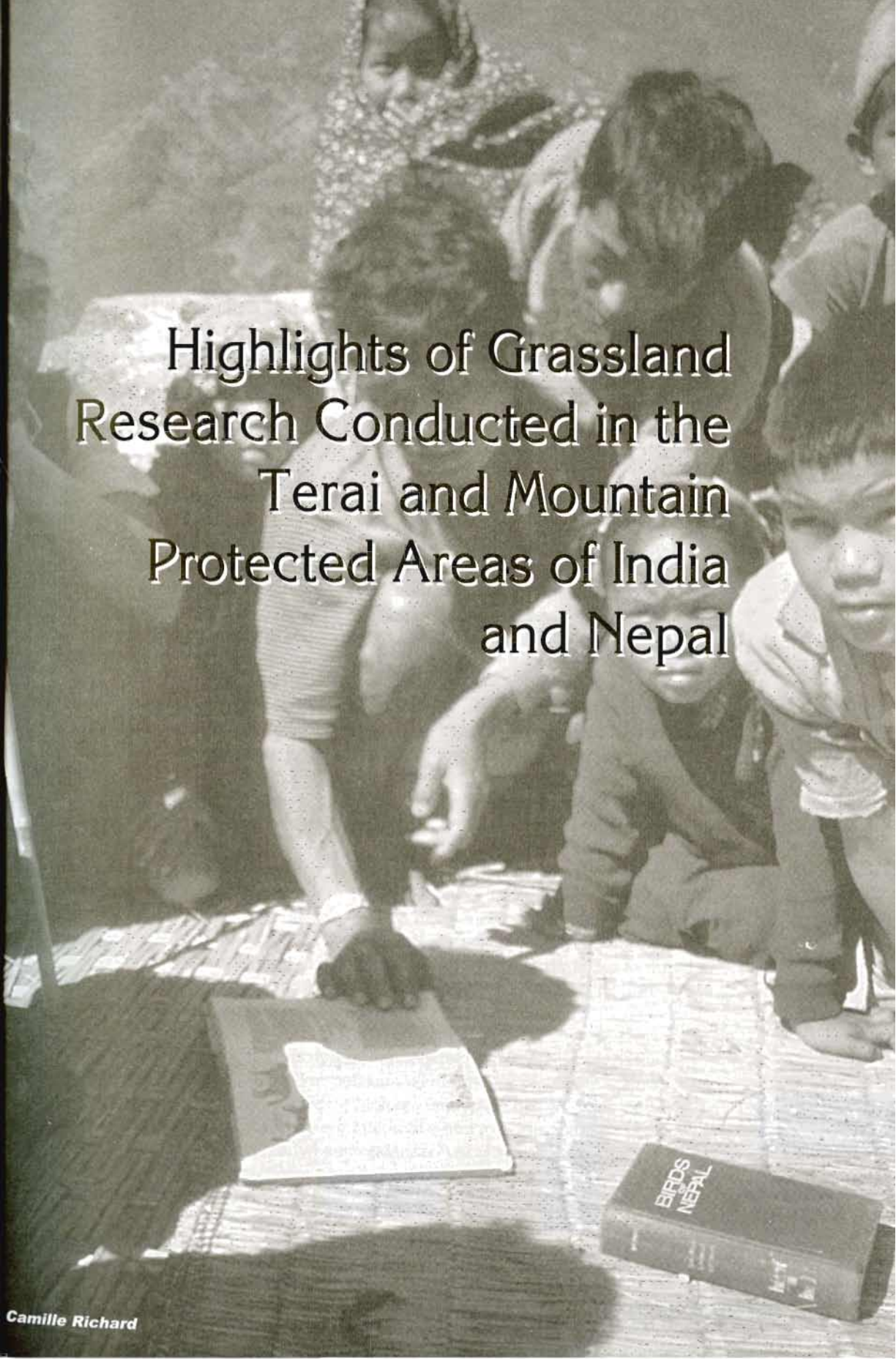
Implications for Buffer Zone Designation and Management

The primary goal in buffer zone management is to intensify land use in areas surrounding a core protected region, thereby reducing pressure on protected area resources, raising the living standards of local residents, and increasing local interest in conservation. However, the prevailing environment affects the potential to intensify livestock or agricultural output. This needs to be taken into consideration when developing plans for buffer zones, or even designating them in the first place. For example, in sub-tropical regions, the potential for intensified livestock management and its integration with cropping and forestry activities is greater than in high elevation areas, where the emphasis should be more on extensive livestock movements, thereby maintaining mobility of herds and quality of rangeland condition. Thus, at lower elevation (such as in the *Terai* protected areas), true core areas can be designated which exclude human use, with well-differentiated buffer or eco-development areas that effectively diversify land use options where access to markets and infrastructure is greater. At high elevation, livestock must be mobile and have access to remote

pasturage, which often occurs in core protected areas. Here the option to exclude human use of natural resources is limited, given the need for remote access in such marginal environments and the remoteness of these regions. This is exemplified in papers presented in this workshop from the Trans-Himalayan zones. Thus clearly defining a **buffer zone** (BZ) characterised by intensive use vs. a **core area** that ideally has no human resource use becomes a more difficult, if not impossible, task.

This raises the question of how we can reasonably designate and manage protected areas in the Himalayas. The extent to which access to protected areas can be restricted to human use is ultimately determined by the degree to which alternatives can be provided to resident communities. This rests on the potential for intensification of both land and industries as a livelihood base. Land use systems, especially those in resource poor areas without access to markets and infrastructure, will continue to rely on core PA resources for many years. Without a basic understanding of the ecological and socioeconomic constraints faced by resident communities, alternatives cannot be realistically identified, resulting in inevitable park-people conflicts. Furthermore, a management approach without local involvement in decision-making will not reveal a realistic picture of options. The best way to understand local land-use systems and their constraints is to adopt an 'inclusive' strategy to research, jointly assessing local conditions and mutually identifying courses of action for the future conservation of Nepal's protected areas. Such approaches are addressed in the two final papers in Volume III of these workshop proceedings.

Highlights of Grassland Research Conducted in the Terai and Mountain Protected Areas of India and Nepal



Camille Richard

Terai Grasslands[2]

A Landscape Approach to Managing the Indian *Terai* Ecosystems with Reference to Uttar Pradesh, India

Vishwas B. Sawarkar

This paper addresses some of the broad issues relating to the management of *Terai* grasslands which are considered to be among the most threatened ecosystems in India. Historically, the National Forest Policy of 1952 included most grasslands in the category of village forests in recognition of their utility as grazing areas for cattle and production of fodder, otherwise, they were included in unclassed or vested forests, in ignorance of their biological values and ecological functions.

The *Terai* grasslands, which are unique in their biological and physical attributes and ecological functions, cannot be seen in isolation from the matrix of forests (woodlands) and other categories of land use within which they are located. This area has 21 types of forest belonging to five sub-groups. The forests are mainly upland woodlands, whereas the grasslands occupy the lowlands amidst interspersed seasonal and perennial swamps. Both the forests and the grasslands are parts of a landscape that has rich agricultural, human habitation, livestock, and other land uses.

Current inventories highlight the rich biodiversity of the area; 75 tree species, 37 shrubs, 20 species of climbers, 179 species of aquatic plants, and 77 species of grasses have been recorded among the plants and 56 species of mammals (12 endangered), 455 species of birds (29 endangered), 16 reptiles (5 endangered), 19 amphibians, and 79 species of fish among the animals. Many of these animals are strongly dependent upon the maintenance of the *Terai* grasslands.

The first attempt to bring wildlife management under a specific Wildlife or Protected Area Plan came about in 1972. However, it is only very recently that the concept of buffer zones outside the PAs have enabled the wildlife planners to extend management outside PA boundaries where strategies are normally covered by eco-development plans. In practice, the current strategies to manage buffer zones chiefly address the management and reduction of social and economic pressures on PAs and forest resources.

In a landscape approach to ecosystem management, principles of landscape ecology constitute an intersection between all disciplines of wildlife science, viz., ecology, geography, forestry, wildlife biology, landscape design, sociology, and economics. In other words, they are integrative and inte disciplinary. Various issues in the *Terai* have already been addressed using a landscape approach. For example, when many tigers were killed in the seventies, it was found that the pattern of kills conformed to the intensity of spatio-temporal activity of

[2] The full papers are presented in Volume II of this Workshop Series

people and the increasing presence of immigrant labour in an unfamiliar environment. Thus, to reduce the propensity of encounters, an integrated approach was recommended which included strong anti-poaching strategies, maintenance of thatch grass patches outside the park, maintenance of corridor links, maintenance of fuelwood reserves, and management of fish resources in swamps and rivers outside the PAs.

The opportunities to resolve the issues surrounding a single wide-ranging species and the interests of the people mainly lay in planning land use over a large tract outside the park. For example, the northern swamp deer (*Cervus duvauceli duvauceli*) is an obligate species of the *Terai* grasslands and is one of the most endangered deer species in the world. The same factors that affected the tiger have affected the swamp deer. Thus, to secure its future, the whole flood plain grassland habitat, extending well beyond the wildlife sanctuary, needs planned attention. Similarly, it is suspected that elephant herds now range over much larger tracts than it was thought in the past. This has increased the problems for conservation of elephants, and for maintaining economic security of people across the range of elephant movement. These problems underpin the need for landscape/regional planning.

It is clear that most species use more than one habitat. The forest or wildlife departments may not have jurisdiction over such large areas, but they can identify opportunities and accomplish the desired set of practices through building partnerships with other agencies. It is clear that eco-development or buffer zone management cannot succeed without partnerships with motivated and willing stakeholders, among whom the local communities are most important. Furthermore, the procedures also need to set the terms of bilateral cooperation between countries. The landscape planning approach admittedly has many miles to go. The important need is that wildlife managers, planners, and decision makers need to be walking on that road.

Status of Research and Monitoring in Protected Areas of the Indian *Terai*: An Overview

Pradeep Kumar Mathur

India possesses a rich diversity of natural ecosystems as a result of its strategic location at the confluence of different bio-geographic realms. India has been divided into 10 bio-geographic zones, of which one is the *Terai*, the west-east stretch of the northern alluvial flood plains of the rivers Ganga and Brahmaputra. This area once harboured dense vegetation dominated by sal (*Shorea robusta*) forests with interspersed tall grasslands and numerous swamps. The area is now fragmented as a result of abrupt changes in land-use policy, uncontrolled expansion of agriculture and large-scale reclamation of grasslands and swamps, heavy deforestation, and factors like fire, grazing, and floods during the post-independence era. However, even in its present form, this woodland-grassland-wetland ecosystem complex still harbours a wide variety of flora and fauna, including several endemic and endangered species of mammals and birds. Because of the series of changes, mostly resulting from

human activities, the *Terai* has become one of the most threatened ecosystems in India.

As a result of the ongoing positive moves for the conservation of this valuable ecosystem, several large remnant patches of *Terai* forest and grasslands in different states of the country have been declared protected areas, although protected areas in the *Terai* still cover only two per cent of the total area in comparison to the average of 4.5 per cent for the country as a whole. The average size of the PAs in the Indian *Terai* is about 185 sq.km., and, like the majority of the PAs in India, they are isolated islands of wildlife habitats surrounded by people and incompatible land uses.

Extensive research has been done on various aspects of the *Terai* ecosystem. Most of the existing information on this ecosystem is in the form of checklists, inventories, biological surveys, community ecology studies, and species' oriented research on selected, endangered mammals and birds. However, some sporadic studies have been made for selected PAs on resource mapping, socioeconomics, and changes in land use. Baseline information was gathered during the preparation of Forest Working Plans, which largely provide information on the type and extent of forests, taxonomic checklists (plants, birds, and mammals), forest management practices, habitat management, and, to some extent, socioeconomic profiles. In addition to this, several floristic and faunal surveys have been undertaken throughout the *Terai* by survey organizations such as the Botanical/Zoological Survey of India and other scientific institutions.

In the case of grasslands, only preliminary research is available on grassland succession and habitat dynamics. Although extensive areas of the grasslands are affected by a variety of weed plants, little research has been conducted on this aspect. Only general accounts have been provided of the effect of grazing, grass cutting, and burning of grasslands on the species of concern. Furthermore, many studies and reports advocate annual grassland burning, but such recommendations are rarely based on actual experimental studies. Most of the few studies done fail to provide any insight into ecological relationships and interactions among plants, wild animals, livestock, and humans. Despite the fact that the entire *Terai* region is under tremendous pressure as a result of ever—increasing biomass demands by local people and intensive agricultural development, only a few sporadic studies have been done on land-use changes using remote sensing. In addition, only a few socioeconomic profiles have been compiled and preliminary assessments of resource dependence made in selected villages.

Wildlife or protected area management research is of comparatively recent origin in the Indian *Terai*, and the majority of investigations or research studies have been of short duration, at the most three to four years. Thus, a well organized long-term rigorous scientific research and integrated monitoring programme is needed to enhance benchmark knowledge; facilitate decision-making; reduce overall management costs; and enhance ecological integrity through increased public awareness and participation–and thus help PA management.

The recommended topics for priority research include flood plain dynamics, grassland surveys, management-oriented, long-term experimental studies in grasslands, biological control of weeds, genetic study of endangered species, resource dependencies and park-people conflicts, and the impact of changing scenarios, policies, and programmes. A comprehensive, integrated, long-term monitoring programme needs to be designed and developed based on multidisciplinary research inputs. In short, research, monitoring, and management need to be blended. Participatory research and monitoring activities involving local people should be emphasised and given high priority.

Managing the *Terai* Grasslands in Nepal: Recent Research and Future Priorities

Nic Peet, Diana J Bell, and Andrew R. Watkinson (Presented by Nic Peet)

This paper summarises some of the research and management priorities identified as a result of a recent research project in the *Terai* grasslands. The project investigated botanical diversity across four protected areas, animal species-plant assemblage associations, the effects of cutting and burning on *Imperata cylindrica* dominated grassland, the spatial and temporal responses of ungulates to cutting and burning, and the socioeconomics of grassland harvesting.

Nine grassland assemblages were identified in the four *Terai* protected areas. Early successional grasslands are dominated by **Typha elephantina**, **Phragmites karka**, and **Saccharum spontaneum**. Assemblages on drier and better-developed soils are dominated by **Narenga porphyrocoma**, **Saccharum bengalense**, and **Themeda arundinacea**. '*Phanta*' grasslands occur on old village sites and abandoned agricultural land within the protected areas and are dominated by **Imperata cylindrica**. Chitwan has the highest assemblage diversity, whilst Bardia and Shukla *Phanta* are of particular importance for their **Imperata cylindrica** grasslands. Assemblages in Koshi Tappu are limited to early successional grasslands resulting from flooding.

Research activities should be prioritised that will lead to a better understanding of successional processes in the grasslands. The priorities should be investigating and predicting landscape dynamics, quantifying rates of successional change at all seral stages between bare alluvium and early successional flooded grassland and forest, and gaining a better understanding of the role of fire, cutting, and grazing in the successional process. The exploratory models described by Lehmkuhl (1989) to predict changes in river course and alluvial deposition in Chitwan, should be developed further and extended to Bardia and Shukla *Phanta*. Reports indicate that the rates of change between grassland types and between grassland and forest are generally influenced by disturbance, particularly fire. Thus, long-term experiments should be undertaken to examine the influence of fire and cutting on successional change in a variety of different assemblages.

Research on faunal associations with one or several grassland assemblages has concentrated primarily on larger mammals. There is a clear need to extend the

understanding of associations to more faunal groups and to seasonal changes in assemblage utilisation so that the effects of ephemeral forage resource on ungulate populations, and those of cutting and burning on smaller cover-dependent species, can be assessed. Similarly, the results of a management experiment conducted in Bardia indicate that if management of the grasslands is to reflect the conservation of biodiversity other than ungulates and their predators, then it is important for managers to consider leaving uncut and unburned refugia. This would mean leaving patches of grassland unmanaged on a rotational basis. This is of particular importance for grasslands that are not influenced by flooding. The remaining *Imperata cylindrica* dominated '*Phanta*' grasslands are becoming smaller as a result of succession to tall grassland and forest. Thus immediate steps should be taken to monitor encroachment and remove invading tree saplings. Because the most suitable methods for maintaining patches of shorter grassland within the tall grasslands are currently unclear, priority should be given to investigating experimentally methods of preventing succession to tall grassland.

The Organization and Human Use of *Terai* Riverine Grasslands in Royal Chitwan National Park, Nepal

John F. Lehmkuhl (invited paper, not presented at the workshop)

This paper highlights the results of research on the ecology of a tall grass and riverine forest mosaic in the eastern portion of Royal Chitwan National Park, Nepal, during the period from 1985-1987. The experiment focussed on the landscape dynamics in riverine grasslands, the productivity of natural grasslands and village pastures, the effects of fire and herbivores on production, and quantification of human use.

Approximately two-thirds of the study area was sampled with a 188 relevé of 8.5 m x 8.5 m plots in grasslands and 11m x 11m plots in the understory of riverine and sal forest. Black and white aerial photographs from 1964 and 1981 were used to quantify landscape patterns, then model landscape dynamics. Similarly, experiments were conducted in stands dominated by *Imperata cylindrica*, *Saccharum spontaneum*, and *Narenga porphorycoma* to estimate the effects of fire and wild ungulate herbivores on annual production. Primary consumption by rhinoceros (*Rhinoceros unicornis*) and domestic elephants (*Elephas maximus*), and the dominant ungulate herbivores was estimated by multiplying the number of animals by the per capita harvest. The quantification of the human use of grasses was done by multiplying the number of grass cutting permits by per capita harvest.

Results showed that the landscape was not stable but a 'shifting mosaic', with constant properties. Analysis of the photographs and model simulations indicated that three sub-systems of landscape change existed in the area. Those were eroded land, increased area of *Saccharum spontaneum* floodplain, and reclaimed agricultural land succeeding to natural vegetation.

In the study area, ten grassland associations with six phases and three forest associations were identified. Fluvial action was considered as the controlling force of community organization at the landscape level. Similarly, soil moisture development and fire were the primary factors underlying community organization and succession, whereas large mammalian herbivore feeding and fodder cutting for domestic elephants were secondary factors.

Above-ground net primary production of Chitwan's grasslands appears to be among the highest in the world. Fire and grazing had significant effects on the standing biomass of *I. cylindrica*, whereas no significant grazing effects on production were found with *N. porphorycoma*. In both stands, however, early burning without grazing produced the greatest biomass. Both stands received different degrees of human disturbance. Model simulations indicated little change in *I. cylindrica* biomass availability, a 28 per cent decrease in mixed tall grass biomass, and a 15 per cent increase in *S. spontaneum* biomass over 20 years, based on 1987 data. In the village pastures, *Chrysopogon asciculatus, Cynodon dactylon* and *I. cylindrica* dominated the grazed pasture composition; grazed production was 39 per cent less than the ungrazed production inside the exclosure.

Grass consumption by animals was estimated using a value for the average daily intake of fodder per elephant of 45 kg DW (dry weight). About 60,000 grass cutting permits were sold for human use, and there were about 216,000 visitor-days during 1985 and 1986. The harvest of thatch grass and canes for house construction was 6,406 tonnes and 4,726 tonnes, with monetary values of NRs 4.6 million and NRs 5.4 million, respectively.

Results from the experiment showed that staggered burning could foster the formation of pasture-like grazing lawns by concentrating grazing pressure on limited areas. Grazing lawns would produce high-quality forage year-round, may decrease crop depredation by attracting wild herbivores away from agriculture, and would increase herbivore carrying capacity. Similarly, patch burning would also increase cover for wildlife, but patch size would be critical for success.

In conclusion, an increase in the *S. spontaneum* grassland type is good for park management since this type of grassland represents perhaps one of the highest quality habitats in the Park. The species can also be used by the local people, via grass cutting permits, to make paper fibre. The demand for *I. cylindrica* is also extremely high. Thus, a programme to mechanically break up extensive tall grass stands that were formerly *I. cylindrica* into a patchwork of tall grass and I. *cylindrica* might benefit wildlife.

Finally, the concept of adaptive management, which is ideal for testing new grassland management treatments where results are uncertain, for example, the effects of patch burning or mechanical treatments on productivity and ungulate use should be emphasised as a strategy to manage *Terai* grassland for conservation and compatible human use.

Grasslands and Large Mammal Conservation in the Lowland *Terai* : A Preliminary Synthesis Based on Field Research Conducted in Royal Bardia National Park, Nepal

Per Wegge, Shant Raj Jnawali, Torstein Storaas, Morten Odden (invited paper, not presented at the workshop)

This paper describes types of grasslands, their origin, utilisation by the people, role in the conservation of mammals, and mapnagement practices in the lowlands of Nepal, and gives guidelines for their sustainable management. There are two general types of grassland: a) riparian tall grass floodplains and b) wooded grasslands and *Phantas*. The floodplain grasslands, which consist of tall, perennial grasses, are natural in that they become established and are maintained by fluvial action and flooding, but they are successional since they will develop into forest if periodic flooding ceases and the soil substrate stabilises.In contrast, the wooded grasslands and *Phantas* consist of shorter perennial species that originated following human intervention (forest clearing, burning, grazing of domestic stock, and cultivation); and they occur on more or less stabilised soils.

Both types of grasslands have traditionally been utilised by local villagers for different purposes. The tall grasses in the floodplain are mainly cut and harvested for canes, whereas the wooded grasslands and *Phantas* were previously grazed by domestic stock. Grasses are cut and harvested for a variety of local uses. Grazing is now prohibited within the protected areas, but grass harvesting is permitted once a year for one to two weeks in the winter. In addition, both types of grasslands are periodically burnted intentionally, either by the protected area managers or by the local people.

Field studies in Koshi Tappu, Chitwan, Bardia, and Shukla Phanta have documented the crucial role that both types of grasslands play in the conservation of several wild mammalian herbivores, and thus in the conservation of their carnivore predators. The recent census data from the western part of Royal Bardia National Park (RBNP) shows that the total density and biomass of wild herbivores (excluding megaherbivores) in the mosaic of grasslands and grassland-related habitats are among the highest recorded in Asia. They have attributed the mosaic of different habitat patches to the extraordinarily high density and also diversity of ungulates in the grassland-related habitats of RBNP.

Recent investigations have disclosed a higher density of tiger in the mixed habitat complex of RBNP than in the Royal Chitwan National Park (RCNP) or most tiger reserves elsewhere. Since several of the species that occur in the south-western part of Royal Bardia National Park belong to categories endangered or threatened internationally, this region of the park should be considered a bio-diversity 'hot spot', requiring special attention by management.

The two types of grassland mentioned above need different management interventions. If the strategy of no intervention is adopted, some scenarios can be predicted. These scenarios include successional changes from different types of grassland to forest, or from forest to grassland, and their impact on the population of mammals such as hog deer, rhinoceros, wild elephants, chital, tigers, and nilgai. Such scenarios further predict that a reduction of prey biomass through loss of wooded grasslands and *phantas* through natural succession would also intensify the food competition between tigers and leopards. A likely consequence is that leopards would be further displaced to the periphery of the park and increase their predation on small livestock, which could intensify park-people conflicts.

The Park authorities are already practising a moderate human intervention management policy, however. Until recently, this consisted of permitting some 35,000-40,000 villagers to enter the park during a short period in the early dry season to cut and harvest grasses in both types of grassland, and of burning large parts of the grasslands shortly thereafter. Recently, a programme for maintaining the wooded grasslands and *phantas* has also been initiated in which encroaching shrubs and trees are removed through uprooting and cutting. Both of these interventions (grass cutting and *phanta* management) provide benefits to the local communities. Similarly, the recently initiated intervention of mechanically removing encroaching shrubs and larger trees, in order to maintain *Imperata* dominated grass cover on the wooded grasslands and *phantas*, seems well justified ecologically and is probably required in order to maintain the high diversity and density of wild ungulate biomass as a food base for the predator community.

The management guidelines for short grassland types (both cutting and burning), suggested by Moe (1994) and Peet et al. (1997), advise rotational cutting and burning, with patch burning spread over a longer time during the dry season. Less work has been done on the ecological effects of cutting and burning of tall grasses in the floodplain. An equilibrium may be maintained between the relative coverage of grass-dominated communities and later tree-covered successional stages as a result of the regular re-creation of new grassland by river action. Thus a non intervention policy may not cause any loss of these natural grasslands. The continuation of the present practice of cutting and burning by the local people is recommended, but these activities should be fully guided in the interest of conservation principles and the natural integrity of the protected areas.

It is recommended that smaller wooded grasslands and *phantas* should also be developed within the surrounding sal forests in the park. Such an intervention may at first glance appear rather drastic, and not readily acceptable. However, in order to conserve viable sub-populations of tiger and provide a dispersal habitat between existing protected areas, it is necessary to provide sufficient natural prey not only in core areas within the park, but also within remaining forests outside the protected areas.

Further research should be conducted on the ecological effects of cutting and burning in the tall-grass floodplain. and the long-term effects on the productivity and mineral balance of the wooded grasslands and *phantas*. Research is also

needed on grazing lawns and grazing pressure, and on the proposed experimental clear felling of mature sal (*Shorea robusta*) and asna (*Terminalia tomentosa*) forest to create wooded grasslands and *phantas*.

Koshi Tappu's Treasure: Grasslands or Wetlands?

Jay Prakash Sah

In the Koshi Tappu region, located in the eastern *Terai* of Nepal, the dry grasslands are considered by livestock herders as a treasure that will never be exhausted. At the same time, the wet grasslands with their associated lakes, swamps, and marshes are both the ideal habitat for the remaining population of wild water buffalo (*Bubalus bubalis*) and of international importance in terms of staging and wintering sites for different varieties of Trans-Himalayan migrating birds. Thus, it has remained a matter of controversy whether Koshi Tappu is more important for the preservation of grasslands or of wetlands. The author describes the extent of grasslands and wetlands in the Koshi Tappu region, their relative significance, and their management issues and makes recommendations for the integrated management of wetlands and grasslands using a participatory approach.

The areas of grassland and wetland in the Koshi Tappu region were calculated from a land-use map prepared with the help of aerial photographs and Landsat TM Imagery. The significance of grasslands and wetlands in Koshi Tappu were assessed on the basis of their use by local people and the ecological functions they perform. To assess the use value, a household survey was carried out in the villages adjacent to the reserve. Finally, grassland and wetland management issues were identified after formal and informal discussions with reserve authorities, groups of local people, and personal observations.

Grasslands and wetlands together cover almost 92 per cent of the total area in the Koshi Tappu Wilidlife Reserve. There is some difficulty in differentiating between wetlands and grasslands as they occur along a soil moisture gradient from very wet to very dry conditions. Thus distinctions were made under the sub-headings wetlands, wet-grasslands, dry-grasslands, and savanna.

In the Koshi Tappu Region, the major wetlands are rivers, streams, barren floodplain, oxbow lakes, marshes, and swamps. The extent of total water area and regularly flooded barren floodplain changes continuously as a result of shifting of the riverbed. The most important oxbow lakes are the 'kamal pokhari', meaning 'lotus pond', located in the far west of the reserve, and three lakes in the eastern part of the reserve along the eastern embankment. An extensive marshy area lies along the fringes of these lakes, and there is a seepage stream with a 100-250 m wide strip of marshes on its fringes located east of this embankment. There are also other swampy areas covered with combinations of *Phragmites*, *Saccharum*, *Typha*, and *Vetiveria* in different associations. The grasslands in relatively dry areas comprise associations of *Saccharum-Imperata*, *Imperata*, and *Saccharum-Cymbopogon*. This type of area is subjected to frequent burning and livestock grazing. In addition, some portions of the grassland represent a savanna habitat, mainly grasslands with trees scattered throughout.

Both the wetlands and grasslands in Koshi Tappu are important resources, i.e., they possess use values that typically involve some human interaction with the resource. They also have an 'existence value', a form of non-use or non-economic value. The major use values of the wetlands in Koshi Tappu are related to fishing, livestock grazing, fuelwood collection, irrigation, recreation, and the use of wetland plants for supplementary food and other commercial products. The major existence values are as the habitat of water buffalo, the rich biodiversity, and the cultural heritage. The results of the household survey showed that more than two thirds of the local people residing in the vicinity of the reserve considered the grasslands of Koshi Tappu to be an important unlimited resource that would never be exhausted, and they wanted to use the resources for different purposes. The grasslands have use values for livestock grazing, fodder collection, fuelwood collection, thatch grass, and other minor products. They are also rich in biodiversity. Thus there are differences in the relative importance of the wetlands and grasslands in terms of their use and existence values. The grasslands are more intensively used by the local people than the wetlands; the wetlands seem to have more existence values than the grasslands.

Both the wetlands and grasslands have been threatened by natural calamities as well as by anthropogenic disturbances. The problems in managing the wetlands and grasslands in the Koshi Tappu region are flooding and sedimentation, livestock grazing, grass harvesting, fishing, developmental activities, disturbances in the transitional zone, and socio-political interference.

The wetlands and grasslands in Koshi Tappu are important in terms of both use values and existence values. However, the use values, especially consumptive use, should be carefully handled without compromising the goals of conservation, since promoting the consumption of the resources may lead to their deterioration. It is the existence value of the wetlands in the Koshi Tappu region that has drawn naturalists from the international community to include this region on the list of Ramsar Sites (Wetlands of International Importance). But the type of area for which the region is best recognised lies mostly outside the reserve in areas such as the reservoir and marshes near the barrage and a seepage stream with marshes at its fringes to the east of the PA. Thus the extension of the wildlife reserve up to the barrage is widely advocated.

Effects of Management Practices on the Grassland Vegetation and the Use by Ungulates in Dudwa National Park, Uttar Pradesh, India

Harish Kumar

This paper highlights the results of ongoing research in Dudwa National Park (DNP), Uttar Pradesh, India. The tall grassland habitats in the *Terai* of India are described as stages in the successional continuum between the primary colonisation of new alluvial deposits by flood climax grass and herbaceous species, and the non-flooded climax deciduous forest, which is predominantly composed of sal (*Shorea robusta*). These grasslands are maintained by

inundation during the monsoon and/or by fire and grazing. Current management in the grasslands of the park involves annual burning during the early dry season, grass cutting, and harrowing. This study aimed to assess grasslands, different management practices, and their use by wild ungulate species.

The grasslands of Dudwa National Park constitute more than 15 per cent of the entire PA and can be broadly classified into two types: wet, tall grasslands characterised by *Sclerostachya fusca - Saccharum spontaneum*, and dry, short grasslands dominated by *Imperata cylindrica - Veteveria zizanoidis*. For this study, four treatments were laid out in a split block design in the two different grassland communities: i) grass cut and burned; (ii) grass cut, removed, and burned; (iii) grassland harrowed and burned; and (iv) standing grass burned. The initial plant species' composition, phenology, grass height, phytomass, and pellet counts for swamp deer (*Cervus duvauceli duvauceli*) and hog deer (*Axis porcinus*) were measured. Altogether four measurements were made: one before the initiation of the experimental study and treatment, and three at periodic intervals after the treatment.

In both types of grassland, the harrow and burn treatment had a different effect on the sprouting of grasses, particularly of *Imperata cylindrica* and *Veteveria zizanoidis*, the senescence of I. imperata, and the ungulate grazing pattern than did the other three treatments. Grazing seemed to be heaviest in harrowed and burned sections. Hog deer grazed more heavily in short grassland communities following harrow and burn or simple burn treatments, whereas swamp deer grazed more heavily in tall grassland communities subjected to harrow and burn treatment.

In the short grassland community, the above ground biomass (AGB) was the same in all the different treatment areas at the onset of the study. In April, the AGB in the harrowed and burned areas was low compared to the other treatment areas. It was still lower in July, but by the end of monsoon season the biomass in all the treatment areas was more or less the same again. Treatments and seasons had no interactive effect on biomass. The grass was quite a height before starting the treatments, but during the early months after the treatments the grasses were short and palatability was high.

In the tall grassland community, the above ground biomass was also similar in all treatment areas at the start of the study. By April the above ground biomass (AGB) in the directly burned area was higher than that in any of the other treated areas, the difference was less by July, and, after the monsoon, the AGB was more or less the same in all the treated areas. Interactions between treatments and seasons did affect the AGB in the tall grass systems.

This study is a long-term endeavour and will address the basic question of the impact of grassland management practices on grassland diversity and productivity, and the effect of burning in the protected areas, as more long-term data become available.

Impacts of Grassland Management Practices on Grassland Communities at Royal Bardia National Park, Nepal

Jhamak Bahadur Karki

Grassland management has been practised for the benefit of humans and wildlife ever since the Royal Bardia National Park (RBNP) was established as a Royal Hunting Reserve in 1969. The park encompasses several *phantas* (Baghaura *Phanta*, Khauraha *Phanta*, and Lamkauli *Phanta*) that have undergone many years of intensive management, the primary objective being to protect and conserve some of the endangered wildlife species such as black buck (*Antilope cervicapra*), swamp deer (*Cervus duvauceli duvauceli*), Bengal florican (*Eupodotis bengalensis*), and the sarus crane (*Grus antigone*).

These *phantas* have a varied history of *ad hoc* grassland management. Following the removal of resident populations in the late 60s, communities outside the park were allowed access to cut thatch. However, the timing and frequency of grass cutting has not been consistent. For example, from 1969 to 1979, local people were allowed to cut and carry thatch and forage for seven days per year. Subsequently, the period was increased up to fifteen days during 1980 through 1984. However, from 1995-99, it was reduced to ten days per year, and in 1999, it has been reduced again to seven days per year. Annual burning of these grasslands has also been conducted for a number of years. Some *phantas* have even been ploughed to control shrub and tree invasion. Annual grass defoliation has been estimated to remove about 46 per cent of biomass from the three *phantas* and is believed to cause incessant removal of nutrients from the system, although no research has been conducted to evaluate nutrient losses.

The *phantas* contain patches of very short grazed grassland, called 'grazing lawns', intermingled with tall and short stature grassland patches.Wild ungulates congregate heavily in these grazed patches, but despite their obvious importance for ungulates, little research has been conducted to elucidate their ecology. This study was undertaken with two objectives: 1) to gain a better understanding of the overall impact of the different management practices that have been adopted for defoliation and their impact on ungulate habitat; and 2) to gain a better knowledge of the ecology of grazing lawns. The study was conducted from November 1996 to July 1997. One homogenous grassy area was selected visually in each of the three *phantas*. A completely randomised block design was used to fence the study areas, and four blocks were designated for one of four management treatments: cut+burn (CB), burn (B), cut (C), and control (IN). Each management treatment was also subjected to three different types of fertilizer treatment: di-ammonium phosphate (DAP), urea, and control. Sample plots of one square metre were selected randomly within each of these fertilizer, management, and grazing treatment areas (fenced and unfenced) after one, two and three months following the treatments. The following parameters were measured: green above ground biomass (AGB), species' composition, grass height, grass cover, number of species, and ungulate use. In addition, six fenced areas were erected in the middle of Baghaura *phanta* to study the effect

of grazing on the grazing lawns. Similar parameters were measured for these areas. Laboratory analyses were made of nutrients and minerals in all samples.

One month after treatment, above ground biomass (AGB) was highest in the control areas, followed by the C treatment, the CB treatment, and the B treatment in that order.Utilisation by ungulates was highest in the C treatment areas. After two months and three months, B plots had the highest AGB, followed by C plots, then CB plots. Fertilizer treatment had no effect. Grazing reduced the AGB in C treatment plots in the first month, in CB and B treatment plots in the second month, and in the control plots in the third month.

Grazing lawns had greater species' richness and diversity than the adjacent taller grassland, with broad-leaved herbaceous species contributing more biomass. Grazing lawns also differed substantially in community structure and morphology. The grass growing on grazing lawns tended to have prostrate morphological characteristics, forming a dense mat near the soil surface.

The crude protein content in all species sampled was significantly higher following CB treatments in all three months. Samples from grazing lawns also contained higher crude protein levels, than did samples from the neighbouring taller grass patches. *Oxalis* sp grew abundantly on grazing lawns and had higher concentrations of Na. This dicot species appears to contribute a higher proportion of Na than grass species on grazing lawns, thus accounting for the high total Na in the patch community as a whole, compared to adjacent grassland. Grazing lawns appear to provide more nutritious forage per unit area than the neighbouring taller grassland patches. Thus, they are more attractive to ungulates, who in turn fertilize the grazing lawns with urine and dung, thus promoting plant growth.

Disturbances like fire, flood, and high intensity grazing by mega-herbivores such as elephant (*Elephas maximus*) and rhinoceros (*Rhinoceros unicornis*), open up tall grasslands to form a dynamic patchy mosaic in equilibrium with the prevailing timing and frequency of such disturbances. Grazing lawns are maintained by continuous grazing by these ungulates. It appears that they do not need management intervention as they provide high levels of nutrients and minerals to grazing animals. These important forage resources merit long-term study to provide better understanding of grassland succession and of mechanisms for nutrient and mineral enrichment and maintenance of grazing lawn communities.

It appears that the current management practices of grass harvest and subsequent burning do not have a negative impact on the quantity and quality of grassland. These grasslands presumably sustain the current level of nitrogen loss through additions from rainfall, flooding, fixation from soil microbes and legumes, and from ungulate dung and urine. However, little research has been done to assess losses from the ecosystem resulting from erosion and leaching. Mosaics of grass patches are required to maintain bio-diversity, some areas should be left uncut or unburned on each grassland for cover-dependent ungulates. In addition, the long-term effects of management on lower fauna should be investigated immediately so that loss of endangered/rare species from management actions like harvesting and controlled burning can be avoided.

Importance of Tall Grasslands in Mega Herbivore Conservation

Shanta Raj Jnawali and Per Wegge (presented by Shanta Raj Jnawali)

Tall grasslands were once distributed throughout the floodplains of the Ganges and Brahmaputra river systems of the northern Indian sub-continent but are now confined within the boundaries of protected areas both in Nepal and India. In Nepal, they are now restricted to the river basins of four protected areas in the *Terai*. Tall grasslands provide refuge for a large number of wild mammals, including the greater one-horned rhinoceros (*Rhinoceros unicornis*), wild elephant (*Elephas maximus*), tiger (*Panthera tigris tigris*), swamp deer (*Cervus duvauceli duvauceli*), and wild water buffalo (*Bubalus bubalis*). Besides, a remarkable number of mammals, both birds and reptilian species, use this ecosystem as a refuge. The main objective of the work described in this paper was to assess the importance of the tall grassland ecosystem in mega herbivore conservation with special emphasis on the greater one-horned rhinoceros.

The data presented in the paper were collected from two national parks, Royal Chitwan National Park (RCNP) and Royal Bardia National Park (RBNP). Both areas have a similar climate and more or less similar vegetation types. Of the habitat types common to both areas, Sal Forest, Tall Grassland, and Bushy Pasture are floristically similar in the two areas, whereas Riverine Forests differ in species' composition with *Trewia nudiflora* dominating in Chitwan and *Mallotus phillippinensis* in Bardia. Similarly, the tall floodplain grasslands are dominated by *Saccharum spontaneum*, *Saccharum bengalensis*, and *Phragmites karka in both areas*, but whereas *Themeda arundinaceum* grows in large tracts in Chitwan between the Churia foothills and Rapti river, it does not grow in Bardia's floodplains; *Narenga pophyrocoma*, which is one of the dominant tall grass species in Chitwan, only grows in a localised area in Bardia in the northern section of the floodplain; and *Arundo donax* is more common in Bardia's floodplain than in Chitwan..

The fauna in both parks are similar except that some species are confined only to particular areas. Uncommon mammals include nilgai (*Boselaphus tragocamalus*) and swamp deer (*barasingha*) in RBNP and gaur (*Bos gaurus*) in RCNP. Bardia contains a small sub-population of rhinoceros translocated from Chitwan during 1986 and 1991.

Micro-histological analysis of faeces from Bardia and Chitwan rhinos was used to calculate Relative Importance Values (RIV) for each plant species observed in the faecal sample and thus assess the importance of grasses in conserving rhinoceros. The rhinoceros foraged a wide range of wild food plants, but, in Bardia, nine species, including five grasses and four browse species, contributed more than 70 per cent of the total volume in the annual diet, and, in Chitwan, seven species, including three browse species, made up 85 per cent of the total volume in the annual diet.In both areas the diet was dominated by grass species dominating the Tall Grassland vegetation type. Their proportion was higher in Chitwan (73%) than in Bardia (63%). Browse species made up about 20 per cent of the diet, and agricultural crop plants greater than six per cent in both

areas. Other food plants, mainly herbs, forbs, climbers, horsetails, and pteridophytes, constituted approximately eight per cent with a slightly higher proportion in Bardia.

Both the annual and the seasonal diets of rhinoceros in Bardia and Chitwan were dominated by grass species primarily growing in the tall alluvial floodplain grassland.*Saccharum spontaneum*, a dominant grass species in the floodplain, made the highest volumetric contribution in the diet of both populations. When grasses become coarse and less palatable during the winter season, rhinoceros compensate by foraging on the green leaves of browse species, mainly *Callicarpa macrophylla*, *Calamus tenuis*, and *Mallotus phillippinensis* in Bardia, and *Murraya paniculata*, *Coffea bengalensis*, and *Litsea monopatela* in Chitwan.

In both the protected areas the grasslands are being invaded by different tree species. In Chitwan, *Trewia nudiflora* is aggressively invading grasslands, whereas, in Bardia, *Dalbergia sissoo* is the primary invader in newly established *Saccharum spontaneum* dominated grassland, and *Murraya koinigii*, *Callicarpa macrophylla, and Lantana camara* in association with *Dalbergia sissoo* and *Acacia catechu* the invaders of older tall grasslands. Several management efforts are being made by the park authorities to control invasion by tree species, but so far no interventions have been made to manage the tall floodplain grasslands needed to accommodate the increasing number of megaherbivores and floodplain-dependant ungulates in the two areas. Regular burning of grassland is mostly regarded as an effective tool for controlling invasion of woody vegetation. However, although the current practice of burning helps to some extent to control invasion of woody vegetation into *Narenga*-dominated patches, , it has a very limited effect in Bardia where the *Saccharum* dominated floodplain has a relatively high substrate moisture, and the species sprouts all year round.

The dynamics of the floodplain ecosystem are still poorly understood, since no long-term scientific research has been conducted to understand its ecological processes. Therefore, a comprehensive scientific research effort is needed before any management prescription can be made.

Grassland Management Impacts on Small Mammals

Tika Ram Adhikary

Cutting and burning grass in the protected areas of the lowlands of Nepal arrest plant succession, thereby promoting the growth of new shoots and providing ungulates with an important forage resource from the regenerating grasslands. However, its affects on small mammals have not been studied in detail. Small mammals are an integral component of grassland communities, contributing to energy flow and nutrient cycling, and they have an extremely important role as seed predators, and dispersal and pollination agents in grasslands. Thus, it is very important to review the impacts of grassland management on small mammals with reference to the *Terai* grasslands of Nepal and provide recommendations for conservation.

Past research done elsewhere on the biology and conservation problems of the hispid hare (*Caprolagus hispidus*) and the pygmy hog (*Sus salvanius*) indicated that both species were confined to patches of unburned tall grassland along streams where, without this protective cover, they were vulnerable to predation. Thus, the long-term survival of the hispid hare and pygmy hog populations remains at risk as a result of the current management policies where tall grassland is burned or harvested for thatch and cane during the dry season. Livestock grazing can also affect small mammals directly by trampling of burrows, compacting soil, or competing for food; or indirectly by altering the structure or species' composition of vegetation in a manner that influences habitat selection by small mammals. However, it is very difficult to generalise the effects of grazing on small mammals. Usually, the variety and abundance of small mammal communities depends on how grazers have used the grassland.

Widespread cutting and burning together with grazing can have a significant effect on disturbance-intolerant or cover-dependent small mammals. However, fire not only reduces litter inputs, it can lead to increased floristic diversity and also appears to benefit other small mammal species. Thus a patch management system may be an effective way of maintaining a variety of habitats for various species,. Finally, little is known about the response of small mammal species to management prescriptions and the ecological consequences, and further studies should be conducted on small mammal populations.

Impact of Grassland Management on Avian Fauna

Hem Sagar Baral (invited paper, not presented at the workshop)

Grasslands in the *Terai* are an important habitat of many bird species. This paper highlights preliminary research conducted to assess grassland bird diversity using linear transects of varying length in three protected areas in the *Terai* (Chitwan, Koshi Tappu, and Shukla Phanta) during the years 1996-98. During each visit, data were collected on species, number, sex, location, and behaviour of birds, as well as several environmental parameters such as species' composition, phenophase, average height of grasses, soil moisture, bare ground percentage, percentage of other vegetation cover, proximity to water and forest, and grazing, burning, cutting, and other disturbances..

Fire, floods, cutting, grazing, and disturbance are the major ecological factors that effect avifaunal life in grasslands. In the study, a total of 219 species of birds were identified, 10 of which were species that are globally threatened and exclusively depend on lowland grasslands. Chitwan and Koshi Tappu contained the largest number of globally threatened species among the three protected areas. However, Shukla Phanta appeared to be the most outstanding grassland reserve of Nepal, followed by Chitwan, from the point of view of harbouring populations of globally threatened species. At the national level, Chitwan and Shukla Phanta seem to be the most outstanding grassland reserves of Nepal.

Partially burned grasslands away from forests (>100 m) showed slightly increased bird diversity but significant increase in abundance. Unburned and

totally burned grasslands showed less diverse bird communities and lower abundance. Flooding mainly affects the sedentary grassland specialist birds. Low and moderate levels of grazing may be beneficial for bird communities, but cutting and ploughing generally contributed to decreased avian diversity.

The present grassland areas are not sufficient to maintain the population of several globally and nationally threatened taxa. Therefore, internationally important grasslands in Chitwan and Shukla Phanta should be declared grassland reserves. In addition, open lands in some parts of the extension area of Shukla Phanta should be converted to a grassland area of outstanding importance for birds, as well as for mammals. Finally, the current practice of grassland management, which is mainly aimed at increasing the population of large mammals but overlooks the threats to other smaller taxa, should be changed.

Discussion

After the presentation of technical papers on *Terai* Grasslands, the presiding chairperson, Sushil Bhattarai, opened the floor for discussion.

The key points raised are listed below.

- A regional approach to the study of grassland ecology and management practices in protected areas in both Nepal and India is needed, rather than addressing individual protected area(s).
- There is a concern that continuous burning of grasses could result in nutrient losses and change the composition of the grassland. However, it was agreed that disturbances such as burning, grazing, and flooding are vital to the maintenance of habitat and promoting of nutrient cycling. Leaving unmanaged biomass with no nutrient cycling could have far worse effects.
- Nepal and India have adopted different strategies with respect to cut and burn practices in the grasslands. In India, PA managers have completely banned local communities from harvesting grasses and grazing livestock, as a result of the park-people conflicts that arose. In Nepal, PA managers allow local grass harvesting as a tool for managing the grasslands.
- The question was asked whether an agro-ecosystem approach could be applied in *Terai* PAs. It was reiterated that land in the *Terai* has a greater potential to produce biomass than land at high elevation, and thus better potential for land-use intensification, for example, growing thatch grass near villages. An agro-ecosystem perspective is perfectly suited to the *Terai*, as the land-use practices in the area are changing fast and, without understanding those changes, sustaining a protected area will be difficult.
- The management in Bardia has initiated activities with local people regarding collaborative efforts between park and buffer zone communities to manage forests outside the *Terai* PAs. Forests outside the park could eventually be developed as corridors for wildlife species for their movement, although managed through mobilisation of the buffer zone communities. Indian protected areas were experimenting with joint forest management practices to improve the rural economy. The aim was not only to conserve endangered and other wildlife species but also to improve forest quality. There was general consensus that it was difficult to manage grasslands and forests

outside protected areas unless there was support from stakeholders such as other government departments and the local communities.

- On the question of the use of fertilizer to treat grasslands, it was agreed that PAs should not be managed like a garden, although fertilization could be carried out on a controlled basis as an experiment.
- Confusion arose over the use of the term 'semi-natural grassland'. The term as explained has management implications, as it is a grassland community that is maintained by anthropogenic activities such as burning and grazing that otherwise would revert to forest. Alluvial grasslands would not be considered semi-natural as they are maintained by a natural hydrological process, not a primarily anthropogenic one, although humans do have an impact.

Mountain Forests and Rangelands[3]

Indigenous Livestock Management Systems in Upper Slope Forests of Central Nepal

Santosh Rayamajhi, Don Messerschmidt and Bill Jackson
(paper invited, but not presented at the workshop)

The upper slopes of Nepal, with their rich biological and cultural resources, are defined as the area lying between 2,000 and 4,000 masl, and are located in the High Himalayan and High Mountain physiographic regions. They possess a rich wealth of grasslands and forests that can sustain sizeable populations of livestock. Strategically, livestock management is considered to be the most viable option in natural resource management for the upper slope communities. This paper describes the outcome of research on indigenous livestock management systems of upper slope communities in Central Nepal. The research was done by a multidisciplinary team during January to June 1996 in Sindhupalchowk and Kabhrepalanchowk districts. The paper specifically deals with the upper slope's demographic, socioeconomic, and bio-physical settings; the impact of livestock herding on the natural resources and environment of the upper slopes; and the strategy of the livestock management system in response to the changing demographic, socioeconomic, and bio-physical settings of the upper slopes.

The upper slopes are also called *'lekh'*. The ethnic identities of the people who live in or in close proximity to upper slope forests vary by locale (especially by altitude), sometimes by season, and specifically by *lekh* and district. Tamangs and Sherpas are the majority populations living in these areas. Secondary and tertiary users of upper slope resources reside at lower altitudes and represent a wider and more typical range of hill ethnic and caste groups.

There are three main land-use type categories: agricultural, forest, and shrubs and non-agricultural, including grasslands. The forest and shrub category can be

[3] Full papers are presented in Volume III of this Workshop Series

further divided into four broad vegetation types: coniferous forest, broadleaf forest, mixed forest, and shrubs and the non-agricultural land category into grasslands and other. The distribution of vegetation types mainly reflects climate, topography, altitude, and aspect.

The upper slope environment contains a vast wealth of natural floral and faunal resources, but these resources are heavily impacted by human and livestock utilisation. The particular 'hot spot' for management attention is the transition zone (2,500 to 3,000 masl) where lower altitude and higher altitude livestock herding overlaps.

Nepal's highland people have developed some unique lifestyles and cultures which, in the modernising national economy of Nepal, are in danger of losing their distinct identities. The paper briefly deals with the people's culture in the highlands in Sindhupalchowk and Kabhrepalanchowk Districts. Transhumant livestock herding in Nepal is a cultural system characterised by mobile camps (*goths*) and seasonal movement between pastures (*kharkas*), ascending during spring to the summer pastures and descending during autumn to the winter pastures. Three styles of livestock management are found in the upper slopes in Sindhupalchowk and Kabhrepalanchowk Districts, full transhumance, semi-transhumance, and stall-fed (non-transhumance). The first two are based on seasonal transhumant movements of herds on the *lekh*, and are distinguished by variations in livestock type, altitudinal range, seasonality, and ethnicity. The third focusses on stall-fed animals in villages. These three distinct patterns of livestock management are clear indications of the strategic response of the herders to resource scarcity.

The indigenous livestock management systems in the highlands have recently been influenced by several factors. These include the construction of new roads into formerly remote locales; the opening of new markets for agricultural, livestock, and forest products; greater access to schooling and health facilities, including clean water supply, and new or expanding opportunities for migrant labour and small business investment in and out of Nepal.

Despite various social and political constraints, traditional livestock systems are still prevalent in some locales and those practising them are making every effort to rationalise resource use by extra-legal restrictive measures under community or communal pasture management systems. Various characteristics of these systems that would facilitate effective collaboration in forest conservation initiatives are discussed.

Alpine Vegetation of North Western India: An Ecological Review

Gopal S. Rawat

This paper presents a reviewed report of the major ecological work related to the alpine vegetation of the Greater and Trans-Himalayas within north-west India. The vegetation characteristics in terms of major physiognomic and community types, factors influencing the species' richness, and biomass

production are discussed together with major conservation issues. The implications, the different research findings for the conservation, and management of alpine ecosystems are also mentioned.

The vegetation of the alpine region has been described under two broad headings: a) alpine vegetation of the Greater Himalayas[4], and b) vegetation of the Trans-Himalayan regions. Nearly 1,500 to 1,600 species are estimated to occur exclusively in the alpine region; the species' richness in the Greater Himalaya is higher than that in the Trans-Himalayas.

The alpine zone within the western and north-western Himalayas is generally separated by a distinct treeline characterised by birch-rhododendron (*Betula utilis - Rhododendron campanulatum*), fir (*Abies pindrow*), or brown oak (*Quercus semecarpifolia*) forests. The major vegetation types in the alpine zone include; a) Alpine Scrub, b) Alpine Meadows, and c) Scree slopes and moraines. In addition, timberline ecotone and sub-alpine (anthropogenic) herbaceous formations, which gradually merge with the alpine communities, are also included under high altitude vegetation. The Trans-Himalayan areas are generally devoid of forest vegetation. However, a few patches of *Juniperus macropoda* and *Salix* woodlands can also be seen in some parts. The major formations in this area include; a) Steppe Formations, b) Herbaceous and Grassy Meadows, and c) Cold Deserts.

The alpine habitats are, perhaps, the most heterogeneous and fragile. The vegetation in these areas exhibits a complex mosaic of succession. Basically, two parallel courses of succession are found: meadow succession and forest succession. In the first, several annual herbaceous formations are considered as the climax community; in the latter the birch-rhododendron (*Betula utilis - Rhododendron campanulatum*) community is considered to be the most stable vegetation.

Vegetation in the alpine zone has also been affected by several human activities. Livestock grazing, collection of medicinal herbs, collection of fuelwood, and wildlife use are the main conservation issues in these areas. An increased number of livestock and overuse of certain pastures can lead to degradation of high altitude grasslands, including the habitats of wild herbivores. However, as livestock grazing has a differential impact on various plant species, the practice cannot be seen as completely negative. In contrast, overexploitation has led many species of medicinal herbs to be in danger of local extinction causing concern among conservationists. Extraction of fuelwood, particularly from the low productive areas of the Trans-Himalaya, is one of the major issues in the conservation of steppe communities. Some of the options are management of grazing areas and livestock in the Trans-Himalayan zone, partial grazing in the protected areas, practice of site specific or species' specific conservation plans for management of rare plants and their habitats, management of degraded areas, research and monitoring, and peoples' participation in the conservation process.

[4] Synonymous with the High Himalayan Physiographic Zone in Nepal. Please note only when referring to well-defined geological regions will the Sanskrit term Himalaya be used (Ed).

Rangeland, Animal Husbandry and Wildlife in Annapurna, Nepal: A Case Study

Som Ale

Livestock are vital for the economy of communities residing in the remote high altitude valleys of Nepal. Many of the traditional pastoral systems, however, are currently in the process of substantial change as a result of external influences related to modern developmental activities, and this is affecting the age-old balance between herbivores and plants, and thereby the whole predator-prey system. This is the situation in upper Manang, which is a dry alpine valley and a transition zone between the moist southern Himalayan slopes and the high deserts of Tibet. The abundant pastures of upper Manang have long supported the traditional herding of yaks, yak-cattle cross, cattle, sheep, and goats. Over the past several decades, however, major changes have taken place that have greatly affected the lifestyle and land use of the people, as well as the array of wildlife that occurs.

Since the 1990s, the valley has drawn the attention of both government and non-government agencies. The Ghenjyang Irrigation Project and the large Buddhist monastery under construction in Ngawal are two examples. The Annapurna Conservation Area Project (ACAP) of the King Mahendra Trust for Nature Conservation (KMTNC) extended its work in Manang in 1993 and has now successfully established a cohesive partnership with the local populace which involves from planning to implementing arrays of activities directly or indirectly related to nature conservation. There are a several pressures on the valley. It has been one of the most popular trekking routes in Nepal for the past two decades. At the same time several households have recently returned to Manang following a stint of international trading, and most of them now maintain livestock herds in response to tourism and local demands. There is a growing concern that the pressure on wildlife habitat is increasing. Thus it is vital to monitor the potential impact of changing numbers of wildlife and livestock on the vegetation composition and productivity of these remote wild lands, and thereby on ecosystem functioning.

Rangelands comprise approximately 12 per cent of the total area of Manang District. The rangelands consist of scrubland vegetation and alpine grasslands. Scrublands are dominated by such genera as *Juniperus, Rosa, Berberis,* and *Lonicera*, whereas the alpine grasslands are dominated by sedges, such as *Carex* and *Kobresia,* and grasses such as *Calamagrostis* and *Stipa* .

In Manang Valley, grazing is an important land use and has a functional relationship with the existing agricultural, economical, social, and religious activities, as well as influencing the survival of the region's wildlife. Such old indigenous practices may also explain the existence of large herds of blue sheep (*Pseudois nayaur*) on high pastures in the valley. The present numbers of livestock in some parts of the valley have been reported to be three times higher than those of blue sheep, suggesting unavoidable livestock depredation and direct conflict between the local populace and predators. On the other hand,

livestock may be helping to sustain the population of predators such as snow leopards (*Panthera uncia*) in the valley.

In a landscape of marked relief where cultivable ground is scarce, cropping for direct human consumption takes precedence over fodder cultivation. Nevertheless, hay fields are maintained throughout the valley. Even so, supplementary feeding in the form of hay and crop residues is small and not enough to last the winter, so livestock must depend on what the land offers. The area is semi-desert, so, although summer grazing is luxuriant, the most important constraint is the availability of winter feed. This essentially means that animal numbers must be regulated in accordance with the limits of winter feed. In Manang, the response of farmers and pastoralists has been to create a detailed set of social rules and regulations for grazing.

The strategies that are associated with pastoralism are seasonal movements of livestock, multi-species' diversification, and the maintenance of large herds as insurance against losses from disease and unpredictable storms. In order to practice these strategies, the community schedules livestock movement. The key to effective control is the *tohsom* system, literally meaning 'field-watcher'.The *tohsom* system maintains rotational grazing between high pastures located between 4,000 and 5,000 masl and the fields around the villages, thereby maintaining the balance among the existing scarce forage resources.

Research and monitoring activities are essential for assessing the impact of the ACA project and providing adequate feedback to make corrections and refinements. The long-term goal of research and monitoring should be to support ACAP's database and help to better conserve and manage the endangered snow leopard, its prey species, and their remote and fragile high altitude habitats. The major scientific contribution of the proposed research project would be to test ecological theories of food-chain dynamics in field conditions and help develop other theories related to the Himalayan alpine ecosystem. It is clear that one of the factors affecting biodiversity and rangelands in Manang Valley is the changing pastoral system. Thus the proposed project will address basic ecological questions such as range-use patterns by wild and domestic ungulates, selection of grazing habitats, and anti-predator behaviour. Blue sheep may be used as an indicator species for the alpine and sub-alpine grassland habitats in Manang.

Grasslands in the Damodar Kunda Region of Upper Mustang, Nepal

Rita Arjel Koirala, Rinjin Shrestha, and Per Wegge
(Presented by Rita Arjel Koirala)

Himalayan grasslands are complex; they contain a mosaic of vegetation communities along a steep altitudinal gradient combined with a myriad of topographical features. The region provides habitats for a unique assemblage of large wild ungulates, like naur (or blue sheep) (*Pseudois nayaur*) and argali (*Ovis ammon hodgsonii*). In addition, the area also provides a livelihood for

mountain people. Information on the floristic composition and other habitat features is a prerequisite for land-use planning and management. The objectives of the study described here were to describe and compare different plant communities and habitats used by the rare Tibetan argali, the more common naur, and domestic goats. The study was carried out in the Damodar Kunda region of Upper Mustang.

The general physiognomy of the study area is that of high elevation cold desert, and the vegetation is desert steppe vegetation of the Trans-Himalayas. The grasslands have been used for a long time by pastoralists to graze domestic stock.

After a preliminary survey, the study area was delineated into three zones (argali, naur, and goat) for a detailed study of vegetation types and forage availability. Community structures were determined by placing 474 quadrats along transects in five different vegetation types. The percentage cover of individual species was estimated in each quadrat. The species were classified into three lifeform classes, graminoids, forbs, and shrubs and into palatable and unpalatable categories based on interviews with herders and secondary sources. The phenological stages were recorded in the form of vegetative/sprouting, flowering, and senescence. Physical parameters like altitude, aspect, slope, and percentage of bare ground or scree were noted to assess the general habitat characteristics. Prominence values were determined and then weighted in order to obtain an expression of species' abundance in the total study area. Finally, the species' richness value (SRV) in the different zones was determined.

The three zones differed in landscape pattern, spatial arrangement of vegetation types, and distribution of ungulates. The argali zone was situated at the highest altitudinal range and consisted of three vegetation types; a) Desert Steppe, b) Dry Meadow, and c) Dry Grassland. The naur zone was located on the south side of the Namta River at lower altitude and consisted of three vegetation types; a) Dry Grassland, b) Wet Meadow, and c) *Lonicera* Community. The goat zone was located in the area of moderate topography and luxuriant vegetation. It consisted of three vegetation types and was dominated by the *Lonicera* Community with Wet Meadow and Dry Grassland as subordinate communities.

Of the five different vegetation communities, the Dry Grassland type was distributed in all three zones, Desert Steppe and Dry Meadow vegetation types were only found in the argali zone, and Wet Meadow and *Lonicera* types were found in the naur and goat zones. Most of the plants were in the flowering stages in all three zones. Some plants were in the early growing stages and a few species in senescence. The important palatable species included *Kobresia pygmea, Kobresia sp, Saussurea graminifolia,* and *Stipa* and *Elymus nutans* in the argali zone; *Kobresia* sp., *Stipa* sp. and *Lonicera rupicola* in the naur zone; and *Lonicera rupicola, Stipa, Kobresia,* and *Elymus nutans* in the goat zone. The species' richness in terms of total number of species was higher in the goat and naur zones than in the argali zone. The total available forage was lowest in the argali zone and highest in the naur zone. Both graminoids and forbs were most available in the naur zone, whereas shrubs were most available in the goat zone. Thus the argali zone, which covered the largest area, was poorest in total available forage.

Because the three ungulates were spatially separated with distinct differences in summer diets, resource competition is probably minimal during summer at current animal densities. Domestic stock grazing by goats could probably be increased without negative effects on the rare and endangered Tibetan argali, provided animals are only herded within the Namta watershed. Extending domestic stock grazing into the Tehchang watershed of the argali zone should not take place until the seasonal habitats of Tibetan argali are better known, as increased summer grazing may have negative effects on the winter pastures of this wild sheep species.

The Damodar Kunda region provides a mosaic of habitats with a unique aggregation of rare and endangered wild animal species. Hence the region can appropriately be termed a bio-diversity 'hot spot' and requires special management programmes for the conservation of this asset. Pasture condition was found to be good, as indicated by a healthy breeding population of argali and naur, and low coverage of unpalatable species, thus the idea has been raised of promoting increased livestock husbandry in the region. However, grazing by domestic stock during summer may limit forage availability during winter for wild ungulates if the latter do not move out of the area. It is not yet known whether the rare and endangered argali remain in Damodar during winter, but naur traditionally move down to lower elevations during and after the rutting season in December. Hence, studies of the seasonal habitat use by argali, and of pasture condition, particularly the impact of summer grazing by livestock on forage quality and availability during winter, are required to assess the possibility of promoting animal husbandry in the region.

Ecological Separation between Ibex and Resident Livestock in a Trans-Himalayan Protected Area

Yashveer Bhatnagar, Gopal S. Rawat, A.J.T. Johnsingh, and M. Stüwe
(Presented by Yashveer Bhatnagar)

In recent years, the perceived pressure on the Himalayan rangelands and protected areas resulting from the rise in livestock populations has led government agencies to prohibit livestock grazing within wildlife protected areas in India, as per the Indian Wildlife Protection Act 1972. Several observations show that agro-pastoral communities in the Himalalyas have no place other than in protected areas to graze their livestock. Thus it is important to assess whether livestock in a protected area are actually detrimental to the ecosystem before prohibiting grazing. In this study, we attempted to quantify the extent of habitat separation between sympatric populations of ibex, the primary wild ungulate in Pin Valley National Park, and resident livestock.

Pin Valley National Park, located in the Lahul and Spiti district of Himachal Pradesh, India, is characterised by a cold, arid climate with a short plant growth period. Approximately 1,250 people live in 17 villages located in the buffer zone in Pin Valley where people graze their livestock in the park between May and December every year. The study was limited to the possible competition between ibex and livestock in that area. The main techniques used in the study

were local interviews, counting livestock in the field, survey of the habitat used by livestock along the trails, and monitoring radio-collared ibex.

Resident livestock in Pin Valley were grouped into two categories; a) species dependent on human settlements, i.e., the livestock that were directed to pastures every morning and herded back into pens in the evening; and b) species independent of human settlements, i.e., those that could have been herded back into pens, but which were essentially kept in pastures far from settlements. The dependent villages had a livestock holding of 1,266 animals, but only *ca.* 350 of these were grazed within the national park and adjacent tracts that formed the study area. About 200 to 250 ibex in the Parahio watershed shared the area with the *ca.* 350 resident livestock between May and December each year, i.e., more than 1.4 livestock per ibex, indicating a clear possibility of competition pressure.

The livestock showed seasonal differences in the use of terrain type, aspect, distance to escape terrain, and altitude. There were, however, no seasonal differences in the use of slope categories. The ibex also showed seasonal differences in habitat use. There was a high degree of spatial overlap between ibex and resident livestock in spring. In summer, however, ibex moved to higher elevations, while most livestock remained along the valley bottom, resulting in spatial separation.

There was some overlap in the use of altitudes, terrain types, and aspect by ibex and livestock during spring and autumn. However, the separation between the two was clear regarding the use of slope and distance to escape terrain during all seasons. The separation between ibex and livestock was highest during summer when they differed in the use of altitude and terrain type. Ibex and livestock could potentially compete for resources during spring and autumn, while during summer the possibility of either 'exploitation' or 'scramble' competition is excluded as a result of the spatial separation.

In most natural communities, competition usually leads to niche partitioning in such a manner that species can co-exist. Sympatric animals using similar resources may separate at the spatial level, at the level of use of habitats, and/or at the level of selection of plant species or plant parts. Even during the spring and autumn months, the ibex in Pin Valley separated from resident livestock in the use of habitat. They used steeper areas and areas closer to escape terrain. During summer they used higher altitude. The question is whether ibex separate into such areas owing to competition from livestock, or independent of this. The results showed that the two groups were usually separated by over 500 m in altitude, with little overlap, and there was also a considerable magnitude of difference in the use of slope and distance to escape terrain. Thus it is likely that at present, resident livestock use the largely 'vacant area' that ibex rarely use owing to their adaptations and are unlikely to pose a direct threat to ibex.

The other question is how summer foraging by livestock limits the availability of forage during winter, the period when they were not present in the area. It seems unlikely that summer grazing by resident livestock depletes winter forage for ibex, because most of the grazing areas used by livestock are covered by

heavy snow during winter and are not used by ibex, which prefer steep, snow blown rocky outcrops. Thus, even during this period, resident livestock probably do not adversely impact forage availability for ibex.

In conclusion, although there is likely to be no adverse impact of resident livestock on ibex at present, the situation could change if people increase their livestock holdings. Thus intervention by owners to regulate the number of livestock and pastures for livestock grazing is an effective compromise towards conservation goals in protected areas in the Trans-Himalayas that have a scarcity of pastures. Research should be performed to determine whether resident livestock may pose a threat to ibex through transmission of contagious diseases, and whether habitat use by migratory livestock and fuelwood removal from the park needs to be controlled to ascertain the long-term conservation of ibex in the Pin Valley National Park.

A Participatory Approach to Rangeland Research and Management: Developing an Action Plan for Rangeland Conservation in Mountain Protected Areas

Camille Richard and Colleen McVeigh (Presented by Colleen McVeigh)

Rangeland ecosystems of Nepal are experiencing rapid socioeconomic changes that are influencing the way people use resources and herd their livestock, often resulting in reduced land for grazing and overexploitation of forests, thus leading to over-grazing and degradation.. In order to understand and address such complex issues it is necessary to use an inter-disciplinary and participatory approach, but although this is often talked about it is rarely actually done. In countries such as Nepal, people's participation in conservation management is actually mandated by law. Despite the rhetoric and legislation, however, true participation in resource management and forestry and conservation practice is far from satisfactory. This stems mainly from a lack of institutional capacity to implement participatory approaches and a lack of understanding of what is truly meant by the term **participation**.

Participation is a process based on a philosophy of empowerment that facilitates the active involvement of stakeholders in decision-making and gives credence and value to all stakeholders' knowledge, including both scientific and indigenous knowledge. True participation offers a number of advantages, such as:

- building rapport among stakeholders;
- bridging the gap between scientific and indigenous knowledge;
- improving conservation awareness among stakeholders;
- facilitating interdisciplinary data integration;
- strengthening local capacity for planning, implementing, evaluating, and continuing activities;
- expediting the project implementation process;
- increasing research and project planning transparency; and
- ensuring project continuity.

Although it has its limitations, the benefits far outweigh the disadvantages, so such approaches make sense from both a managerial and economic point of view.

Developing action plans for participatory rangeland research and management require adopting particular operational methodologies. First is the need for an **agro-ecological perspective**, taking into consideration the different ecosystems and associated farming systems in the region. **Participatory action research (PAR)** is then used as the framework for assessment, planning, and implementation. This approach helps determine future courses of action through community empowerment and collaborative decision-making among communities, government entities, and other relevant stakeholders.

The paper further elaborates on PAR as a methodology. In summary, PAR requires a series of phases to assess and plan for interventions in rangelands, starting with a diagnostic phase intended to define local conditions and to identify key stakeholders. When designing the initial participatory action research plan for a particular protected area, consider these preliminary steps.

- Consider your resources in terms of available funds and capacity
- Collect and collate the existing information on the PA
- Identify knowledge gaps
- Present the gap analysis to various stakeholder groups for feedback
- During group meetings, set initial priorities and objectives for research based on mutually shared issues and concerns
- Select the initial Core Team to conduct diagnostic phases based on group interest
- Conduct a diagnostic rapid assessment using an agro-ecosystem framework with methods such as participatory rural appraisal (PRA) or rapid rural appraisal (RRA)
- Present this information in stakeholder group meetings for feedback
- Mutually define the next phase based on the outcome of studies and group consensus
- Implement the next phase, evaluate, and continue the process

The primary goal of a participatory approach is to link stakeholders so that solutions and options are mutually identified and planned and all involved have ownership of conservation initiatives. Although sometimes difficult to initiate, in the long term, the results of such an approach lead to a dynamic two-way channel of information flow that will facilitate conservation of Nepal's rich biodiversity. The next paper offers an example of this dynamic process.

Managing People-Wildlife Conflict on Alpine Pastures in the Himalayas

Rodney Jackson (paper invited, but not presented at the workshop)

Many communities in the Himalayas suffer recurrent loss of valuable livestock to wild predators like the endangered snow leopard (*Uncia uncia*), thereby

presenting park managers with the need to find ecologically sound and economically sensible long-term solutions which best balance the respective needs of pastoralists with those of wildlife sharing the same habitat. Since 1996, the author, The Mountain Institute, and the International Snow Leopard Trust have been experimenting with new and more participatory ways of dealing with this highly contentious issue in Tibet, and to some extent in Sikkim. Community-based workshops, employing APPA (Appreciation Participatory Planning and Action) and PRA (Participatory Rural Appraisal) techniques, seek to reduce depredation loss, increase villagers' income, and protect nature, while at the same time building community self-reliance for planning, resource management, and income generation within the targetted protected area. This paper summarises the methods used and results obtained thus far. It includes, as appendices, a detailed 'tool-box' of simple, participatory techniques and project planning criteria that could be applied to the problem throughout the Himalayas.

Conflict between livestock owners and predators is not a recent phenomenon that is caused by the establishment of nature preserves or new wildlife legislation. Before modern firearms and traps were available, herders had developed simple but effective methods for minimising losses from predation such as maintaining close watch over livestock, avoiding predator-rich areas, employing guard dogs, breeding sheep or goats that have well-developed anti-predator traits, and keeping livestock in predator-proof corrals at night. Erosion of traditional knowledge, reduced herder vigilance, increased livestock numbers, and changes in animal husbandry management systems have aggravated the depredation problem. Although losses vary from site to site, year-to-year, and seasonally, winter is usually the time of greatest concern. Depredation is not evenly distributed, but rather associated with the nearby presence of cliffs, rocky areas, and good cover.

The best long-term strategy lay in combining preventative and remedial measures such as: improving guarding of livestock, especially in depredation 'hot-spots'; encouraging communities to hire skilled shepherds; promoting the use of improved breeds of guard dogs; creating core areas for snow leopard and blue sheep which are largely or entirely livestock free; assisting herders to increase their incomes from alternative sources; offering incentives for community development projects in exchange for predator and wildlife protection/conservation actions by the community; and developing safeguards against herders or communities making fraudulent claims, killing snow leopards, or illegally poaching wildlife.

The dynamic *APPA* process is used to mobilise villagers to adopt these remedial measures and to begin addressing crop or livestock depredation by building a common understanding of conservation objectives. In the case of the projects discussed in this paper, these objectives are: (1) to identify and implement ecologically sound and acceptable measures to reduce or possibly even eliminate wildlife crop and/or livestock damage, while simultaneously increasing crop and animal productivity to the extent possible; (2) to protect wildlife and habitats in accordance with existing PA regulations; (3) to promote alternative but environmentally responsible and socially acceptable forms of income,

implemented and sustained through existing institutions, which foster community pride and build greater self-reliance; and (4) to train villagers and park staff in participatory resource assessment, planning, and management.

The basic steps involved in developing remedial measures for livestock (or crop) damage include the following activities: (1) verify that predators are an important threat to livestock by gathering baseline information on all sources of mortality to a particular village's livestock herd; (2) consider existing and alternative measures for reducing losses; (3) identify the environmentally, socially, and economically most appropriate control measure(s) and sign reciprocal agreements with herders and communities; and (4) implement measures according to a 'best practice' work-plan that details each party's responsibilities from implementation through monitoring and evaluation phases.

Among the assumptions important to appreciate when designing a programme for alleviating wildlife crop or livestock damage are the following: (1) the internal and external threats to snow leopards (or any other target species) and biodiversity have been correctly identified and can be addressed using existing resources; (2) the project site should be biologically significant (i.e., contain good wildlife populations, worth the investment being proposed); (3) local communities have pride in their way of life and culture, but are willing to adjust certain behaviour if it negatively affects species, habitats, or ecosystems; and (4) sufficient resources and skills are available to assist willing communities to develop, implement, and monitor plans for balancing biodiversity conservation and income generation.

In Nepal, there is a pressing need for researchers, development-conservation NGOs, and the Department of National Parks and Wildlife Conservation to collect reliable baseline information on crop and livestock damage sites, rates, and patterns in order to lay a sound framework for developing site-specific and locally adapted remedial measures. Research efforts in the Himalayas should focus on how herding practices could be improved, monitoring the abundance of prey species, establishing actual livestock losses to wild predators, and assessing the ecological impacts of expanding livestock holdings.

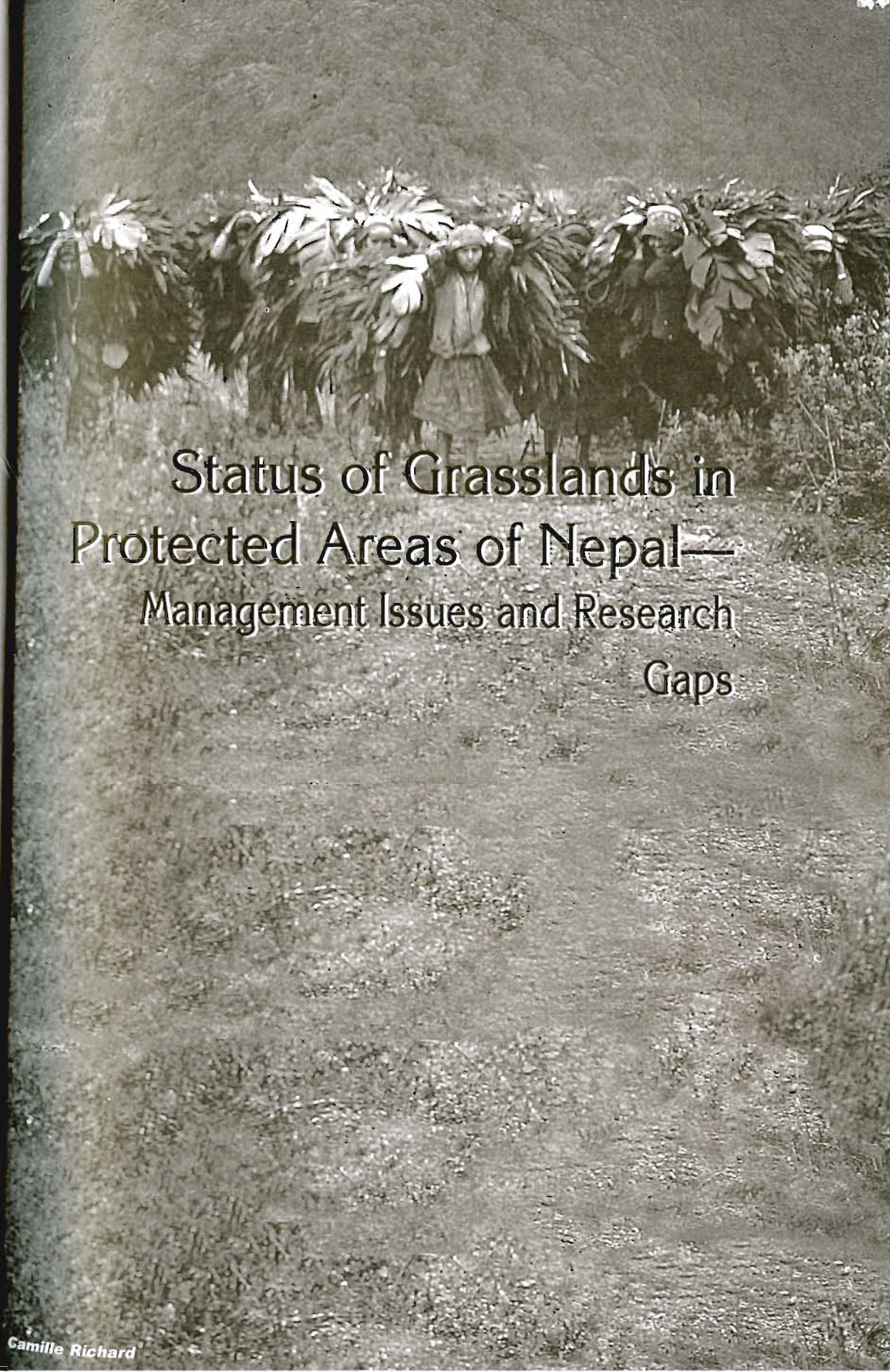
Discussion

Following the presentations on mountain forests and rangelands, the presiding chairman, V. B. Sawarkar, opened the floor for discussion. The salient points raised during the ensuing discussion were as follow.

- It is a misconception that erosional landscapes in the desert areas of the Trans-Himalayas are a result of overgrazing. They are the result of natural processes and showing photos of such landscapes gives the wrong impression about livestock and their impact. However, it was argued that livestock can accelerate the erosional process.
- There was a question on grazing issues in alpine grasslands and concern that these areas might not be able to sustain livestock grazing. However, the question was raised whether it was practical to remove livestock from alpine meadows, given the importance of this grazing resource for local husbandry systems. In many areas of the Trans-Himalayas, livestock and wildlife have

co-existed for centuries and impacts are minimal, it was argued. For example, in Shey Phoksundo National Park in the Trans-Himalayas, people had ready access to protected area pastures, but, as the herds of livestock are small, there has not been much disturbance. While the blue sheep grazed at higher elevation, livestock mostly grazed at a lower elevation in the valley, as was also found in Pin Valley National Park for ibex and livestock.

- Careful planning was strongly urged for these high elevation areas. For example, pressure from grazing might mount in ecologically sensitive zones such as the transitional tree line zone.
- Despite the common belief that all alpine areas of the Himalayas are subject to livestock grazing, the point was raised that there are alpine areas in Bhutan and Arunachal Pradesh that have never experienced livestock grazing. The takin, the Bhutanese national animal, graze there without any disturbance from livestock.
- In reply to a question on whether there were rules and regulations guiding the grazing of livestock in Pin Valley National Park, and about users' rights to such pastures, it was said that under current law resident communities have limited access. However, the local people do not appear to be degrading the habitat, as livestock and ibex are grazing together with little overlap. Often habitat can be enhanced by livestock grazing, and ibex may be following fresh sprout in the spring season as a result of grazing.
- Socioeconomic changes affect the way people herd their livestock and the types of livestock they keep. For example, if tourism is introduced into an area, local people would start using livestock more for transportation purposes.
- Retaliation against snow leopards because of livestock depredation varies among communities. In upper Manang, even though there is a high level of livestock depredation by snow leopards, reprisal killing is low because of religious restrictions.
- Hunting of ibex for sport, as in Pakistan, is not possible in India where all hunting has stopped, it is prevented by both religious sentiment and government laws.



Status of Grasslands in Protected Areas of Nepal—Management Issues and Research Gaps

Camille Richard

Terai Protected Areas[5]

Chief Wardens from the *Terai* PAs presented the status of grassland research and management in their respective areas. The highlights of their talks are summarised below. The Chief Wardens from Royal Chitwan National Park and Koshi Tappu Wildlife Reserve were not present to provide status papers and are thus not represented in this summary. Research from Koshi Tappu and Chitwan is presented in the summary of technical papers.

Parsa Wildlife Reserve (PWR)

Surya Bahadur Pandey

Parsa Wildlife Reserve, located in the central *Terai*, was gazetted in 1984 as an extension of the Royal Chitwan National Park to provide additional coverage of pristine habitat for the increasing population of wild animals in the National Park. The reserve is primarily located in the Bhabhar region south of the Churia hills, so the area is covered with dense forest and has hardly any natural grassland. However, a small patch of grassland has been created by clearing the *Eucalyptus* trees that were planted as part of a research project before the declaration of the reserve. There is a plan to create more grassland by clearing another *Eucalyptus* patch and relocating existing settlements outside the reserve. The newly created grassland has provided additional grazing land to the wild animals and thatching grass to the local people. The same is expected for the planned area, It is hoped that creation of the grassland areas will help in the conservation of biodiversity within the reserve.

Management Issues

Under the proposed management strategy framework and the grassland conversions, four settlements (Rambhouri, Bhata, Ramouli, and Pratappur) will be relocated. This will need the cooperation and commitment of several stakeholders, and these include local people, politicians, and the government authorities.

Research Gaps/Needs

- No detailed systematic research has been carried out on the change in plant species' composition on the grasslands created .
- Research needs to be carried out on biomass production and carrying capacity of the grasslands so that the population of wild animals in the area can be maintained at the optimum level.
- Baseline data should be gathered on the species' composition in and around the fields of settlements.
- The impact of grass harvesting by local people in the newly created grasslands should be monitored carefully so that it can be carried out at the optimum level.

[5] Full papers are presented in Volume II of this Workshop Series

Management Recommendations

- Other grassland conversions should be carried out directly north of and adjacent to the first grassland to expand the created habitat.
- The village areas of Rambhouri, Bhata, Ramouli, and Pratappur should be moved and the area converted into grasslands.
- The plan for extension of the reserve's eastern boundary up to the Pashaha River (Bara District) should be implemented properly to provide extended habitat and protection for wild animals, especially elephants.

Royal Bardia National Park (RBNP)

Shiv Raj Bhatta

The Royal Bardia National Park is the biggest national park (968 sq.km.) in the lowland *Terai* of Nepal. The main types of grassland in the park are the tall floodplain grassland created by the Geruwa, Babai, and Orai river systems, and the *phanta* (previously cultivated and re-vegetated short grassland). There are three major grassland areas in the Karnali floodplain area, Bagaura, Khauraha, and Lamkauli. The granting of grass cutting permits has been continued to provide sociocultural and economic benefits to local communities and as a management tool for the conservation of biodiversity. In addition, cutting grass has helped to minimise park-people conflict. All the grasslands are subject to gradual encroachment by tree species and invasion by unpalatable species. The grassland of the Babai Valley is also decreasing as a result of succession. *Bombax* and *Acacia* have almost covered the valley. Several short-term research projects have been carried out to look at different aspects of the grasslands in the park. Management intervention by the park to maintain these grasslands has incorporated traditional practices adopted by the local community and the recommendations of researchers. Concrete management interventions and a system of continuous monitoring of the impact of interventions is essential for long-term management of the grassland ecosystem.

Research Activities Conducted to Date

Several research projects have been carried out in the grasslands of RBNP. Some of the research findings and recommendations are given below.

- The park authority should have a proper monitoring system.
- The park should try to keep harvests within sustainable levels.
- The floristic composition of the grassland should be recorded and maintained.
- Organic matter is removed annually by cutting grass and there is loss of nitrogen due to burning.
- Patches of sal (*Shorea robusta*) forest should be removed selectively on the Karnali River in order to increase the area of grassland.
- Invasive plant species should be removed.
- Patches of grassland should be left uncut and unburned in a two-year rotation
- Plans to dam the river that enter the park should be strongly opposed (maintaining disturbance from river action and annual flooding is important for the persistence of the grasslands).

- Management experiments should also be established to investigate the effect of rotational patch management of the grassland.
- Disturbance of ungulates utilising regenerating *Phanta* grassland should be minimised by closing roads.
- Input and output of nitrogen and phosphorous should be quantified.
- Grassland ecosystems can sustain the current level of nitrogen loss. However, several experimental plots would need to be monitored for several years to see whether or not continuous harvesting and burning deplete grassland resources.
- The management strategy should be to maintain a mosaic of areas that are cut, cut-burn, and unmanaged tall grass
- Cutting should be done in two phases spaced 20 days to one month apart.

In addition to the research findings, some conclusions on the management practices have been drawn from ongoing regular management practices. However, only systematic research will show whether these practices would improve the condition of grasslands or not. These conclusions are as follow.

- Controlled burning should be carried out twice a year.
  - ❖ Fire should be set immediately after October in the daytime when there is wind.
  - ❖ Fire should be set again after cutting thatch grass in January-February.
- Grass should also be cut twice a year, in January by people and after June by a grass cutter.

Management Issues

- Invasion of tree species such as *Bombax* and *Acacia,* occurring throughout the grassland, and especially pronounced along the boundary of the grasslands
- Invasion by unpalatable species in Baghaura, Khaura, and other small grasslands
- Lack of a proper monitoring system
- Ungulates, ground nesting birds, and smaller mammals are affected by uncontrolled burning as well as by harvesting grass
- Damage to infrastructure, signposts, bridges, and animals during the grass cutting season

Research Gaps/Needs

Long-term systematic study of the impact of grazing, burning, grass harvesting, and other management activities needs to be done.

Royal Shukla Phanta Wildlife Reserve (RSWR)

Ram Prit Yadav, Sher Singh Thagunna, and Jay Prakash Sah (Presented by Sher Singh Thagunna)

The Royal Shukla Phanta Wildlife Reserve, located in the western *Terai*, is famous for its large herd of swamp deer (*Cervus duvauceli duvauceli*). The reserve has diverse types of habitat within its relatively small area. A large tract of grassland, the Shukla Phanta, is the main habitat of 1,500 to 2,000 swamp deer. There are many small and moderate sized grasslands besides Shukla *Phanta*,

some interconnected and others scattered. They include the Barkaula *Phanta*, Sundari *Phanta*, Karaiya *Phanta*, and Haraiya *Phanta*. The open grassland in the forest is locally called *'Phanta'*. One of the main objectives of the reserve is to manage these *phanta* in order to keep them as a suitable habitat for swamp deer and other wild animals . To fulfill the objective, several management activities, including regular burning, ploughing, up-rooting, and constructing water holes, have been carried out within these *phanta*. Despite these activities, portions of many *phanta*, such as the south-eastern part of Sundari *Phanta*, the northern part of Shukla *Phanta*, and the south-eastern part of Karaiya *Phanta*, have been invaded recently by tree species which are spreading fast, and thus threatening the importance of the grasslands. Block-wise management activities with a long-term perspectives need to be conducted in order to manage the grasslands of international importance within the reserve.

Management Issues

- Poor road infrastructure makes patrolling and other management activities difficult during the rainy season, especially near the Bauni River between Singhpur and Shukla Phanta, near Barkaula post, and near the Headquarters in Maghgaon.
- Despite the grazing by swamp deer and other wild animals and regular controlled burning, some areas of grasslands, such as the northern part of Shukla Phanta, Karaiya Phanta, Sundari Phaṇta, and Barkaula Phanta, have been heavily invaded by trees like *Dalbergia sissoo, Bombax ceiba, Acacia catechu,* and *Butea monosperma*.
- Drying up of marshes in the grassland area
- Livestock grazing in Haraiya Phanta and the eastern part of Singhpur Phanta where wild animals have to compete with domestic animals
- Uncontrolled burning of grasslands

Research Gaps/Needs

- Carrying capacity of *phanta*
- State of water quality and status of wetlands in and around the grasslands
- Prey and predator relationships in grasslands
- Flooding pattern and their effect on grasslands
- Effect of grassland burning on grassland quality and wild animals, including lower fauna
- Ecology of swamp deer

Management Recommendations

- Roads should be properly maintained so that the movement of vehicles is smooth throughout the year. The roads near Barkaula post, the Bauni River, and the Headquarters should be repaired by filling with gravel.
- Management activities such as burning and ploughing should be done in a block system. For this purpose, the grasslands should be divided into blocks with additional fire lines, and then these activities should be carried out on a rotational basis.
- To ensure a regular water supply in the Shukla Phanta area, existing ponds should be renovated and filled with water. For this, three pumping sets should be bought and kept in running condition.
- Saplings of simal (*Bombax ceiba*), sissoo (*Dalbergia sissoo*), and other trees growing near the view tower, north of the access road, near the Barkaula

post, and in Sundari Phanta should be uprooted so that further colonisation by these trees is checked.
- Growing trees of sissoo, simal, and palans should be killed by girdling so that further colonisation is checked, and, at the same time, the dead intact trees can provide a habitat for several bird species.
- Uncontrolled burning by people during the grass harvesting season should be checked by employing temporary guards and making people aware of the damage caused by such burning. Fire-fighting equipment should be made available to control uncontrolled and untimely burning.
- The existing villages along the Chaudhar River should be removed as soon as possible. This will help to control livestock grazing in the Haraiya phanta and add additional grassland habitat suitable for swamp deer and even rhinos.
- The location of the army post near the view tower in Shukla *Phanta*, which is a sensitive area in terms of the habitat of swamp deer, needs to be reassessed and appropriate measures taken.
- Regular monitoring programmes should be conducted to monitor the impact of management activities so that necessary changes can be made to the programme.

Mountain Protected Areas[6]

Chief Wardens from the mountain PAs presented the status of grassland research and management in their respective areas. The highlights of their talks are summarised below. The Chief Wardens from Sagarmatha National Park, Makalu Barun National Park, and Manaslu Conservation Area were not present to provide status papers and are thus not represented in this summary. Research from the Annapurna Conservation Area (ACA) is presented in the summary of technical papers.

Langtang National Park (LNP)

Jhamak B. Karki and Colleen McVeigh (presented by Jhamak B Karki)

The Langtang National Park, gazetted in 1976, covers a total area of 2,130 sq.km. in the high mountain and Himalayan region of Central Nepal, including 420 sq.km. of buffer zone. The park has extremely varied vegetation, ranging from sub-tropical forest to alpine. Over 3,000 people reside within the park, and close to 17,000 people in the adjoining villages south of the park depend on park resources to a varying extent. Economically, local residents still rely primarily on agro-pastoralism. They are permitted to graze and gather dead wood within the park. Other human activities that affect rangeland resources include burning practices and hunting/poaching activities. These activities may account for the declining quality of winter pasture and diminishing fodder supplies. Similarly, a growing trade in medicinal plants is threatening entire species outside the PA, particularly those that are naturally rare. Current

[6] Full papers are presented in Volume III of this Workshop Series

management practices include local pastoral management systems which comprise defined user groups and associated access rights, specific decision-making patterns, rotational grazing, deferred grazing, burning practices to promote desired herbaceous growth, and religious beliefs and practices geared at promoting the pastoral sector. Future park management strategies should include: registration of livestock owned by park residents; development of a local policy on trading of medicinal plants; strict monitoring of wild plant harvesting; coordination between the District Forest Office and local park authorities; and participation of local harvesters in policy development and enforcement.

Research Gaps/Needs

RESEARCH GAPS	*RESEARCH NEEDS*
• Local harvesting of wild plants and its impact on plant communities is poorly understood. The available information needs to be updated. There is no information differentiating local vs. outside impacts/ practices; commercial vs. subsistence harvesting; or impacts of specific harvesting practices· (e.g., whole plant being destroyed)	• A park-wide ethnobotanical survey of indigenous plants, including an inventory of local names, uses, and harvesting practices, resident dependence on plant species, and determination of critical population sizes.Monitoring of the resilience of local species to harvesting practices, with emphasis on differentiation between subsistence vs. commercial harvesting, as well as harvesting by local residents vs. outsiders
• Lack of up-to-date information on rangeland resources and conditions throughout the entire park, and the impact of use activities on them. Available information is old and out-dated.	• Detailed survey of all grazing grounds inside the park, identifying 1) active grazing areas; 2) animal user groups (both domestic and wild) including numbers, origin, and time of grazing; and 3) plant species' composition, including seasonal variations and their response to different (including herbivore) user groups and user activities
• Lack of current data on fodder use and management	• Survey of fodder resources and livestock requirements
• Lack of information on the long-term effects of current burning practices	• Study of the short- and long-term effects of burning in alpine grassland and forest areas
• Lack of information on hunting and poaching	• Form anti-poaching units and collect information from informants

Management Gaps and Needs

MANAGEMENT GAPS	*MANAGEMENT NEEDS*
• Ineffective management of wild plant collection and suppression of smuggling	• Strict monitoring of wild plant harvesting, particularly by outside groups • Greater coordination between the District Forest Office and LNP • Development of local policy on trading of medicinal plants • Participation of local harvesters in policy development and enforcement
• Lack of monitoring of livestock numbers and pasture use	• Registration of livestock owned by people from each settlement within the park

Kanchenjunga Conservation Area (KCA)

Fanindra R. Kharel

The Kanchenjunga Conservation Area (KCA) was declared recently with the purpose of ensuring sustainable, productive use of natural resources by local people and protection of threatened habitats and species by means of a system of community participation in natural resources' management and conservation. Transhumant pastoralism is one of the principal livelihoods for people within the KCA, and livestock are a major source of cash income. A management model that neglects biodiversity conservation interlinked with pastoralism could lead to deterioration in the condition of existing grazing lands and rangelands. To address this problem, a two-week exploration trip was made to temperate and alpine zones within the KCA. This paper highlights the findings of the trip. The potential solutions discussed here emphasise the need for the KCA to organize participatory research programmes to address rangeland resource management issues.

Management Issues

- Growing local population
- Poaching of wildlife
- Shortened cycles of shifting agriculture
- Encroachment on forests for cropping combined with transhumant pastoralism creating increasing pressure
- Competition between livestock and wild herbivores
- Acts of herders as informers to professional poachers on the movement of wildlife
- High pressure on the lower temperate zone oak forests by both low altitude resident cattle in the summer and transhumant herds in winter

Research Gaps/Needs

- No information or preliminary assessment of the biodiversity situation in the grazing areas within the KCA

- No research on grazing areas, users, and their grazing area management practices
- No data on the impact of grazing in the KCA
- Participatory research programmes needed to address the issues of grazing land and rangeland resources' management in the KCA

Management Recommendations

- Community-based grazing user groups should be established through formation and mobilisation of Conservation Area Management Committees (CAMC) in all VDCs within the KCA to ensure that biodiversity conservation receives a proper place in rangeland management systems.
- The KCA authority should introduce the concept of joint grazing area management through the development of a forum for collaboration between herders and the KCA management authority.

Dhorpatan Hunting Reserve (DHR)

Ramchandra Kandel

Dhorpatan Hunting Reserve, located in the mountain region of western Nepal, covers 1,325 sq.km. and comprises alpine, sub-alpine, and high temperate forest types of vegetation. It is surrounded by settlements in eleven VDCs in the east, west, and south of Rukum, Baglung, and Myagdi Districts. Pasture lands occupy more than 50 per cent of the total area of the reserve at higher elevation, and more than 100,000 livestock belonging to about 5,000 households are brought to the reserve for grazing each year. The reserve is affected by human activities such as livestock grazing, wood harvesting, poaching, and unauthorised collection of medicinal plants. People from adjoining and neighbouring VDCs in three districts enter the reserve to graze their livestock during mid March to October, in addition to people from distant areas like Palpa District. Any problems may be resolved if the capacity of the grassland is improved in a scientific, strategic, and participatory manner. For this a more comprehensive database is needed that can help the DHR managers to make better management decisions. In DHR, participatory management practices can be a successful tool for pasture land management in the mid-mountain region.

Management Issues

- Local peoples' dependence on forests to meet fuelwood, timber, and fodder needs, resulting in degradation of forest resources, especially in critical high altitude areas
- Potential for overgrazing of pasture by livestock and increased competition for forage between livestock and wild ungulates
- High risk of transfer of diseases from domestic to wild animals, especially from goats and sheep to blue sheep and vice versa
- Cultivation of land for agricultural crops by *gothalo* (herd watchers) during the grazing season may allow them to claim ownership of parts of the reserve area, in addition to the loss and degradation of grasslands resulting from this action

- Extraction of chir pine resin
- Collection of herbs for local treatment and selling to outsiders
- Settlements inside the reserve
- Conflicts between local communities' agricultural and animal husbandry practices and management of the protected areas
- Lack of trained natural resources' managers and inadequate infrastructure for management of the area
- Inadequate knowledge about and planning for the impacts of tourism and grazing in culturally and environmentally sensitive regions
- Poaching and illegal trade of wild and endangered protected species

Research Gaps

- Gaps between the database of the reserve and the strategy for effective management of the reserve; lack of systematic surveys, inventories and studies of fauna and flora, especially threatened species
- Insufficient information about local uses of natural resources including non-wood forest products and illegal exploitation of herbal plants
- Trends in population numbers of key plants and animal species over time, including historical evidence wherever possible
- The measurement of reproductive success or productivity of different species
- Assessment of the quality and condition of species and habitats, including examination of soil loss and water runoff patterns, measuring total biological productivity, and assessing species' composition

Khaptad National Park (KNP)

Nilamber Mishra

Khaptad National Park (KNP) includes parts of four districts, Achham, Bajhang, Bajura, and Doti, and represents a unique landscape of rolling plateau grasslands rich in Middle Hills flora and fauna. It encompasses various religious spots including the Khaptad Baba's hermitage, temples, and stone statues and Khaptad lake. These grassy plateaus are the traditional grazing land of local people from surrounding areas. The grazing pressure in Khaptad plateau is intense during the summer season (April through August) and illegal grazing is common all year round at the periphery of the Park. Potentially this can lead to degradation of the grasslands, increasing soil erosion and gully formation and decreasing the number and variety of flowering plants. The wildlife population, such as musk deer (*Moschus chrysogaster*) is decreasing rapidly as a result of poaching and possibly of disturbance caused by livestock grazing. Little research has been done in the grasslands, and a study should be made on the impact of grazing on grassland composition. Controlled burning of grassland to increase the nutrient quality and reduce unpalatable species is recommended, although this needs confirmation from trial research.

Grassland Management Issues

- The livestock population is increasing annually due to the growing human population in the proposed buffer zone community.
- During the summer and rainy seasons, there is no alternative pastureland outside the park for grazing livestock.

- The quality of pastureland is being degraded (warden's observation).
- The population density (biomass) of flowering plants in the grassland is decreasing (warden's observation).
- Because of the degradation of grasslands, gully formation and soil erosion are increasing.
- The number of wolves in the park is gradually decreasing and the reason for this is not known.

Research Gaps/Needs

- There is no up to date information on the number of livestock grazing in the Khaptad National Park area.
- The effect of controlled burning on grasslands has not yet been studied.
- The impact of grazing on the species' composition and productivity of the grassland needs to be studied.
- There is no research on the impact of livestock grazing on the wild animals.
- The reason for wolf decline is not known, and prey predator studies need to be made.

Management Recommendations

- Participatory research needs to be conducted on grassland management and sustainable resource utilisation to address research gaps and improve conservation awareness among local communities. Such programmes could include such activities as mass meetings, an extension programme, and establishment of demonstration plots.
- If controlled burning in this area is proved beneficial by research, it should be applied on a rotational basis.
- A plan should be prepared to encourage the communities in the buffer zones to plant more fodder and grass species on their private and community forest lands.

Rara National Park (RNP)

Gopal Chimire

Rara, the smallest National Park in the country, covers an area of 106 sq.km. and is situated in the Mugu and Jumla Districts of the Mid-western Region of Nepal. The park was established with the objective of maintaining its natural beauty by protecting its watershed area. The beautiful landscape around the lake is the main attraction of the park. Important ungulate species found in the park are musk deer (*Moschus chrysogaster*), jharal (*Hemitragus jemlahicus*), barking deer (*Muntiacus muntjak*), and ghoral (*Nemorhaedus goral*). About 20 per cent of the park area is semi-natural and natural grassland. As a result of the implementation of strict conservation practices, such as a complete ban on grazing, pine trees have re-established in the majority of these grasslands. In other parts of the park, the grasslands are experiencing illegal livestock grazing. The impact of such grazing on biomass production, species' composition, and livestock-wildlife competition needs to be studied in detail in order to manage the grasslands more efficiently.

Management Issues

- Potential overgrazing in the Bota side of Jumla District and around Ghuchchi that may cause grazing competition with wildlife
- Invasion of the grassland areas near Rara Lake by pine trees; although a natural component of the ecosystem, re-establishment of these trees may be reducing habitat for wild ungulates
- During winter, some locals use routes along grassland areas to take their livestock to drinking water, causing trampling effects in localised grassland areas

Research Gaps

- No research has been done on the impact of grazing on species' composition and biomass production in the grasslands.
- There may be competition between livestock and wildlife for food, at least in some parts of the grasslands, and this needs to be studied in detail.
- The reason for the invasion of grasslands in some areas by pines is not well understood.

Management Recommendations

- Once research is done to discover whether livestock grazing is an effective grassland management tool in Rara National Park, appropriate steps need to be taken for management of the grasslands that are being invaded by pine trees and those that might be overgrazed.
- Reports show that, in other areas, controlled burning suppresses the invasion of grasslands by tree species, thus it might be needed in Rara National Park.
- Water resources in areas outside the National Park should be managed so that livestock do not need to be taken through the National Park. This would avoid the negative impact, if any, of trampling .
- If research shows signs of competition between wild herbivores and livestock for food, then appropriate measures should be taken to avoid such competition.

Shey Phoksundo National Park (SPNP)

Tulsi Ram Sharma

Shey Phoksundo National Park is the largest park in the country (encompassing an area of 3,555 sq.km.) and represents the Trans-Himalayan ecosystem. It was gazetted in 1984 and is located in the Dolpa and Mugu Districts of the Mid-western Development Region of Nepal. With wide climatic variations, the park has more than 1,300 species of plants, 30 species of mammals, 200 species of birds, and six reptile and one amphibian species. There are 2,600 people living within the park boundary, and approximately 5,000 people within its buffer zone. The local economy is mainly based on highland agro-pastoralism. Livestock rearing is the main source of income, food, and transportation. Over 70 per cent of the park area is covered by grassland of which nearly half is estimated to be inaccessible as a result of its steep rocky topography. During the summer, local residents graze their cattle in specific pasturelands delineated

according to their traditional norms. This paper highlights whether grazing by both livestock and wildlife can function as a management tool.

Management Issues

The important management issues in SPNP are livestock grazing and potential livestock-wildlife conflicts. The main question is the severity of the situation. Observational accounts suggest that wildlife–livestock competition for grazing is not very obvious, mainly because of:

- the relatively low density of livestock (compared to pasture area) and the fact that their number has been decreasing recently, possibly as a result of the changing socioeconomic condition of the local people and increasing frequency of predation by wildlife; and
- the fact that pasture productivity (biomass per unit area) and vegetation cover are quite high and in good condition.

People residing in the buffer zone area occasionally graze their cattle inside the park although they do not have a legal right to do so. This may cause competition for food between livestock and wildlife in these border areas.

Detailed survey and research work has been conducted on the following.

- Baseline survey of SPNP
- Socioeconomic and tourism surveys of SPNP
- Bio-diversity survey
- Strategy for sustainable use of medicinal plants
- Traditional system of grazing in highland pastures

Discussion

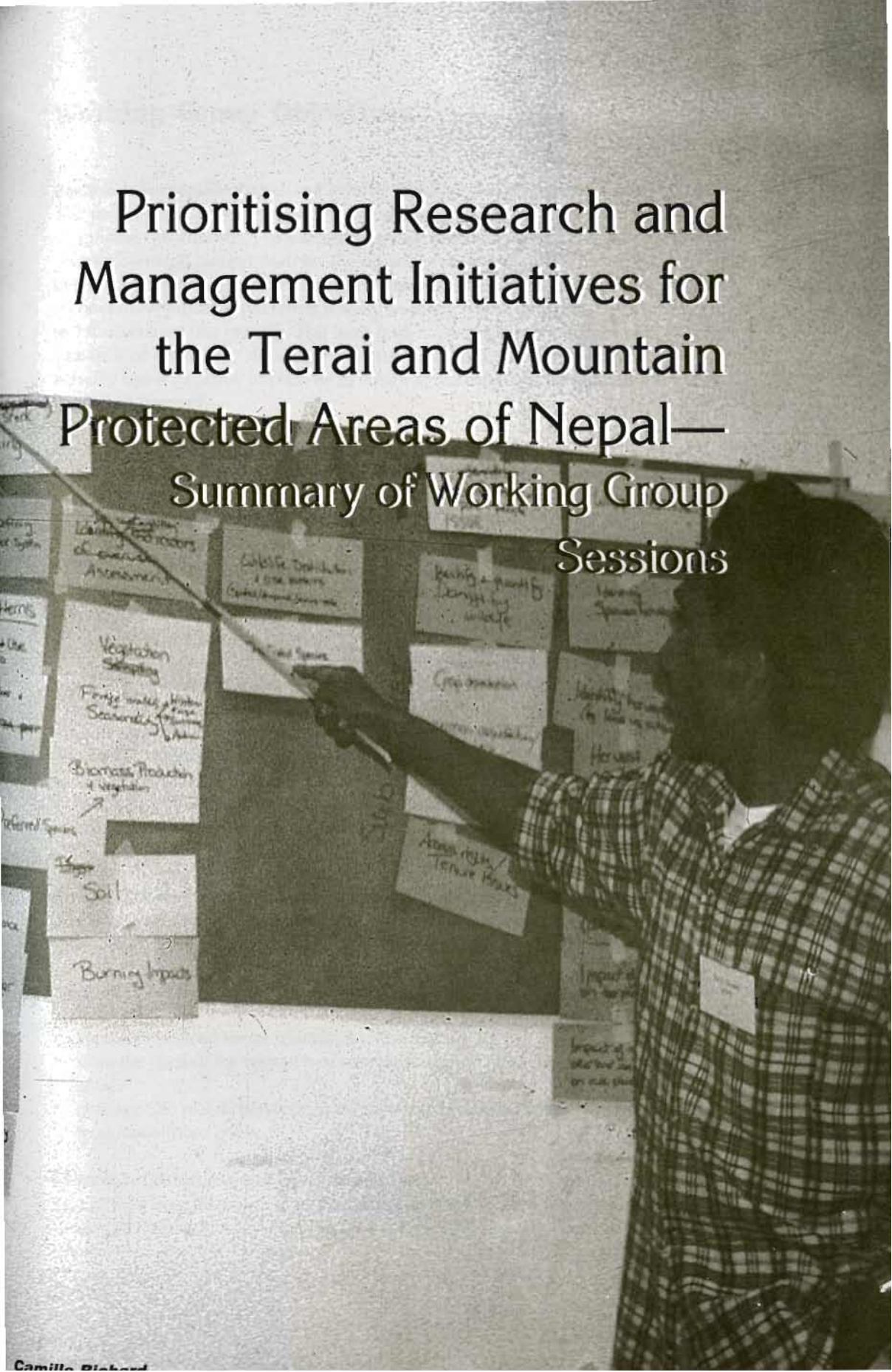
Following the presentation of Papers on the Status in Nepal, the presiding chairperson, Shyam Bajimaya, opened the floor for discussion. The salient points raised were as follow.

- There was concern that nearby irrigation schemes would impact flooding regimes in Shukla Phanta Wildlife Reserve, although there have been no floods in the reserve in the last three years. At present, invading tree species pose the major problem within the reserve.
- Regarding the prerequisites for the declaration of a buffer zone in Shukla Phanta, and the initiative by the government, it was stated that in the absence of additional staff it would be difficult to manage the forests in the buffer zone. The forests outside the reserve have the potential of serving as important corridors for wildlife species, but as yet have received little attention.
- New Management Plans for *Terai* parks should have been completed by the end of 1999. A task force had been formed to look into research needs, prevalent gaps, and the need to do proper mapping of pastureland and important wildlife areas.

- *Terai* parks and the mountain PAs have different regulations regarding settlements within PA boundaries, varying in the degree that regulations permit local people to collect fuelwood and fodder and graze livestock.
- The question was asked whether there were traditional or regulated grazing practices in Dhorpatan Hunting Reserve, and the point made that the local people practice traditional grazing management which includes customary pasture rights in the reserve.
- To a query on grazing practices and conflicts, if any, in Shey Phoksundo National Park, it was stated that grazing is a traditional practice in the area and as the settlements are far apart no conflict has arisen. Local communities practice rotational grazing in the alpine pastures and manage well, given the constraints.
- His Majesty's Government of Nepal (HMG/N) has permitted regulated hunting of blue sheep in DHR, as it is not an endangered species.
- There was general consensus that there is a lack of information flow between the mountain parks in Nepal and variable efforts across the PAs. For example, many studies have been done on floral and faunal diversity in some mountain parks such as Makalu, but little in Rara National Park. There should be a balanced effort in all PAs with better efforts at compiling and sharing information.

Prioritising Research and Management Initiatives for the Terai and Mountain Protected Areas of Nepal—

Summary of Working Group Sessions



Camille Richard

Working Group Objectives

Session 1. Summarise Issues and Identify Research and Management Gaps
The first working group session was conducted with the primary objective of identifying the important issues affecting the protected areas of Nepal and prioritising those issues based on the degree of research and/or management initiatives conducted to date. The term **issue** is used in this discussion to denote a concern regarding a particular activity or phenomena that may be detrimental to PA objectives like grazing. The term **gap** is used in this context to mean either 1) a lack of research to determine whether a particular activity or phenomenon actually has a negative impact, or 2) a lack of management to address a **known negative impact**.

Participants were separated into two working groups, based on their expertise and interest: the *Terai* and mountain protected areas. Each group was asked to:

- assign a group coordinator and scribe;
- list all issues that were raised in the Status Papers;
- indicate whether a particular issue had been addressed by any research and/or management initiatives (using categories of good, partial, or none);
- prioritise issues based on the degree of initiative among all the *Terai* or mountain PAs in Nepal.

The focus was on the major issues that cut across most PAs of the *Terai* or mountains. Granted, one issue may be of greater importance in one PA versus another. However, the purpose of prioritising these cross-cutting issues was to find commonalities among PAs so that initiatives carried out well in one PA can be of value in another. This would reduce the need to conduct redundant research in all the PAs addressing a particular issue, an example being research approaches to study livestock grazing or management approaches for burning of grassland.

Session 2. Devise Research and Management Strategies to Address Gaps
The final working group session focussed on defining research and management guidelines to address the gaps identified in the previous session.

Each group was asked to:

- list the prioritised issues identified in the first session;
- state the goal of the research or management initiative needed to address the issue;
- give specific recommendations on the research and/or management needed to achieve these goals.

Session 3. Conclusions and Recommendations
The groups later reconvened to discuss the outputs of each group and to determine future courses of action for the DNPWC and other conservation groups.

Terai PA Working Group Sessions

Session 1: Identifying and Prioritising Issues Related to *Terai* PAs

Participants in the *Terai* working group first identified various grassland management issues in each of the five protected areas in the *Terai*. Later, those issues were combined together and then the existing research and management initiatives in those protected areas were listed.

Table 1 shows all the management issues identified in relation to the protected areas in the *Terai*. Altogether, 17 issues were identified. Those issues were then ranked within each PA, the value '17' being the highest priority issue, based on discussions in working groups and review of Status Papers. If the value was '0' for a particular issue, it means that it was not found to be relevant to that PA. The score is the total points across all five PAs divided by the number of PAs where that issue is relevant. These scores were then ranked to indicate the more important issues facing all PAs. This ranking scheme will need to be revisited in later planning sessions for particular PAs.

TABLE 1. GRASSLAND MANAGEMENT ISSUES IN THE *TERAI* PROTECTED AREAS AND THEIR RELATIVE IMPORTANCE

Issues	*RBNP*	*RCNP*	*PWR*	*RSWR*	*KWR*	*Score*	*Priority*
Tree invasion in grassland	17	17	0	17	14	16.25	1
Illegal burning	16	16	14	16	16	15.60	2
Collection of grasses	15	15	15	14	13	14.40	3
Illegal grazing	11	14	12	13	17	13.40	4
Settlement in core area	0	13	16	15	9	13.25	5
Hydrology and flooding	13	10	0	9	15	11.75	6
Research and monitoring	12	6	13	11	10	10.40	7
Scarcity of water	8	3	17	10	0	9.50	8
Crop depredation	9	12	11	8	7	9.40	9
Stakeholder collaboration	7	8	8	7	11	8.20	10
Trans-boundary conservation	5	7	6	12	4	6.80	11
Tourism	10	11	0	2	3	6.50	12
Forest road/park infrastructure	14	4	0	5	6	6.25	13
Corridors and conductivity	3	9	9	6	12	5.80	14
Development activities	6	2	10	3	5	5.80	15
Disease transfer	2	1	7	1	8	3.80	16
Park/camp elephant grazing	4	5	0	4	2	3.75	17

Note: (number indicates severity of the problem on a scale from 1 to 17, "0" = not relevant, score = total points/number of reserves where relevant).

Not all the issues were found equally important among all the protected areas. Some of them are more relevant in one PA than in others, and some were irrelevant in a particular protected area. For example, most of the participants agreed that invasion of grasslands by tree species and burning by villagers during the grass harvesting period are the major issues in grasslands in all the

protected areas of the *Terai*. However, the warden of Parsa Wildlife Reserve, urged that the grasslands in that PA are different from those in others as they have been newly created by clearing *Eucalyptus* plantations, so invasion by tree species is not an issue at this stage although it might be in the future. He further emphasised that unlike the grasslands in other protected areas of the *Terai*, those in Parsa Wildlife Reserve are not affected by floods, tourism, elephant grazing, or roads or any other park infrastructure. Mr. Shiv Raj Bhatta pointed out that settlement in the core area may be an issue in other protected areas but it is not an issue in Royal Bardia National Park. Similarly, it was mentioned that there is no scarcity of water in Koshi Tappu.

Participants also emphasised that, in a particular protected area, some issues are more severe than others (as indicated by the ranking scheme in Table 1), and thus should be given priority and addressed urgently. For example, grazing by domestic livestock is the major issue and impact of tourism the least important in Koshi Tappu Wildlife Reserve. Whereas the impact of tourism is more prominent in RCNP and RBNP. Invasion by tree species is the most important threat to the grasslands in three protected areas, RCNP, RBNP, and RSWR and a major threat in Koshi Tappu, but it is not an issue in PWR. When all the issues were combined and prioritised, tree invasion in grasslands was considered to be the major threat overall in the *Terai* PAs.

In some protected areas, many research and management initiatives are already being undertaken to differing degrees. Table 2 shows the state of management initiatives and research activities in the protected areas of the *Terai*. The priority score is a different ranking scheme, based not just upon what is considered to be the major issue, but also the extent of activity initiated to address that issue. A score of 1.00 means that the issue has been well addressed with either research or management initiatives and thus would have a low priority for follow-up action (the formula used is explained in the table). A score of 0 means no effort has been made to address this issue, thus a higher priority for action. Issues have been sorted in the Table according to the extent of research conducted, although individual PAs will have different priorities. This table is merely a guide. See Annex 1, Tables A-1 and A-2 for the research and management initiatives conducted in each PA.

Session 2: Research and Management Recommendations for *Terai* PAs

Before identifying further management initiatives to be taken to address such issues, the broad objectives were first described so that the management initiatives would be problem and site specific. Thereafter, management oriented research gaps were identified. During the discussion, it was realised that the outcome of such research would strengthen the existing knowledge, help conduct the specific management activity, and help in monitoring.

Table 3 lists all the issues raised during Session 1, ranked in order of priority according to Table 1, followed by recommendations for follow-up management and monitoring activities. The activities recommended in Table 3 should not be generalised for all the protected areas. Their implementation should be site specific based upon local prioritisation exercises to be conducted at a later date.

TABLE 2. SUMMARY OF ISSUES AND RESEARCH / MANAGEMENT INITIATIVES FOR ALL *TERAI* PROTECTED AREAS (TOTAL OF 5 PAS). SUMMARISED FROM TABLES A-1 AND A-2 IN ANNEX 1

Issues	Issue	Research Initiatives			Management Initiatives		
	*Yes**	*Good*	*Partial*	*Priority Score***	*Good*	*Partial*	*Priority Score***
Disease transfer	5	0	1	0.10	0	5	0.50
Tourism	4	0	2	0.25	2	2	0.75
Transboundary conservation	5	0	3	0.30	0	3	0.30
Development activities	5	0	5	0.50	0	2	0.20
Tree invasion in grassland	4	0	4	0.50	0	3	0.38
Corridors and conductivity	5	0	5	0.50	0	4	0.40
Illegal burning	5	2	1	0.50	0	5	0.50
Illegal grazing	5	0	5	0.50	0	5	0.50
Scarcity of water	4	0	4	0.50	0	4	0.50
Forest road/park infrastructure	4	1	2	0.50	0	4	0.50
Hydrology and flooding	4	0	4	0.50	0	4	0.50
Park/camp elephant grazing	4	2	0	0.50	0	4	0.50
Stakeholder collaboration	5	0	5	0.50	0	5	0.50
Settlement in core area	4	1	3	0.63	0	3	0.38
Research and monitoring	5	2	3	0.70	2	3	0.70
Collection of grasses	5	3	2	0.80	0	5	0.50
Crop depredation	5	3	2	0.80	0	5	0.50

* Total number of *Terai* PAs (out of 5) that were identified as facing this issue.
**Priority score calculated as [(#Good) + (#Partial/2)] / #Yes

Mountain PA Working Group Sessions

Session 1. Identifying and Prioritising Issues Related to Mountain PAs

The mountain working group identified 19 issues that are affecting the mountain PAs to varying degrees. Table 4 lists the issues and whether that particular issue is relevant to a particular PA or not. As with the *Terai* PAs, not all issues are important to all mountain PAs. However, some issues are cross-cutting such as livestock grazing, livestock-wildlife competition, poaching, tourism, extraction of forest products, stakeholder collaboration, indigenous management systems, and conservation awareness. They differ in the degree to which PA managers have addressed these issues.

Table 5 summarises the issues identified for all mountain PAs combined, together with the research and management efforts conducted to date to address these issues. The specific research and management initiatives for each mountain PA can be found in Tables A-3 and A-4 in Annex 1. A priority score was calculated based on the extent of activities initiated in the PAs to address an issue (the formula used is explained in the table). A score of 1.00 means that the issue has been well addressed with either research or management initiatives and thus would have a low priority for follow-up action. A score of 0 means that no effort has been made to address this issue, thus a higher priority for action.

TABLE 3. MAJOR OBJECTIVES AND THE RESEARCH AND MANAGEMENT ACTIVITIES RECOMMENDED TO ADDRESS THE ISSUES IDENTIFIED IN THE *TERAI* PA WORKING GROUPS

Issues	Goal/Objectives	Management Activities	Research/Monitoring Activities
1. Tree Invasion - Important to control invasion to maintain habitat for wildlife species	• Maintain existing diversity and area of grassland • Maintain patchy structures of grasslands within and between grasslands	• Identify prime critical/at risk grassland • Describe past history and determine present status • Survey, map, and demarcate with other habitat • Identify and determine the status and trends of invading species (woody, shrubs, weeds, etc) • Remove (uproot, cut, dig) invading species • Test and adopt controlling strategies • Develop monitoring strategies	• Conduct survey and mapping (RS, GIS, ground samples) of grassland areas • Fixed print photographs • Fixing poles/posts and plane table survey • Inventory of diversity • Impact of removing the invading species • Research for methods to maintain mosaic grasslands (e.g., short and tall grasslands)
2. Burning - managed burning as well as illegal burning. Patch burning preferred to maintain grassland mosaic	• Develop prescribed burning, cutting, harvesting regimes to maintain grassland habitat quality, based on the movement of wildlife	• Divide the grasslands into blocks • Conduct rotational control burning • Leave some areas without burning • Finish all controlled burning before mid February • Combine burning and harvesting treatments, such as: a) no burning and no harvesting; b) no burning but harvesting, c) burning but no harvesting, and d) burning and harvesting	• Monitor rotational burning • Monitor timing of burning • Monitor combined treatments
3. Collection of Grass - both legal and illegal harvesting. Not known whether grass harvesting is having a negative impact. This is currently being used as a grassland management tool.	• To maintain a diverse, patchy mosaic of grasslands	<u>Legal</u> • Develop a policy to regulate grass cutting (a task force can be made for this) <u>Concessional</u> • Review the policy of concessional grass cutting <u>Illegal grass cutting</u> • Develop a resource base in the Buffer Zone (BZ) to reduce pressure on PA resources	• Examine the impact of grass harvesting on grassland ecosystems and on the socio-economy of the people • Research on nutrient cycling • Research on the impact of babiyo (*Eulaliopsis binnata*) harvesting
4. Livestock grazing - especially pronounced problem in KWR. Little information on the extent of impact.	• 1. To minimise impacts of grazing	• Identify problem areas in PA's/ corridor areas • Coordinate with local community to manage community areas (BZ) for grazing • Create effective physical barriers (trench, bio-fencing) around affected areas • Coordinate with other line agencies to reduce grazing pressure	• Conduct site specific research on the impact of grazing as well as removal of grazing • Conduct trials of grazing and non-grazing
5. Settlement inside the core area - All PAs other than RBNP have settlements within the core areas that need to be removed.	• Make the core area free of settlements • Increase the area of grassland such as in the PWR	• Relocate the settlement and convert that area into grassland • Prepare plan for relocation (e.g., PWR) • Expedite relocation and land compensation (e.g., KWR) • Make a plan for management inputs after relocation (e.g., levelling, making water holes, uprooting, bio-fencing)	• Conduct research on the impact of relocation on the ecology of the area and the socio-economic condition of relocated people

TABLE 3. CONT....

Issues	Goal/Objectives	Management Activities	Research/Monitoring Activities
6. Hydrology and Flooding - grasslands of the *Terai* are reliant on flooding to arrest succession to forest but flooding can also be detrimental, such as in KWR.	• Conserving catchment area • Maintaining proper hydrological regime	• Catchment conservation • Public conservation awareness programme • Lobbying to government to conserve catchment areas	• Research on the impact of flooding and sedimentation on grassland structure and function • Research on river dynamics in and around grasslands
7. Research and Monitoring	• To generate database • To improve networking and information flow with other protected areas.	• Identify and prioritise research and monitoring fields/tools • Identify research/monitoring resource persons or agencies both domestically and internationally • Develop skill of DNPWC staff to carry out management, research, and monitoring • Develop and implement monitoring system within PA's management framework	
8. Scarcity of Water – water is limiting for wildlife in some PAs such as RSWR and PRW.	• Providing drinking water to the wildlife consistent with the grassland ecosystem	• Create alternative water holes where needed	• Conduct research on the movement of wildlife in relation to the sources of water and their use by wildlife • Compile existing information on water sources • Develop water maps • Identify gaps
9. Crop Damage – crop raiding from adjacent PAs is a common problem.	• 1. Reduce park-people conflicts	• Effective measures to minimise crop damage by fencing, making trenches, and working with local communities to change their cropping patterns.	• Research on extent of damage and appropriateness of method in site-specific areas
10. Stakeholder Collaboration and Coordination among Agencies	• Strengthen collaboration among stakeholders	• Identify stakeholders and make reports • Strengthen coordination	• Stakeholder and user group identification
11. Trans-boundary Conservation and Coordination	• Effective implementation of trans-boundary meetings with India	• Develop mechanism and processes to achieve the goal • Exchange tours between countries	•

TABLE 3. CONT....

Issues	Goal/Objectives	Management Activities	Research/Monitoring Activities
12. Tourism - More than 60,000 tourists visit RCNP annually and numbers are increasing in RBNP	• To minimise disturbance in grassland areas from lodges, camps, and resorts within the PAs	• Assess the impacts caused by tourism - activities/number of tourists • Assess spatio/temporal impacts of visitors • Propose strongly to relocate tented camps to buffer zone, especially in Chitwan, Bardia, and Shukla Phanta. • Relocate others when their contracts expire • Zonation in potential tourism areas (e.g., Babai Valley)	• Conduct research on the impact of tourism on grassland ecosystems • Document socio-economic conditions and culture of the local community
13. Park Infrastructure – although necessary for routine management within the PAs, there is concern that such infrastructure may disturb wildlife and habitat	• To minimise disturbance to grassland areas resulting from the presence of roads, guard posts, towers, etc	• Review the existing infrastructure in grasslands and their vicinity • Classify infrastructure based on the use and importance • Regulate the use of infrastructure accordingly (e.g., in Baghaura Phanta in Bardia where a road passes through the grassland from January to April; in Shukla-review the location of a guardpost near the *machan* and relocate if possible)	• Conduct research on the impact of infrastructure affecting any grassland ecosystem
14. Corridors and Connectivity – wildlife numbers are increasing in PAs and will need habitat beyond PA boundaries	• Conserve/protect existing corridors and if possible create additional corridors	• Generate good maps of corridors • Develop strategies to reduce human impact in corridors • Tighten linkages with other line agencies working outside the PAs	• Ground investigation for the use of corridors by wildlife and people
15. Non-PA Development Activities – activities outside the PAs that impact core areas such as dams, high tension line, highways, and irrigation schemes	• To minimise/stop activities adversely impacting the grasslands	• Lobbying from local level to international level	• Conduct research on the environmental impact of any kind of developmental activities
16. Disease Transfer and Genetic Pollution – potentially resulting from interaction with domestic livestock	• Maintain healthy and disease free wildlife populations	• Immunise (anthrax, FMD, rinderpest) livestock in Buffer Zone to reduce disease transfer • Minimise wildlife-livestock interaction	• Conduct blood/stool analysis • Disease survey in wildlife • Monitor wildlife health by external morphological features • Genetic study in wildlife
17. Park/Camp Elephant Grazing – impact from domestic elephants unknown	• Sustainable use of grassland resources for park elephants	• Do not increase the present number of elephants grazing inside the park (based on research findings in Bardia)	•

TABLE 4. ISSUES IDENTIFIED FOR EACH MOUNTAIN PROTECTED AREA OF NEPAL

ISSUES	KNP	RNP	SPNP	LNP	DHR	KCA	ACAP	MBNP	SNP	MCA
Forest burning	N	Y*	Y*	N	N	N	Y	Y	Y	?
Wild plant extraction	Y	Y	Y	Y	Y	Y	Y	Y	?	Y
Poaching/hunting	Y	Y	Y	Y	Y♦	Y	Y	Y	Y	Y
Livestock grazing	Y	N▲	Y	Y	Y	Y	Y	Y	Y	Y
Winter forage/fodder	N	N	Y	Y	N	Y	Y	N	Y	?
Livestock depredation	Y	N	Y	Y	Y	N	Y	Y	Y	?
Tourism/pilgrimage	Y (pt)	Y (t)	Y (pt)	Y (pt)	Y (pt)	Y (pt)	Y	N	Y	Y
Livestock-wildlife competition	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Crop depredation	Y	Y	Y	Y	N	Y	Y	Y	Y	?
Transboundary	N	N	Y	Y	N	Y	Y	Y	Y	Y
Agricultural encroachment/ illegal settlement	Y	Y	Y	Y	Y	N	Y	N	N	?
Indigenous management systems	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Disease transfer	Y	N	Y	Y	Y	Y	Y	Y	Y	?
Livestock composition change	Y	N	Y	Y	Y	N	Y	?	Y	?
Extraction of forest products	Y	Y	Y	Y	Y	Y	Y	Y	Y	?
Collaboration among stakeholders	Y	Y	Y	Y	Y	Y	Y	Y	Y	?
Shifting cultivation	N	N	N	N	Y	Y	Y	Y	N	?
Conservation awareness	Y	Y	Y	Y	Y	Y	Y	Y	Y	?
Non-park development projects and activities	N	N	N	Y	N	Y	Y	N	Y	N

Index: 'Y' = yes; 'N' = no '?' = not known; (p) = pilgrimage; (t) = tourism; (pt) = both pilgrimage and tourism

* controlled burning, lack thereof leading to disease in livestock/wildlife as indicated locally

♦ managed hunting

▲ lack of livestock grazing/fire leading to invasion by pines

Issues have been sorted in the table according to the extent of research conducted, although individual PAs will have different priorities. This table is merely a guide.

Table 6 shows the total research and management initiatives to date in each of the PAs in the mountain areas. A priority score for each PA was calculated based on the extent of activities initiated in that PA to address the issues pertinent to it (the formula used is explained in the table). The lower the priority score, the less work has been done in that PA to address the issues of concern. This table is presented to show that some PAs have received more attention and resources than others. For example, PAs such as ACAP and Makalu Barun have initiated many activities to address comprehensive issues, while Kanchenjunga (which is a young PA) and Khaptad have not adequately addressed many issues. This table can be a starting point to identify which PAs need additional focus from the Department for research and management planning and resource allocation.

TABLE 5. SUMMARY OF ISSUES AND RESEARCH/MANAGEMENT INITIATIVES FOR ALL MOUNTAIN PROTECTED AREAS (TOTAL OF 10 PAS). SUMMARISED FROM TABLES A-3 AND A-4 IN ANNEX 1

Issues	Issue?	Research Initiatives			Management Initiatives		
	Yes*	Good	Partial	Priority score**	Good	Partial	Priority score**
Forest burning	5	0	0	0.00	0	0	0.00
Disease transfer	8	0	0	0.00	0	1	0.06
Livestock-wildlife competition	10	0	4	0.20	0	5	0.25
Livestock composition change	6	0	3	0.25	0	0	0.00
Crop depredation	8	1	3	0.31	0	2	0.13
Wild plant extraction	9	1	4	0.33	2	0	0.22
Shifting cultivation	4	1	1	0.38	1	1	0.38
Winter forage/fodder	5	1	2	0.40	1	2	0.40
Livestock depredation	7	2	2	0.43	0	3	0.21
Transboundary conservation	7	1	4	0.43	1	4	0.43
Non-park development projects and activities	4	0	4	0.50	0	2	0.25
Indigenous management systems	10	3	4	0.50	3	2	0.40
Extraction of forest products	9	0	9	0.50	1	7	0.50
Conservation awareness	10	2	7	0.55	0	6	0.30
Collaboration among stakeholders	9	2	6	0.56	1	7	0.50
Livestock grazing	9	4	4	0.67	4	2	0.56
Tourism/pilgrimage	10	4	6	0.70	3	6	0.60
Agricultural encroachment/ illegal settlement	9	8	1	0.94	0	4	0.33
Poaching/hunting	10	10	0	1.00	9	0	0.90

* Total number of mountain PAs (out of 10) that were identified as facing this issue.
**Priority score calculated as [(#Good) + (#Partial/2)] / #Yes.

TABLE 6. TOTAL RESEARCH AND MANAGEMENT INITIATIVES IN EACH MOUNTAIN PA (ADDRESSING THE 19 ISSUES)

PA:	Total No. of Issues Identified	Research Initiatives			Management Initiatives		
		Good	Partial	Priority score*	Good	Partial	Priority score*
KCA	15	2	6	0.33	0	4	0.13
KNP	14	1	8	0.36	2	6	0.36
DHR	14	2	7	0.39	1	3	0.18
RNP	11	2	5	0.41	2	6	0.45
SPNP	17	5	8	0.53	3	7	0.38
LNP	17	4	10	0.53	4	7	0.44
SNP	16	6	7	0.59	3	6	0.38
ACAP	19	9	7	0.66	8	8	0.63
MBNP	14	8	5	0.75	5	6	0.57
MCA	not counted						

* Priority score calculated as [(#Good) + (#Partial/2)] / #no. of issues identified

Session 2: Research and Management Recommendations for Mountain PAs

The mountain group sessions indicated a significant absence of research related to high elevation rangelands and forests. Thus the participants focussed on developing research strategies to address the high priority issues of wildlife-livestock competition, crop and livestock depredation, medicinal plant extraction, stakeholder involvement, and transboundary protection. Table 7 highlights the major goals and activities needed to address the lack of research in mountain PAs. It was felt that to address these issues best, there should first be a solid understanding about the pastoral production systems operating in the various PAs, including the socioeconomic and bio-physical constraints these communities face. This in turn would help prioritise research and management activities in the future, especially if the decision-making process regarding research and management is to be truly collaborative and participatory. Issues should be prioritised within each PA specific to their own needs and concerns, but with a clear picture of local land-use systems. All the 19 issues identified can be addressed to varying degrees in each PA.

General recommendations were made by the group to address research and management gaps.

- Each PA to prioritise research and management according to specific PA needs and concerns
- Promote collaboration/cooperation at the local and national level (among line agencies and NGOs working in the natural resource sector)
- Promote collaboration/cooperation among international entities
- Include local herders and other relevant stakeholders in the decision-making and planning process
- Tighten linkages between research entities and PA management
- Improve communication and sharing of information within and among PAs
- Revise and update management plans for all PAs, including policies, programmes, implementation strategies, schedule and budgets
- Adopt an interdisciplinary approach to both research and management
- Develop on-going research facilities and systems to conduct and manage research for each PA
- Develop and implement relevant monitoring systems for each PA such as monitoring of livestock numbers and composition

Conclusions and Recommendations of Working Groups

Each group approached their assigned tasks in different ways, but overall the recommendations made were appropriate to address the key issues related to grassland conservation and management.

The *Terai* working group sessions revealed that, while much research on grasslands has been conducted to date, the results have not been incorporated into grassland management practice. The *Terai* PAs are at a stage where they can begin implementing many of the management recommendations provided by researchers over the years. Therefore, the participants of the *Terai* working group outlined a number of research and management strategies to address gaps, primarily focussing on maintenance of grassland habitats for key wildlife

species. In addition, policy recommendations were put forth to deal with the more difficult aspects of landscape management, such as stakeholder involvement in buffer zone and corridor areas, hydrology impacts of upriver dams, and land conversion in corridor areas.

The mountain group sessions indicated a significant absence of research related to high elevation rangelands and forests. Management of mountain PAs offers a challenge because human use in these areas is much more extensive than in the *Terai* (where human use is mostly concentrated in buffer zones outside the core PA), making park-people conflicts more likely, more pronounced, and more difficult to manage. Thus, stakeholder involvement in the management of core areas of the PAs becomes much more important, especially as these communities are allowed access by law. The working group felt that to address the major issues best, it is vital to understand the rationale of why local communities use resources in the manner that they do and to document the extent of that use and its overlap with PA resources of concern such as wildlife. Thus the participants focussed on developing research strategies to address the high priority issues of wildlife-livestock competition, crop and livestock depredation, medicinal plant extraction, stakeholder involvement, and transboundary protection.

The Following Follow-up Actions were Recommended

- An editorial committee would be established to compile the *Terai* and mountain papers and summarise working group sessions for the workshop proceedings. A summary of the workshop would be sent in the form of an action document to the DNPWC for review before publishing by ICIMOD.
- This action document should be provided to small working committees assigned to refine and implement the research and management guidelines identified in the workshop: one for *Terai* and one for mountain PAs. No agreement was made regarding who should be on these committees as this would need to be the initiative of the DNPWC. The DNPWC needs to identify who should be on these committees, define tasks, and develop logistical arrangements for how and when these committees could meet.
- Each warden should refine the priorities discussed in the working groups according to specific PA needs in a subsequent planning workshop.
- Levels of follow-up and action should depend on the type of recommendation: such as policy, management, or research. A core grassland committee could act as a link between these various levels of action.
- Follow-up training in research methods and management techniques should be done.
- Conduct a future regional meeting to discuss the status of grassland research and management in *Terai* and mountain PAs of India and Nepal.

Concluding Remarks

Mr. K.M. Shrestha chaired the concluding session of the workshop. Speaking on behalf of the mountain PAs, Mr. Fanindra Kharel thanked the organizers for providing a forum to interact on relevant issues of grassland management. He also said that the workshop dealt with genuine issues and explored inherent problems pertaining to the effective management of both mountain and *Terai* parks.

TABLE 7. MAJOR OBJECTIVES AND THE RESEARCH AND MANAGEMENT ACTIVITIES RECOMMENDED TO ADDRESS THE ISSUES IDENTIFIED IN THE MOUNTAIN PA WORKING GROUPS

Objectives	Issues Addressed (of the total 19 identified in the workshop)	Research Activities	Variables to Study	Management/ Policy Activities
I. To document pastoral systems in mountain protected areas - Rationale for use of PA resources (indigenous knowledge) - Socio-economic constraints - Bio-physical constraints	ALL	• Initiate participatory action research to help local communities and stakeholders to identify their own constraints and solutions in a collaborative manner (methods: RRA, PRA, APPA, etc) • Document work done by other government departments for the area in the livestock, forestry, and agricultural sectors	• Indigenous knowledge regarding livestock husbandry, rangelands, forests, burning practices, agriculture, etc • Grazing patterns – extent and distribution • Livestock numbers and composition/distribution by type • Preferred forage species and seasonal availability • Animal performance • Economic value of livestock products, etc • Demographic patterns	• Train local DNPWC staff in participatory research techniques, agro-ecosystem analysis • Set up legal framework to allow collaborative management of resources with local communities • Establish collaborative links with other relevant government departments/NGOs • Establish basic livestock monitoring/ permit system
II. To document bio-physical resources and their extent/ ecology	ALL	• Compile literature to date on PA resources in spatial and temporal format • Map known resources • Identify gaps • Collect additional information	• Map resources: land-use patterns, topography, settlement areas, trails, drainage areas, livestock distribution, pastures (resident and transhumant) wildlife distribution, extent of burning • Conduct ecological studies on forest and rangeland condition with regard to human use (grazing, burning, forest product extraction)	• Develop on-going research facilities/system for each PA • Develop a literature depository at DNPWC and each PA • Develop mapping unit at DNPWC • Train staff in research and mapping techniques • Strengthen collaborative links with other research organizations (e.g., NGOs, government agencies, universities)
III. To document wildlife habitat and movements and how it overlaps with human uses of resources	• Wildlife-livestock competition • Crop and livestock depredation • Disease transfer	• Compile literature to date on livestock-wildlife conflicts • Identify gaps • Study wildlife and livestock distribution patterns • Patterns of crop raiding • Disease incidence	• Wildlife distribution and autecology, livestock distribution, forage niches, landscape characteristics, cropping patterns and associated landscape, patterns of crop raiding, types and extent of disease in wildlife/livestock	• See above

TABLE 7 CONT....

Objectives	Issues Addressed (of the total 19 identified in the workshop)	Research Activities	Variables to Study	Management/ Policy Activities
IV. To document the ecology and use of medicinal plants	• Wild plant extraction	• Compile literature to date on medicinal plants • Identify gaps • Studies on plant ecology • Studies on use patterns, home consumption and commercial use • Legal aspects	• Autecology of plant species (environment) • Distribution, quantity • Impacts of harvesting on plant growth, etc • Estimates of quantity for home consumption • Estimates of quantity for commercial sales • Policy review	• See above
V. To explore means to improve transboundary collaboration at the local and national levels	• Poaching and export • Transboundary collaboration • Wild plant extraction and export • Forest burning • Stakeholder collaboration	• Feasibility studies along border areas to identify issues facing local communities and capability at local level to manage transboundary conservation (already initiated for some PAs) • Legal analysis	• Review literature • Identify border sites of high biodiversity significance • Document perceived threats to biodiversity by various stakeholders • Extent of cross-border resource use and indigenous management • Trade of illegal plant and animal products • Identify opportunities for economic incentives	• Initiate collaborative research with local communities in border areas • Increase local awareness of transboundary issues • Trans-national meetings to determine strategies • Training of local staff in monitoring illegal/legal trade
VI. Improve stakeholder collaboration	ALL	• Participatory action research regarding various issues • Stakeholder identification regarding particular issues (e.g., forest, grazing, medicinal plants) • Document tenure (customary and legal) • Conflict resolution strategies	• Define user groups for particular resources • Tenurial rights among different groups (caste, gender, legal, customary) • Identify world views among stakeholders and conflicts in those views • Conflict resolution techniques	• Train local DNPWC staff in participatory research techniques, stakeholder identification, and conflict resolution strategies • Set up legal framework to allow collaborative management of resources with local communities • Establish collaborative links with other relevant government departments/NGOs

Dr. Nic Peet commended DNPWC, the WWF Nepal Program, and IUCN for organizing the three-day workshop. He also said that the workshop had floated good ideas and made useful recommendations for effective grassland management.

Mr. Vishwas B. Sawarkar spoke on behalf of the Indian participants and acknowledged their gratitude to the organizers for providing the opportunity to interact with researchers, park managers, and conservationists. He said the workshop was successful in setting goals and objectives for effective grassland management. He added that the Wildlife Institute is looking forward to similar interactions in the future.

Ms. Camille Richard thanked the collaborating organizations and remarked that the workshop had been very beneficial not only for conservation groups in Nepal, but also for ICIMOD's programmes in biodiversity conservation and rangeland management. She also said that the workshop presented a clear picture of the major issues on grassland ecology for both the *Terai* and mountain parks in Nepal.

Mr. Shyam Bajimaya of DNPWC commented that the Status Papers and Research Papers presented in the workshop highlighted the ecosystems in the protected areas. They also dealt with the complexities of grassland management. He hoped that the outcome of the workshop would help in developing realistic guidelines for park managers to use practically in the field. The Chief Warden of Royal Bardia National Park thanked ICIMOD, the WWF Nepal Program, and DNPWC for providing support to organize the workshop in Bardia. He also thanked all those who directly or indirectly contributed to the success of the meeting.

The chairperson stated that the extensive discussions and sharing of experiences with each other was enriching. He thanked all the participants for making the workshop a success, and formally closed the session.

Literature Cited in Volume I

Ali, S. (1994) *Field Guide to the Birds of the Eastern Himalaya*. Delhi: Oxford University Press.

Basnet, K. (1996) *Biodiversity Inventory of Royal Bardia National Park*. Report # 2. Kathmandu: BICP/WWF Nepal Program.

Basnet, K. (1998) *Biodiversity Inventory of Shey Phoksumdo National Park: Wildlife Component. WWF Nepal Program*. Report series 34. Kathmandu: WWF Nepal Program.

Basnet, K.; Pandey, S.B.; and Adhikari, T.R. (1996) *A Five-year Management Plan for Shey Phoksumdo National Park*. Preliminary draft Submitted to WWF Nepal Program.

Basnet, K.; Shrestha, K.M.; Sigdel, E.R and Ghimire, P. (1998) *Royal Bardia National Park Extension Area. Biodiversity Inventory*. Kathmandu: WWF

Nepal Program and Department of National Parks and Wildlife Conservation.

Bell, D.J.; and Oliver, W.L.R. (1992) Northern Indian Tall Grasslands: Management and Species Conservation with Special Reference to Fire. In Singh K.P.and Singh J.S. (eds), *Tropical Ecosystems: Ecology and Management,* pp109-123. New Delhi: Wiley Eastern Limited.

BPP, (1995) *Biodiversity Profiles Project (Technical Publication # 12-14).* Kathmandu: Department of National Parks and Wildlife Conservation.

Carson, B. (1992) *The Land, The Farmer, and The Future: A Soil Fertility Management Strategy for Nepal.* Kathmandu, Nepal: ICIMOD Occasional Paper No. 21.

DNPWC and WWF (1996) *A Five-year Operational Plan for Royal Bardia National Park,* Bardia Integrated Conservation Project. Report #1. Kathmandu: Department of National Park and Wildlife Conservation and WWF Nepal Program.

Fleming, R.L., Fleming, R.L. (Jr), Bangdel, L.S. (1976) *Birds of Nepal.* Kathmandu: Avalok.

Ghimire, S.; Parajuli, D.B.; Gurung, T.N.; Lama, Y.C.; and Aumeeruddy, Y. (1998) *Conservation of Plant Resources, Community Development and Training in Applied Ethnobotany at Shey Phoksumdo National Park and its Buffer Zone, Dolpa.* Report series #38. Kathmandu: WWF Nepal Program.

Grimes, J.P. (1979) *Plant Strategies and Vegetation Processes,* pp222. New York: Wiley.

Gyamtsho, P. (1996) 'Asessment of the Condition and Potential for Improvement of High Altitude Rangelands of Bhutan'. PhD Thesis. Switzerland: Swiss Institute of Technology.

Inskipp, T. and Inskipp, C. (1997) Unpublished lists of Himalayan Birds and Range Distribution Maps of Endemic Bird Species submitted to WWF-Nepal Program as part of this analysis.

IUCN (1996) *IUCN Red List of Threatened Animals.* Gland, Switzerland: IUCN.

KMTNC (1998) *Annapurna Conservation Area: Management Plan.* Kathmandu: King Mahendra Trust for Nature Conservation.

Lehmkuhl, J.F. (1989) 'The Ecology of a South-Asian Tall-grass Community'. PhD thesis. Seattle: University of Washington.

Lehmkuhl, J.F. (1994) *A classification of Subtropical Riverine Grassland and Forest in Chitwan National Park.* Kathmandu: Nepal. *Vegetatio* 111:29-43.

MacKinnon, J., MacKinnon, K. Child, G., Thorsell, J. (1986) *Managing Protected Areas in the Tropics*. Gland, Switzerland: IUCN.

Miller, D. (1998) Conserving biodiversity in Himalayan and Tibetan Plateau rangelands. In *Ecoregional Cooperation for Biodiversity Conservation in the Himalaya*, pp291-318. Kathmandu: UNDP, WWF and ICIMOD.

Miller, D.J. (1995) *Herds on the Move: Winds of Change Among Pastorliasts in the Himalaya and Tibetan Plateau*. ICIMOD Discussion Paper MNR 95/2. Kathmandu: ICIMOD .

Moe, S.R. (1994) 'Distribution and Movement Pattern of Deer in Response to Food Quality and Manipulation of Grassy Habitat: A Case Study with Emphasis on Axis Deer *Axis axis* in Lowland Nepal'. PhD Dissertation. Ås: Agricultural University of Norway.

Olson, D.; and Dinerstein, E. (1998). The Global 200: *A Representation Approach to Conserving the Earth's Distinctive Ecoregions* (Draft manuscript). Washington DC, USA: WWF-US Conservation Science Program.

Panwar, H.S. (1992) 'Ecodevelopment: An Integrated Approach to Sustainable Development for People and Protected Areas in India.' Paper presented an the IV World Congress on National Parks and Protected Areas. Carcas, Venezuela. 10-21 February 1992.

Peet, N.B.; Watkinson, A.R.; Bell, D.J. and Brown, K. (1997) *The Management of Tall Grasslands for the Conservation of Biodiversity and Sustainable Uutilization*. Research Report. Department of National Parks and Wildlife Conservation and University of East Anglia.

Pokharel, S.K. (1993) 'Floristic Composition, Biomass Harvests in the Grassland of Royal Bardia National Park, Bardia, Nepal'. M.Sc thesis. Ås: Agriculture University of Norway.

Rawat, G.S. (1997) *Floral Diversity Gap Aanalysis for the Himalayan Region*. Unpublished WWF-Nepal Program report.

Richard, C.E. (1999) Indigenous natural resource management in the highlands of the Himalayas: integrated assessments for protected area design. In Watson, Alan E.; Aplet, Greg. 1999. *Personal, Societal, and Ecological Values of Wilderness: Sixth World Wilderness Congress Symposium on Research, Management, and Allocation, Vol. II*, Proc. RMRS-P-000. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Shengji, P. (1996) *Banking on Biodiversity. Report on the Regional Consultation on Biodiversity Assessment in the Hindu Kush-Himalayas*. Kathmandu: ICIMOD.

Shrestha, K. K., Ghimire, S.; Gurung, T.N.; Lama, Y.C.; and Aumeeruddy, Y., (1998) *Conservation of Plant Resources, Community Development and Training in Applied Ethnobotany at Shey Phoksumdo National Park and Its Buffer Zone, Dolpa.* Report series #33 Kathmandu: WWF Nepal Program.

Shrestha, T.B. and Joshi, R.M. (1996) *Rare, Endemic and Endangered Plants of Nepal.* Kathmandu: WWF-Nepal Program.

Singh, L. (1989) Grassiand Ecosystems in the Himalayan Region of India. In Shah, B. and Rafique, S. (eds.), *Regional Seminar on Problems Affecting Range and Pastureland Development in Himalayan Region.* pp 145-152. Nov. 19-26, 1989, Peshawar, Pakistan: FAO.

Stoddart, L.A.; A.D. Smith, and Box, T.W. (1975) *Range Management*, New York: McGraw-Hill.

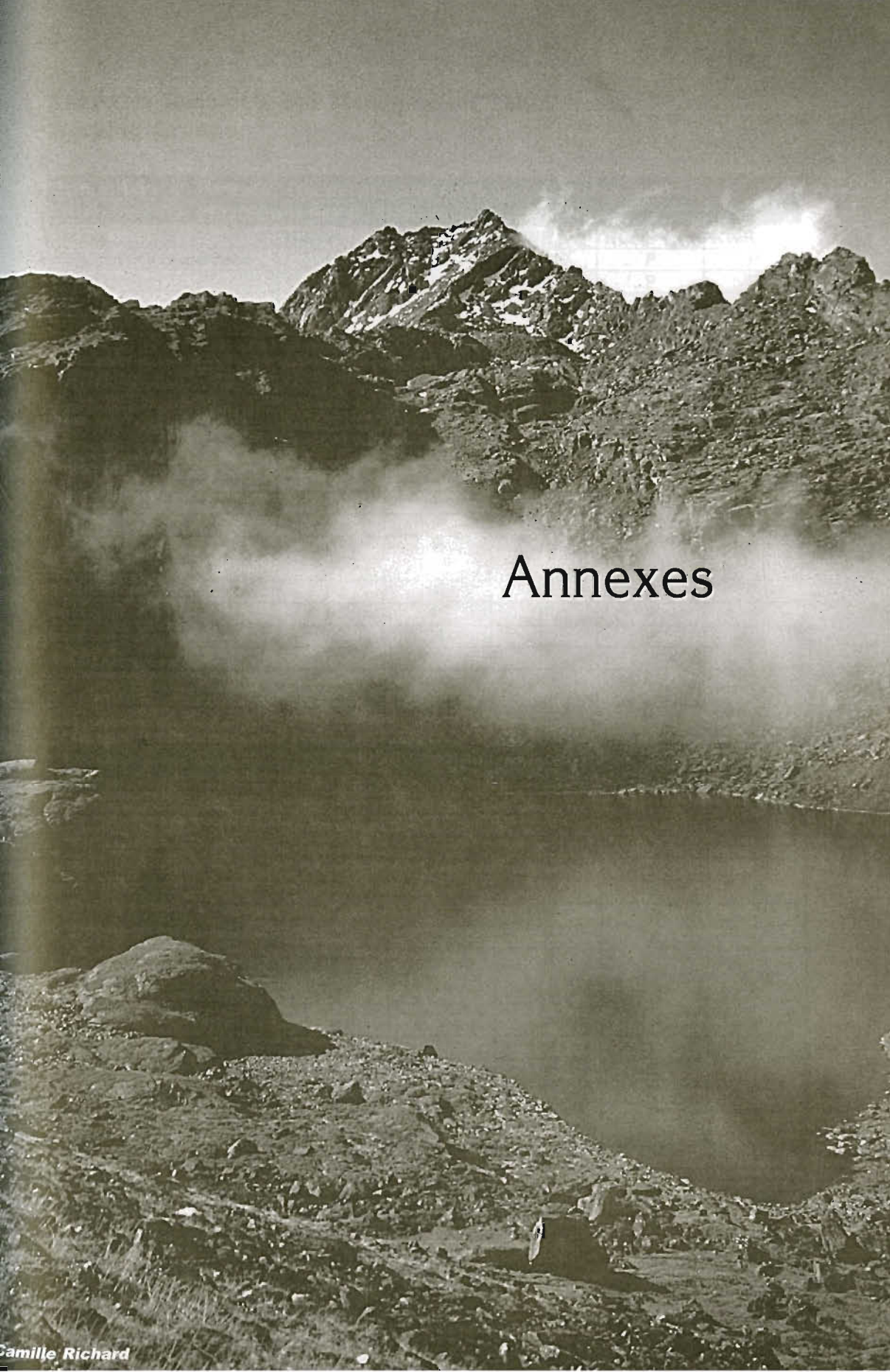
Tilman, D.; and Downing, J.A. (1994) 'Biodiversity and Stability in Grasslands' In *Nature* 367: 363-365.

UNDP (1998) *Ecoregional Cooperation for Biodiversity Conservation in the Himalaya.* Kathmandu: UNDP, WWF, and ICIMOD.

WCMC (1992) *Global Biodiversity.* London: Chapman and Hall.

Whittaker, R.H.; and Likens, G.E. (1973) Carbon in the Biota. In Woodwell, G.M., and Pecan, E.V. (eds), *Carbon and the biosphere.* U.S. Atomic Energy Commission, Technical Information Center.

Wikramanayake, E.; Dinerstein, E.; Loucks, C.; Wettengel, W. and Allnut, T. (1998) *A Biodiversity Assessment and Gap Analysis of the Himalayas.* Washington,D.C.: WWF-US.


Annexes
Camille Richard

Annex 1: Research and Management Tables from Working Groups

TABLE A-1. RESEARCH ACTIVITIES AND GAPS IDENTIFIED FOR EACH *TERAI* PROTECTED AREA

Issues	RBNP	PWR	RSWR	RCNP	KWR
Tree invasion in grassland	P	N	P	P	P
Illegal burning	P	N	P	P	P
Settlement in core area	--	P	P	--	P
Illegal grazing	P	P	P	P	P
Collection of grass	P	P	P	P	P
Scarcity of water	P	P	P	P	--
Forest road/park infrastructure	P	--	P	P	P
Hydrology and flooding	P	--	P	P	P
Tourism	P	--	P	P	P
Park/camp elephant grazing	P	--	P	P	P
Corridors and conductivity	P	P	P	P	P
Research and monitoring	P	P	P	P	P
Transboundary conservation	P	P	P	P	P
Stakeholder collaboration	P	P	P	P	P
Development activities	P	P	P	P	P
Disease transfer	P	N	P	P	P
Crop depredation	P	P	P	P	P

'G' = good initiative; 'N' = no initiative; 'P' = partially addressed; and '--' = not relevant

TABLE A-2. MANAGEMENT ACTIVITIES AND GAPS IDENTIFIED FOR EACH *TERAI* PROTECTED AREA

Issues	RBNP	PWR	RSWR	RCNP	KWR
Tree invasion in grassland	P	P	P	P	N
Illegal burning	P	P	P	P	P
Settlement in core area	--	G	G	--	P
Illegal grazing	P	P	P	P	P
Collection of grass	P	P	P	P	P
Scarcity of water	P	P	P	P	--
Forest road/park infrastructure	P	--	P	--	--
Hydrology and flooding	P	--	P	P	P
Tourism	P	--	P	P	P
Park/camp elephant grazing	N	--	N	P	N
Corridors and conductivity	P	P	P	P	P
Research and monitoring	P	P	P	P	P
Transboundary conservation	P	P	P	P	P
Stakeholder collaboration	P	P	P	P	P
Development activities	P	P	P	P	P
Disease transfer	P	N	P	P	P
Crop depredation	P	P	P	P	P

'G' = good initiative; 'N' = no initiative; 'P' = partially addressed; and '--' = not relevant

TABLE A-3. RESEARCH ACTIVITIES AND GAPS IDENTIFIED FOR EACH MOUNTAIN PROTECTED AREA

Issues	KNP	RNP	SPNP	LNP	DHR	KCA	ACAP	MBNP	SNP	MCA
Forest burning	N	N	N	N	N	N	N	N	N	N
Wild plant extraction	P	N	G	P	N	N	P	P	N	?
Poaching/hunting	G	G	G	G	G	G	G	G	G	G
Livestock grazing	P	P	G	P	P	N	G	G	G	?
Winter forage/fodder	N	N	P	P	--	N	G	--	N	?
Livestock depredation	P	-	G	P	N	--	G	--	?	?
Tourism/pilgrimage	P	P	P	G	P	P	G	G	G	P
Livestock-wildlife competition	N	N	P	N	N	N	P	P	P	?
Crop depredation	N	N	N	P	--	N	P	G	P	?
Transboundary conservation	N	--	N	G	--	P	P	P	P	?
Agricultural encroachment/ illegal settlement	P	G	G	G	G	G	G	G	G	?
Indigenous management systems	N	N	P	P	P	P	G	G	G	?
Disease transfer	N	--	N	N	N	N	N	N	N	N
Livestock composition change	N	--	P	N	P	--	--	--	P	?
Extraction of forest products	P	P	P	P	P	P	P	P	P	?
Collaboration among stakeholders	P	P	P	P	P	N	G	G	P	?
Shifting cultivation	--	--	--	--	N	N	P	G	--	?
Conservation awareness	P	P	P	P	P	P	G	P	G	?
Non-park development projects and activities	--	--	--	P	--	P	P	--	P	--

'G' = good initiative; 'N' = no initiative; 'P' = partially addressed; and '--' = not relevant

TABLE A-4. MANAGEMENT ACTIVITIES AND GAPS IDENTIFIED FOR EACH MOUNTAIN PROTECTED AREA

ISSUES	KNP	RNP	SPNP	LNP	DHR	KCA	ACAP	MBNP	SNP	MCA
Forest burning	N	N	N	N	N	N	N	N	N	N
Wild plant extraction	N	N	N	G	N	N	G	N	N	?
Poaching/hunting	G	G	G	G	G	N	G	G	G	G
Livestock grazing	G	G	P	P	N	N	G	G	N	?
Winter forage/fodder	N	N	N	P	--	N	G	--	P	?
Livestock depredation	N	--	P *	P *	N	--	P	--	N	?
Tourism/pilgrimage	P	P	P	G	N	P	G	P	G	P
Livestock-wildlife competition	P	P	N	P	N	N	P	P	N	?
Crop depredation	N	N	P *	N	--	N	N	P	N	?
Transboundary conservation	--	--	N	G	--	P	P	P	P	?
Agricultural encroachment/ illegal settlement	P	P	P	N	N	--	P	N	?	?
Indigenous management systems	N	N	G	N	P	N	G	G	P	?
Disease transfer	N	--	N	N	N	N	P	N	N	N
Livestock composition change	N	--	N	N	N	--	--	--	N	?
Extraction of forest products	P	P	G	P	N	P	P	P	P	?
Collaboration among stakeholders	P	P	P	P	P	N	G	P	P	?
Shifting cultivation	--	--	--	--	N	N	P	G	--	?
Conservation awareness	P	P	P	P	P	P	G	G	G	?
Non-park development projects and activities	--	--	--	N	--	N	P	--	P	--

'G' = good initiative; 'N' = no initiative; 'P' = partially addressed; and '--' = not relevant
* = other initiatives indirectly address this issue

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Annex 3: Workshop Programme

DAY I (MARCH 16, 1999)	
	I. INTRODUCTORY SESSION
9:00 – 10:00	**A. Inauguration** ***Chief Guest:*** Mr. Sushil Bhattarai, Under Secretary, Ministry of Forests and Soil Conservation ***Chairperson:*** Mr. Dibya Dev Bhatta, Director General, Mid-western Forests Office ***Welcome Addresses by:*** Chief Warden Royal Bardia National Park - Mr. Shiva Raj Bhatta Mr. Shyam Bajimaya - Department of National Parks and Wildlife Conservation Presiding Chairperson Mr. Dibya Dev Bhatta Chief Guest Mr. Sushil Bhattarai Lighting of the Panas by Mr. Sushil Bhattarai
10:00 – 10:20	**B. Background, Goals and Objectives of the Workshop** Jhamak Bahadur Karki, DNPWC
10:20 – 10:40	**C. An Agro-ecosystem Approach to Grassland and Rangeland Management in Protected Areas** Camille Richard, ICIMOD
10:40 – 11:00	Tea
	II. PRESENTATION OF TECHNICAL PAPERS **A. Terai Grasslands** ***Coordinators:*** Mr. Narendra Babu Pradhan Mr. Jhamak B. Karki ***Chairperson:*** Mr. Sushil Bhattarai
11:00 – 11:20	A Landscape Approach to Managing Terai Ecosystems with Reference to Uttar Pradesh, India V.B. Sawakar
11:20 – 11:40	Status of Research and Monitoring in Protected Areas of the Indian Terai: An Overview P.K. Mathur
11:40 – 12:00	Managing the *Terai* Grasslands: Recent Research and Future Priorities Nic Peet
12:00 – 12:20	Koshi Tappu's Treasure: Grasslands or Wetlands? Jay Prakash Sah
12:20 – 12:40	Grassland Management Impact on Small Mammals Tika Ram Adhikary
12:40 – 13:00	Effects of Management Practices on the Grassland Vegetation and Their Use by Ungulates in Dudwa National Park, Uttar Pradesh, India Harish Kumar
13:00 – 14:00	Lunch

14:00 – 14:20	Wetlands and Their Importance in Grassland Management in Royal Shukla Phanta Wildlife Reserve Jay Prakash Sah
14:20 – 14:40	Importance of Grasslands in Mega Herbivore Conservation Shanta Raj Jnawali
14:40 – 15:00	Impacts of Grassland Management on Ungulates at Royal Bardia National Park Jhamak Bahadur Karki
15:00 – 15:20	Discussion
15:20 – 15:40	Tea
	B. Himalayan Forests and Rangelands *Coordinators:* Mr. Narendra Babu Pradhan Ms. Camille Richard *Chairperson:* Mr. Shyam Bajimaya
15:40 – 16:00	Representation of Grasslands in the Eastern Himalaya Ecoregions Dr. Khadga Basnet
16:00 – 16:20	Rangeland, Animal Husbandry and Wildlife in Annapurna, Nepal: A Case Study Som Ale
16:20 – 16:40	Alpine Vegetation of North Western India. An Ecological Review Gopal S. Rawat
16:40 – 17:00	Grasslands in the Damodar Kunda Region of Upper Mustang, Nepal Rita Koirala
DAY II (MARCH 17, 1999)	
9:00 – 9:20	Ecological Separation between Ibex and Resident Livestock in a Trans-Himalayan Protected Area Yashveer Bhatnagar
9:20 – 9:40	Participatory Approaches to Rangeland Research and Management: Developing the Action Plan for Rangeland Conservation in Mountain Protected Areas Colleen McVeigh
9:40 – 10:00	Discussion
	III. PRESENTATIONS OF STATUS PAPERS AND WORKING GROUP SESSIONS
10:00 – 12:20	**A. Mountain Protected Areas** *Chairperson:* Mr Shyam Bajimaya Tea Langtang National Park Jhamak Karki Kanchenjunga Conservation Area Fanindra Kharel Dhorpatan Hunting Reserve Ramchandra Kandel Khaptad National Park Nilamber Mishra

	Rara National Park Gopal Ghimire Shey Phoksundo National Park Tulsi Ram Sharma
12:20 – 12:40	Discussion
12:40 – 14:00	Lunch
14:00 – 16:00	**B. Working Group Session to Prioritise Mountain PA Issues** ***Facilitators:*** Narendra Pradhan and Colleen McVeigh
16:00 – 18:00	Field Trip
DAY III (MARCH 18, 1999)	
9:00 – 10:00	**C. Terai Protected Areas** ***Chairperson:*** Mr Shyam Bajimaya Parsa Wildlife Reserve Surya Bahadur Pandey Royal Bardia National Park Shiva Raj Bahtta Shukla Phanta Wildlife Reserve Sher Singh Thagunna
10:00 – 10:20	Discussion
10:20 – 10:40	Tea
10:40 – 11:40	D. Working Group Session to Prioritize Terai PA Issues ***Facilitators:*** Jhamak Karki and Narendra Pradhan
11:40 – 14:00	**E. Working Group Sessions to Identify Research and Management Guidelines for Terai and Mountain PAs** Lunch) Terai PAs ***Facilitators***: Jhamak Karki and J.P. Sah Mountain PA's ***Facilitators:*** Colleen McVeigh and Narendra Pradhan
14:00 – 16:00	**F. Working Group Summaries** **IV. CONCLUSION OF THE WORKSHOP AND CLOSING CEREMONY**
16:20 – 17:00	Follow-up Actions Closing Remarks and Vote of Thanks
18:30	Reception

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Afghanistan


Bangladesh


Bhutan

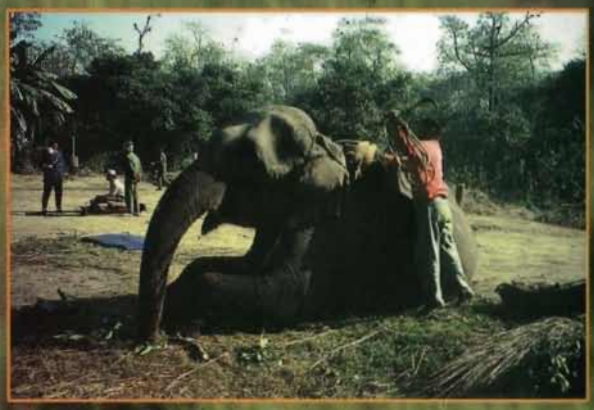

China


India


Myanmar


Nepal


Pakistan



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