

# **National Biodiversity Strategy & Action Plan - India (NBSAP)**

*Executive Agency:* Ministry of Environment & Forest, Government of India

*Funding Agency:* United Nations Development Programme (UNDP)  
Global Environment Facility

*Technical Implementing Agency:* Technical & Policy Core Group (TPCG)  
coordinated by Kalpavriksh

*Administrative Agency:* Biotech Consortium India Ltd

## **Ladakh Sub – State Biodiversity Strategy & Action Plan**

*Nodal Agency:* Ladakh Ecological Development Group (LEDeG)

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## **BIODIVERSITY STRATEGY AND ACTION PLAN**

# **SUB - STATE LADAKH**

*Prepared under the*

**NATIONAL BIODIVERSITY STRATEGY & ACTION PLAN-INDIA**

*by*

***LADAKH ECOLOGICAL DEVELOPMENT GROUP (LEDEG)***

*Sonam Dawa, Ladakh BSAP Coordinator*

*Blaise Humbert-Droz, Drafting & Finalisation Coordinator*

May 2003

*(Final Draft)*

## **1. INTRODUCTION**

### **1.1 BACKGROUND & OBJECTIVES**

Situated across the main Himalayan chain, Ladakh forms the bulk of the Indian Trans-Himalayas, a unique region distinguished by highly evolved and diverse life forms, including a variety of aromatic and medicinal plants, several wild relatives of domesticated plants and animals and a charismatic mega-fauna, still preserved in its entirety unlike most other parts of the world. Ladakh is a repository of vibrant traditions and indigenous knowledge which have evolved in harmony with its natural wealth.

For these reasons Ladakh has been selected by the Indian Government, Ministry of Environment and Forest, as one of eighteen Sub - State sites in the country, for which implementation of a *Biodiversity Strategy & Action Plan* is deemed imperative in view of impending environmental threats. These threats brought about by rapid and often unsustainable modes of development, have already resulted in significant losses in biodiversity affecting both natural and agro-ecosystems. Several species of medicinal plants and wild tree species like Junipers have become endangered due to over-collection and habitat degradation. Natural grasslands and forests have been reduced or degraded including by plantations of faster growing exotic species. Several local crop varieties and breeds have also been displaced or become extinct following the introduction and widespread use of exotics, “High Yielding Varieties” and crossbreeds. Rare and endemic species of wild fauna have been pushed to the brink of extinction even in remote areas, under the pressure of uncontrolled developmental activities including tourism, overgrazing and poaching.

Such erosion of the natural resource base poses a major challenge to the long term development and prosperity of Ladakh. However, large scale environmental degradation and biodiversity loss is a relatively recent phenomenon in the region. There are thus good prospects to mitigate these threats if effective conservation and sustainable development steps are taken rapidly and decisively by the main stake holders. This is the rationale for the *elaboration of the Biodiversity Strategy & Action Plan for Ladakh Sub – State (BSAP)*. Ladakh BSAP forms an integral part of a major Project of the Ministry of Environment and Forest, the *National Biodiversity Strategy & Action Plan (NBSAP)* undertaken throughout the country at National, State and Sub-State levels. The NBSAP Project aims to produce a series of planning documents focusing on the conservation of India's biodiversity, the sustainable use of its biological resources and the promotion of equity in access to and benefits accruing from them. The Project is funded by the Global Environment Facility through the United Nations Development Programme (UNDP). This important endeavour is part of the world wide effort for biodiversity protection, initiated at the Rio Summit of 1993 with the adoption of the *Convention on Biological Diversity* by almost every country on earth. This treaty commits each signatory country to “develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity...”

A unique aspect of the NBSAP is that its execution has been entrusted to a *Technical and Policy Core Group (TPCG)* coordinated by an NGO, *Kalpavriksh* and administered by a private concern, *Biotech Consortium India Ltd.* The NBSAP process has included widespread consultations throughout the country and across all sectors of society involving tens of thousands of people. This major consultation process is resulting in the formulation of 18 sub-state plans, 33 state & union territory plans, 10 eco-regional (inter-state) plans and 13 thematic plans. All these will coalesce in a national plan while also remaining independent for implementation purposes.

In Ladakh, in line with the overall participatory and people oriented approach of the BSAP process, a major local NGO, *Ladakh Ecological Development Group (LEDeG)*, has been entrusted with the task of coordinating preparation of the Sub-State Plan.

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## **1.2 SCOPE**

The broad scope of the BSAP process in Ladakh has been the elaboration, with all main stake-holders, of implementable and participatory Strategies & Actions, that could significantly help to:

- conserve Ladakh's rich biodiversity, both wild and domesticated
- arrest degradation and ensure sustainable use of the natural resource base
- Protect local livelihoods and promote equitable share of benefits accruing from bio-resources.

Integral to this process has also been the development of awareness and better understanding amongst stake-holders, of Ladakh unique natural & cultural value and of the need to coordinate actions for its protection.

### 1.3. CONTENT

This document presents a detailed action plan to protect the biodiversity of Ladakh. Following on the Introduction (1), Chapter 2 describes salient bio-physical and socio-economic features of Ladakh. Chapter 3 presents key components of Ladakh biodiversity, its range and status, based on a review of published information and other sources. The causes of biodiversity loss are explored in Chapter 4, followed, in Chapter 5, by a review of the main stake holders and their initiatives aimed at arresting the degradation process and conserving biodiversity. Based on these chapters, major gaps in information, and conservation means are examined in Chapter 6. Finally, Chapter 7 & 8 present the main strategies and the Action Plan itself, jointly elaborated by the main stake-holders and concerned members of the public to promote long term biodiversity conservation in Ladakh.

### 1.4 APPROACH & METHODOLOGY

#### *First Steps*

The first step taken by *Ladakh Ecological Development Group*, the nodal agency for preparation of the plan in Ladakh, was the constitution of a Local Advisory Committee with representation of key sectors concerned with biodiversity conservation: the civil administration, line departments, NGOs, research and cultural institutions.

In its first meeting convened by (LEDeG) in May 2001, the Committee outlined some important aspects of Ladakh biodiversity needing to be addressed by the Plan, and advised that further consultations be conducted on key issues in the form of workshops and seminars.

Two main focus areas were identified initially:

- conservation, indigenous knowledge & sustainable use of Ladakh plant diversity, the emphasis being laid first on medicinal plants and Sea Buckthorn (*Hippophae rhamnoides*), a widespread indigenous fruit bearing bush with important nutritional and commercial potential.
- integrating wildlife conservation and sustainable/eco-tourism

Sector	Member's Designation
District Administration	Civil Chief Executive Councilor, Ladakh Autonomous Hill Development Council
Government Departments	Indian Forest Service Officer
	Wildlife Warden, Wildlife Department
	Chief Agriculture officer
	District Sheep Husbandry Officer

NGOs	Executive Director, LEDeG
	Chief Amchi, Ladakh Amchi* Astro Sabha (LAAS)
Research Institutions	Associate Professor, Sher-e- Kashmir University of Agricultural Sciences & Technology (SKUAST)
	Director, Field Research Laboratory (FRL), DRDO
Cultural institutions	President, Ladakh Cultural Academy

\* Amchi: traditional medical practitioner of Ladakh

### ***Thematic Workshops & Consultations at Grass Root Level***

In keeping with the recommendations of the Advisory Committee, LEDeG organised throughout 2001, firstly at the grass root level, a series of thematic workshops (7) addressing these focal areas. The main stake holders were directly involved in these consultations: local communities and their organisations, NGOs and in particular WWF and the Snow Leopard Conservancy, Line Departments (Wildlife, Forest, Tourism), Ladakh based Research Institutions (SKUAST, FRL), Industry (Tourism, Food processing).

### ***Conservation of Medicinal Plants***

Protecting the diversity and traditional knowledge of medicinal plants, widely used in Ladakh traditional system of medicine, is an important issue for Ladakh with direct bearing on wild flora conservation and public health: nearly half of the 600 flowering plants reported in Ladakh have medicinal value, 46 (85%) of its 54 rare/endangered plant species are medicinal plants. The c. 120 traditional medical practitioners of Ladakh or Amchis are estimated to cater to 60% of the public health needs of the region (Kala, 2001). Seventy Amchis participated in the 4 day thematic workshop during which 100 species of medicinal plants were collected and 12 sites for *in situ* conservation identified.

### ***Sustainable Use of Sea Buckthorn (*Hippophae rhamnoides*)***

Sustainable use of Sea Buckthorn (SBT), the wonder plant of Ladakh, assumes special significance given its widespread growth in the region, the value addition potential of its processing for local communities and the recent interest of the food processing industry in large scale exploitation. A series of consultations and workshops on the theme saw wide stake-holder participation including local communities of the main growing areas along the Indus Valley and Women Sea Buckthorn Societies. The main outcome of the workshops include preparation of a draft Policy for SBT sustainable use and training programmes in SBT harvesting, processing and economics.

### *Integrating Wildlife Conservation and Sustainable/Eco-Tourism*

With biodiversity rich areas adversely affected by tourism development, the promotion of non destructive and more equitable forms of the industry has become a central issue in Ladakh. Recommendations and actions elaborated in the course of four workshops and village meetings include framing up of action plans for sustainable tourism in biodiversity hot spots, forming community conservation cum eco-tourism organisations and training programmes in conservation and community based tourism.

### ***Identification of other Key Biodiversity Issues***

The next major step was to identify other key biodiversity issues and gather the views of the main stake holders, including concerned line Departments, the Armed Forces, NGOs, Research Institutions such as the Wildlife Institute of India and various segments of society like schools and teachers, politicians, independent researchers and interested members of the public. This was achieved through wide circulation of biodiversity questionnaires, individual meetings, brain storming sessions within LEDeG and groups of stake-holders. These consultations took place throughout August – October 2002.

### ***Baseline Data Compilation***

In parallel with the consultation process, baseline data on the status of Ladakh biodiversity, its main stakeholders and their initiatives was compiled from a variety of sources including scientific and other publications, Government/NGO records, reports, press articles, verbal communications and so on. These data and their analysis are essential to identify gaps in knowledge and stake holder's roles and constitute a key step in the elaboration of sound strategies for biodiversity conservation.

### ***Framing up Ladakh SAP***

Formulation of Ladakh SAP culminated in a series of workshops held in Leh from October to December 2002 with participation of all main stake holders, concerned segments of society and members of the public. Key issues pertaining to both domesticated and wild biodiversity were reviewed. A detailed Action Plan was elaborated with a clear time frame and specific stake holders' responsibilities and commitments. Salient aspects of Ladakh SAP were presented to the final national NBSAP workshop in New Delhi end December. The Draft Plan was revised and augmented in January-February 2003 to incorporate further inputs from the National Workshop and key stake holders including the Armed Forces, NGOs and the Wildlife Institute of India.

### ***Report Preparation***

Ladakh BSAP report (draft) was prepared in February-April 2003 based on an analysis of the compiled data and a review of the series of interactions and inputs of the biodiversity stakeholders and other concerned parties.

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**INSERT MAP OF LADAKH]**

## **2. PROFILE OF LADAKH**

### **2.1 GEOGRAPHY**

Situated in the State Jammu & Kashmir between 32°15' - 36° N and 75°15' - 80°15' Ladakh forms the Northern most extension of the country, across the Great Himalayan range. It is bounded by Tibet to the North and South East, the Kashmir Himalayas to the West and the Lahul & Spiti District of Himachal Pradesh to the South

Ladakh displays a very wide range of altitudes, from 2800m in Kargil to the 7600m Saser Kangri peak in the Karakorum, and extreme climatic conditions: Temperatures range from over 30 °C in summer to less than -40°C in winter and the region receives very low precipitations, which decrease eastwards from ca 250mm in Zaskar to less than 100mm in the Indus Valley and the Chang Tang (South Eastern plains).

Ladakh spans over an area of 96700 square km lying athwart four major mountain ranges which run in a general South East – North West direction and delimit Ladakh main sub-regions:

- the Suru and Zaskar river valleys situated between the Great Himalayan Range, which marks Ladakh Southern boundary, and the Zaskar Range to the North
- the Indus valley between the Zaskar and Ladakh ranges
- the Shyok and Nubra river valleys between the Ladakh range and the Karakorum, which bounds Ladakh to the North

In the South Eastern part of Ladakh, the parallelism of range and valley dissolves in a complex of high altitude ridges and plateaux, many of them forming enclosed basins dotted with lakes and wetlands. Known as the Chang Tang, this region is considered an extension of the Tibetan Chang Tang (Northern Plains) into India (Anon. 1997).

Administratively, Ladakh is subdivided into two Districts: Kargil comprising of the Zaskar and Suru Valley region occupies 14036 km<sup>2</sup> while the Leh District (Indus, Shyok & Nubra valleys and ChangTang is spread over 82665 km (of which c. 37500 under Chinese occupation) which makes it by far the largest District in the country.

## 2.2. SOCIO – ECONOMIC CONDITIONS

### *Demography*

Owing to extreme agro-climatic conditions and topography, which offer limited livelihood opportunities, Ladakh has the lowest population density of the country: 3 persons per square km in Leh District (total population = 118000), 8 in Kargil (tot. pop. = 115000), 4 for the whole of Ladakh (tot. pop. = 233000, 2001 census). However, population figures have been rising very rapidly over the past thirty years, with steady decennial growth rates of over 30%, resulting in a more than two fold increase: from 101000 (1971 census) to 233000 (2001 census).

With a total of 242 villages (113 in Leh District, 129 in Kargil) and only 2 towns, Ladakh population is predominantly rural. However urbanization is proceeding at a rapid pace especially in Leh District, where the urban/rural population ratio has almost doubled in the past 20 years: while only 13% (8700) of Leh district inhabitants were city based in 1981, they were more than 23% (28000) in 2001.

Literacy figures show a tremendous increase in the past decades, from 16% in 1971 to 62% in 2001, which is higher than the 50% State average (Anon., 2001b).

Table 2. Population Features: Leh District	
<i>Feature</i>	<i>Value</i>
Total population (2001)	117637
Female	52471
Male	65166
Decennial Growth	
1961-1971	+ 19.05 %
1971-1981	+ 31.78 %
Rural – Urban Distribution	
Rural Population	76.61 % (90124)
Urban Population	23.39 % (27513)
Literacy Rate	62.24 %
Female	50.03 %
Male	71.98 %

Religion (1981 census)	
Buddhists	81.18 % (55514)
Muslims	15.32 % (10457)
Hindus	2.99 % (2046)
Other	0.51 % (345)

Source: District Statistical & Evaluation Agency, LAHDC, Leh, 2001

### ***Religion & Ethnic Groups***

Both physically and culturally, Ladakh can be roughly divided into the jumbled mountains and gorges of the Muslim inhabited western end of the great Himalayan and Zaskar ranges (Dras, Suru Valley) and the more open Trans-Himalayan mountains and high plains of the central and eastern regions (Leh & Zaskar valleys, Chang Tang) which are predominantly Buddhist and more closely linked to Tibet (Fox, 1994). The Muslims of Kargil District are predominantly Shias. There is also a Shia population in Leh District centered on the village of Chushot located in the Indus valley below Leh. Altogether Muslims, both Shias and Sunnis, account for 15 % of Leh District population, with a smaller Hindu community representing 3 %. Buddhists are by far the largest community in Zaskar and especially in Leh District where they account for 81% of the total population. Amongst the Buddhist community, a particular ethnic group of nomadic herdsman, the Chang Pas, inhabit the High altitude plains and rolling hills of South Eastern Ladakh, the Chang Tang.

### ***Occupational pattern***

#### ***Agriculture & Livestock Rearing***

In line with its predominantly rural characteristics, Ladakh main economic sector is irrigated agriculture and livestock rearing, which employ over 70 % of the workforce, including cultivators, agricultural labourers and herdsman.

Ladakh livestock population has been rising rapidly in the past decades and far exceeds the human population. In Leh District, between 1972 and 1997, livestock numbers have increased more than two fold (+136 %), the highest rise being observed in sheep (+165%), followed by cattle and goat. Livestock per household averaged 14 in 1997 (Anon. 2001b).

<b>Table 3. Livestock Population: Leh District</b>			
<i>Livestock Category</i>	<i>1972</i>	<i>1997</i>	<i>% Increase</i>
Cattle	14563	34813	+139 %

Yak X Cow Hybrids	7220	18525	+157 %
Yak & others	14267	25362	+78 %
Goat	69290	160271	+131 %
Sheep	35801	94788	+165%
Total	141541	333759	+136%

Source: Livestock Census Reports, District Statistical & Evaluation Agency, LAHDC, Leh, 2001

### *Other Economic Sectors*

Other main sectors of Ladakh economy are *trade & commerce*, employing 2.5 % of the workforce in Leh District, *construction* (1.8%), *manufacturing & processing* (1.5%), *transport* (1%) and *household industry* (0.8%). Employment by the *government*, the *armed forces* and the *tourism industry* are other major sources of livelihood (presumably occupying most of the 22% workers classified as *others* in Leh District Census Department statistics).

<b>Table 4. Occupational Pattern: Leh District, 1981 Census</b>		
<i>Occupation</i>	<i>Number</i>	<i>%</i>
Cultivators	17415	58.5 %
Agriculture Labourers	2191	7.4 %
Livestock & allied Activities	1442	4.8 %
Manufacturing & Processing	451	1.5 %
Household Industry	250	0.8 %
Construction	546	1.8 %
Trade & Commerce	735	2.5 %
Transport & allied Activities	305	1 %
Other	6439	21.7 %
Total Main Workforce	29777	100%
<i>Workforce in Relation to Total Population</i>		
Main Workforce	29777	42.5 %

Marginal Workers	4700	6.8 %
Non Workers	23003	40.6 %
Total Population	68380	100 %

Source: Census Department, District Statistical & Evaluation Agency, LAHDC, Leh, 2001

### 2.3. GOVERNANCE & ADMINISTRATION

Ladakh was an independent kingdom till 1834 when it came under the rule of the Maharaja of Jammu & Kashmir. Henceforth and till 1947, Ladakh was administered by a Wazir, appointed by the Maharaja, with headquarters at Leh in summer and Skardu in winter. The British rulers of India also stationed their own trade representative in Leh from the mid-1800s.

After India's independence, Ladakh became part of the State of Jammu & Kashmir, with Skardu coming under the control of Pakistan (Pakistan Occupied Kashmir). Initially constituting one district, Ladakh was later on (1979) sub-divided into Leh and Kargil districts due to political exigencies and for administrative convenience. As is the case for other Districts, Leh and Kargil are administered by Deputy Commissioners, replacing the old Wazarat administrative system of the erstwhile princely State.

Another milestone in the history of governance in Ladakh is the adoption, following political agitation in the late 1980s, of the Ladakh Autonomous Hill Development Council (LAHDC) Act in 1995. With the Act envisaging separate Councils for the two districts of Ladakh, Leh opted for the immediate formation of the autonomous body and has been administered by it since 1995. Creation of the Kargil Council was only decided recently (December 2002) and is due to take effect in 2003. Ladakh Hill Council (Leh) comprises of a general body of 30 Councillors: 26 elected and 4 nominated by the Governor. The General Body elects its Chairman who is also the Chief Executive Councillor. Barring law and police, the Council has powers to plan and execute all developmental works and take decisions on land use and allotment in the district. The Deputy Commissioner is the Chief Executive Officer of the Council.

### 2.4 ECOLOGICAL PROFILE

#### *Geology*

A transect across the Western Himalayas from the Upper Spiti valley (Himachal Pradesh) in the South to the Tso Moriri lake and Indus valley to the North offers a continuous section through different tectonic levels of the Himalayan chain, revealing major stages of the Himalayan history from the Pre-Cambrian to the present including a well preserved fossil record (Steck et al.1998). The Upper Indus valley marks the suture zone where the Indian plate is being thrust under Asia (Van Andel, 1985). This chisel like penetration into Asia, started 4 million years ago and still proceeding at a speed of some 5 cm per year, has given rise to the Himalayas themselves and on

Ladakh scale, to the complex system of mountain ranges as well as active faults and enclosed basins where the region's main rivers and lakes are located.

### ***Natural Ecosystems***

Lying in the rain shadow of the main massif, Ladakh is best described as a *high elevation cold desert*. Ladakh vegetation has been variously described as alpine steppe, dry alpine scrub or stony desert. Low density and abundance as well as a high level of endemism and adaptation to high altitude and aridity are typical characteristics of both the flora and fauna of Ladakh cold desert.

Ladakh complex hydrological system of rivers, lakes and enclosed basins has allowed the development of important *wetlands*. These ecosystems function as oases of productivity in an otherwise arid environment, hosting varied plant communities, including most of the bush and trees growing naturally in the region, as well as a diverse wildlife including an abundant migratory bird fauna.

### ***Agro-Ecosystems***

Extreme climatic conditions and low soil productivity place severe constraints on Ladakh agriculture, which is entirely dependent on irrigation of alluvial terrain and raised terraces on stream sides and in valley bottoms. Less than 1% of Ladakh land mass (< 0.3% in Leh District) is fit for cultivation, which is based on a single yearly crop of mainly naked barley (grim), wheat and irrigated fodder. Between them these three crops account for almost 90% of total sown area in Leh District. The other main crops are pulses, lesser millets and vegetables accounting for another 8 % (Anon. 2001b). Raising two crops a year is only possible in a few lower lying areas, with longer vegetation period and milder climate including part of Nubra and Khaltse region in Leh District as well as Batalik, Garkun and Kargil (Mir, 2002). Silviculture is also widely practiced especially in the lower reaches of Ladakh river valleys, with poplar, willow, apricot and apple as the main crops.

In Western and central Ladakh, farming is traditionally combined with livestock rearing which includes short seasonal migrations to higher pastures (transhumance). Within this traditional system, livestock provide food (milk and meat), fibre and skin for clothing as also power for ploughing. Equally important, livestock convert the nutrients and cellulose of sparsely distributed vegetation and crop residues into dung which is a concentrated form of energy, used as organic fertilizer as well as fuel for cooking and heating (Fox, 1994). Traditional community management systems of Goat (Rarzy) and Cattle rearing (Barzy) are still in force in many villages of the region.

In contrast with the sedentary farmers of central and western Ladakh, the nomadic Chang Pa herders inhabiting the high plateaux of eastern Ladakh undertake substantial migrations at different time of the year, making extensive use of pasture resources. High altitude and a harsh climate do not generally permit cultivation in most of the Chang Tang. Goat and sheep husbandry is the mainstay of the local economy: the high quality pashmina wool produced by the Changra Goat as well as wool and meat from the local breed of sheep are the main cash crops.

## **2.4 HISTORICAL BACKGROUND**

For several centuries Ladakh was a region of small independent kingdoms strategically located on the main trade route linking Kashmir, Yarkhand and Tibet. In the 18 & 19<sup>th</sup> century Ladakh became more closely linked to Kashmir till it was eventually conquered by the Sikh rulers of Jammu & Kashmir in 1834. The British rulers of India also established a presence in Ladakh in the mid 1800s installing a trade agent in Leh.

Army occupation of the Upper Indus Valley during that period reportedly resulted in intense exploitation of wealth and natural resources especially around Leh. Another effect of the Kashmir army and British presence in the region was a spurt in sport and trophy hunting activities with many hunter writers mentioning important decreases in large game population early in the 20<sup>th</sup> century (Fox et al. 1991). A more positive legacy of this period, as far as wildlife conservation is concerned, is the designation of several small game reserves in the latter part of British rule, most of which have since been incorporated in Ladakh Protected Areas network (Chundawat et al 1994).

Since India's independence from Britain which saw the incorporation of Ladakh in the State of Jammu & Kashmir, a series of military conflicts erupted in the region. International trade through Ladakh, once an important staging post on the silk route, effectively stopped as a consequence of the hostilities between the late forties and the early sixties. However the introduction of a large military presence associated with the wars, the opening of road and air links with peninsular India and the development of tourism in the region since the seventies have more than compensated for the loss of revenue from the decline in international trade. As a result, Ladakh has been undergoing a substantial change from the earlier pattern of traditional farming, pastoralism and caravan based trade and conservation of the region's natural resources is becoming an increasing concern (Fox 1994).

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### **3. RANGE & STATUS OF BIODIVERSITY**

Situated at the confluence of two of the world major bio-geographical realms, the Palearctic to the North and Indo-Malayan (Oriental) to the South, Ladakh is endowed with a diverse and highly evolved fauna and flora, both wild and domesticated, with a high percentage of rare and endemic species, indigenous varieties and breeds.

#### **3.1. BIO-GEOGRAPHICAL ZONES**

Located across the main Himalayan chain, Ladakh forms part of the Trans-Himalayas, a vast area of arid high altitude steppe spread over 2.6 million square km situated in the Tibet autonomous region of China with a smaller portion of ca. 180,000 sq. km falling in Indian territory.

Together with the neighbouring District of Lahul & Spiti in Himachal Pradesh, Ladakh constitutes the bulk of the Indian Trans-Himalayas, one of the ten bio-geographical zones identified in the country. The zone has been further sub-divided between the Ladakh mountains (1A) which include the high ranges and valleys of Zaskar, Indus Shyok-Nubra and Lahul & Spiti (60% of the zone) and the Indian portion of the Tibetan Plateau (zone 1B, the remaining 40%) constituted by the Chang Tang region of Eastern Ladakh and a small area of Sikkim in the rain shadow of Kanchen Zonga (Rodgers et al. 2000).

#### **3.2. ECOSYSTEM DIVERSITY**

##### ***Cold Desert Ecosystem***

Spread over some 85000 sq. km in the rain shadow of the main Himalayan massif, Ladakh is classified as a *high altitude cold desert* characterized by extreme climatic conditions and low productivity. Though not as rich as other Himalayan ecosystems, the region is surprisingly diverse in species assemblages and life forms.

Ladakh vegetation is characterized by a predominance of annual plants (therophytes=33%) followed by dwarf shrub (chamaephytes=27%) and perennial herbs (geophytes), a life form spectrum typical of desert environment. Tree species (phanerophytes) represent the smallest component of the vegetation (less than 3%, Kachroo et al. 1977). Across Ladakh landscape, the vegetation changes gradually from alpine meadow (*Kobresia*, *Carex*, *Potentilla*, *Nepeta*) on the North side of the Himalayan crest to steppe vegetation (*Caragana*, *Artemisia*, *Stachys*, *Ephedra*, *Stipa*) to the North and East, with shrubland (*Hippophae*, *Myricaria*, *Salix*) along river courses. The region is virtually treeless except for isolated patches of juniper (*Juniperus macropoda*, *J. indica*) and birch (*Betula utilis*) in some valleys and mostly cultivated varieties of poplar (*Populus ssp*) and willow (*Salix*) along the major water courses (Fox et al. 1994).

Despite its harsh climate, poor vegetation cover and the substantial presence of domestic livestock, Ladakh still host unique and quasi complete faunal assemblages, including the whole range of mammalian herbivores and carnivores characteristic of the steppe ecosystem (Humbert-Droz, 2001). The region thus contains 8 wild ungulates and 6 large carnivores most of them threatened globally (see faunal diversity below). Of particular significance for science and conservation is the presence of four species of wild sheep and goats, the region being considered one of the original centres of *Caprinae* evolution (Miller, 1998).

Ladakh cold desert also harbours a diverse bird fauna including charismatic species like the Golden Eagle (*Aquila chrisaetos*), Lammergeier (*Gypaetus barbatus*), Common raven (*Corvus corax*) and several species endemic to the Tibetan Plateau such as the Tibetan Snowcock (*Tetraogallus tibetanus*), Tibetan partridge (*Perdix hodgsoniae*), Tibetan Sandgrouse (*Syrrhaptes tibetanus*), Snow Pigeon (*Columba leuconota*), Great and Streaked Rosefinch (*Carpodacus rubicilla*, *C. rubicilloides*).

The preservation of such varied and complete faunal assemblages points to a relatively low level of competition between wild and domesticated grazers in Ladakh rangelands. This coexistence between man and wildlife has most probably been made possible by traditionally low human and livestock density and an extensive exploitation of grazing resources, involving seasonal migrations, which are characteristics of Ladakh agro-pastoralist systems. It is also likely that the introduction of domestic livestock, a large component of which originated from domestication of wild herbivores present in the region, has induced only limited changes in the original steppe vegetation (Fox, 1994). However along with important livestock population rises in the recent past, the increasingly endangered status of the wild grazers of the open plains (Urial, Wild Yaks, Tibetan Gazelle, Tibetan Antelope), most likely to be in direct competition with them, seem to indicate a growing degradation of at least part of the cold desert ecosystem. Such trends, already documented in other parts of the Trans-Himalayas including neighbouring Spiti (Mishra 1999), have probably been aggravated by other recent development such as a rapid increase in tourism activities, important road construction in fragile habitats, development of armed forces establishment etc.

### ***Wetland Ecosystems***

The arid steppes and barren hills characteristic of Ladakh cold desert are interspersed with glacial streams, rivers and, especially in the eastern Chang Tang region, numerous lakes and ponds, fed by ice and snow melt. These water bodies, still relatively undisturbed, play a key hydrological role as headwaters of two of Asia's largest river systems, The Indus and the Sutlej (WWF-India 2002).

#### *Riverine Wetlands of Central and Western Ladakh*

These wetlands which have developed in valley bottoms along Ladakh main river courses (Indus, Shyok, Nubra, Zaskar & Suru) and their tributaries, are characterized by the presence of scrub vegetation such as Sea Buckthorn – Tamarisk association (*Hippophae-Myricaria*), marsh meadows and reed beds (*Phragmites*, *Typha*, *Equisetum*). In the more remote areas, these riverine wetlands provide one of the very few remaining habitats, where natural woodland still survive, including several indigenous willows (*Salix* spp), some poplars (*Populus euphratica*, *P. ciliata*, *P. alba*) and birch (*Betula utilis*) (Mallon, 1990). These areas have however not been delineated or placed under any form of protection as yet. Elsewhere in the major valleys, natural woodlands have been largely replaced by plantations of willow and exotic poplars (*Populus nigra*, *P. balsamifera* etc.). Generally wetlands along the main rivers have been much transformed by human activities, with many areas, the major Shey wetland near Leh being an example, drained and reclaimed for cultivation.

Ladakh major rivers and adjoining wetlands constitute important habitats for a diverse fauna including animals not commonly observed in Ladakh such as the Otter (*Lutra lutra*) and the Ibisbill (*Ibidorhyncha struthersii*) which is known to breed in the region (Anon.2001, Pfister 2001). These habitats constitute key pathways for wildlife migration and dispersion throughout Ladakh and beyond. However, other than the higher course of the Indus presumably incorporated in the undelineated Chang Tang Wildlife Sanctuary and part of the course of the Nubra and Shyok included in the Karakorum Wildlife Sanctuary, these vital corridors are under no statutory protection at present.

#### *High Altitude Wetlands of the Chang Tang (Eastern Ladakh)*

The Chang Tang plateau of Eastern Ladakh harbours extensive areas of wetlands which have formed in vast enclosed basins dotted with lakes and ponds and in flood plains along the higher course of the main rivers (Indus, Shyok and Hanley). These high altitude wetlands which range from freshwater to saline marshes, seasonally flooded meadows and valley bogs constitute prime habitat for a wide range of flora and fauna including several rare and endangered species.

##### *Vegetation of the Chang Tang Wetlands*

While the shallower parts of lakes and ponds support some aquatic vegetation (*Potamogeton* species, *Myriophyllum verticillatum*, *Hippuris vulgaris*, *Ranunculus natans*, *R. trichophyllus* etc.), surrounding marshes and wet meadows have a more varied and abundant plant life including several species of sedge (*Carex* spp.), *Blysmus* spp, *Eleocharis* sp, grasses (*Poa* spp), rush (*Juncus thomsonii*) as well as many herbs (*Ranunculus*, *Pedicularis*, *Gentiana*, *Gentianella*, *Primula*, *Leontopodium* etc.). A number of species are found more specifically in and around saline marshes (halophytes) including *Atriplex tatarica*, *Pucinellia* spp, *Suaeda olufsenii*, *Triglochin maritimum* (Anon. 1993, Klimes, 2001, Humbert-Droz, 2001). A total of 177 species of vascular plants were recently reported along the shoreline and up to 10m. above three major lakes of the western Chang Tang (Tso Moriri, Tso Kar, Kiagar Tso, Klimes, *ibid.*).

The Chang Tang wetlands thus play a key ecological role in sustaining a locally important and floristically diverse vegetation cover which is a main, and in winter quasi sole source of food for both wildlife and livestock.

The shallow lake margins, slow moving streams and bogs of the Chang Tang harbour a diverse micro-flora and fauna, including several algae (green and filamentous algae, diatoms) and zooplankton as well as a variety of benthic organisms including crustaceans (*Gammarus pulex*, *Artemia salina*), aquatic insects (Hemiptera, Trichoptera, Ephemeroptera, Plecoptera, Diptera, Coleoptera), leeches (*Hirudinea*) and gastropod molluscs (Gopal 2001, Hutchinson 1937, Humbert-Droz 2001). Fish fauna include at least four species of loaches (*Triplophysa* ssp) and a Cyprinoid (carp family), *Schizopygopsis stolizckae* (Humbert-Droz *ibid*).

The wetlands of the Chang Tang have global conservation value as breeding grounds and key migration staging posts for a varied and abundant avifauna, water birds in particular. They represent the only breeding ground of the near threatened Bar-Headed Goose, *Anser indicus* in India and of the globally threatened Black-Necked Crane, *Grus nigricollis*, outside China. At least another seven species commonly breed in the region: the Ruddy Shelducks, *Tadorna ferruginea*, Common Mergansers *Mergus merganser*, Great Crested Grebe, *Podiceps cristatus*, Brown-Headed gulls, *Larus brunnicephalus*, Common Tern, *Sterna hirundo* Lesser Sand Plovers, *Charadrius mongolus* and the Common Redshank, *Tringa totanus*. Totally 60 water bird species belonging to 10 families have been recorded in the region (See Appendix 6). Several mammals endemic to the Tibetan Plateau, some of them threatened globally, also make extensive use of the wetland habitats as feeding or breeding grounds (Kiang, *Equus kiang*, Tibetan Wolf, *Canis lupus chanku*, Himalayan Marmot, *Marmota himalayana*, Woolly Hare, *Lepus oistolus*, Mouse hares, *Ochotona macrotis*, *O. curzoniae* and *O. ladacensis*).

Based on these unique characteristics, Lake Tso Moriri, one of the Chang Tang main wetlands and the largest Trans-Himalayan lake in Indian territory, was recently declared by the Ramsar bureau as wetland of international importance, one of only 16 such sites in the country. Three other major wetlands of the Chang Tang, the Hanley and Chushul marshes and Pangong Tso Lake, are included in the next list of sites to be proposed for Ramsar designation by the Ministry of Environment and Forest. Actually, based on existing information, the whole complex of wetlands located in the Chang Tang "Lake District", fulfils the criteria for designation as Ramsar site. Other than these designations and their incorporation in the undelineated Chang Tang Wildlife sanctuary, the Chang Tang wetlands have no effective protection status at present.

Though most wetlands of the Chang Tang are still in a relatively undisturbed state, degradation has taken place, especially in recent years, in areas submitted to increased anthropogenic pressure including shorelines, stream banks and marshes in the vicinity of armed forces and local settlements, campsites, trekking routes and roadsides. River and lake side meadows have deteriorated, and in some cases disappeared altogether, in the areas more severely impacted. Cases in point are the main campsites, trekking

routes and permanent Indo Tibetan Border Police camp around Tso Moriri Lake, the dirt tracks and camping grounds in the Tso Kar plains and the heavily settled and grazed Hanley floodplain, some of which has been reclaimed for crop cultivation. Habitat degradation has been adversely affecting wildlife, the avifauna in particular. For example, yearly censuses conducted from 1996 onwards indicate a decreasing trend in the numbers of the majority of breeding water birds (Black-Necked Crane, Ruddy Shelduck, Brown-Headed Gull, Lesser Sand Plover, Red Shank, and Common Tern) in the Tso Moriri basin. Marmots whose burrows and feeding grounds often lie close to campsites and wetlands also appear to have been affected. By comparison, the less disturbed Tso Kar basin with no permanently inhabited settlement and no tourist camp in the wetlands show no such marked decline and in some cases a reverse trend for the same bird species (WWF 2002, Humbert-Droz 2001).

### 3.3 FLORAL DIVERSITY

Though relatively poor in species compared to areas of similar altitude in the main Himalayas, Ladakh flora has considerable biological interest in view of its diversity of origin and important proportion of endemic species, depicting a high adaptability to extreme climatic conditions and biotic pressure (Chundawat et al. 1994).

611 species of flowering plants have been recorded from Ladakh (Kachroo et al., 1977) though recent estimates suggest that the number may be as high as 1000 (Dickore et al. 2002). Typically of the cold desert ecosystem, the Asteraceae (Compositae) and Brassicaceae (Cruciferae) predominate as regards both number of species (91 and 55 respectively) and generic diversity (35,26). There is a wealth of wild legumes (45 species, 11 genera), also characteristic of the alpine steppe: important genera include *Oxytropis*, *Astragalus*, *Caragana*, *Cicer*, *Thermopsis* (see Appendix 1, Table 5).

Ladakh flora has affinities with very diverse regions (main Himalayas, Afghanistan, Tibet, Siberia, Europe, the Mediterranean region) and includes at least 23 endemic species (Rawat et al. 2001, Chundawat et al. 1994: see. Appendix 1, Table 6).

Ladakh harbours a large number of plants of special conservation, economic and ethno botanical significance: these include wild forage species and relatives of cultivated plants like Onion & Garlic (*Alium*), Barley (*Hordeum*), Gooseberry (*Ribes*), Rhubarb (*Rheum*), wild legumes (*Cicer*, *Trigonella ssp*) as well as a variety of aromatic and medicinal plants adapted to cold desert conditions (*Artemisia*, *Delphinium*, *Physochlaina*, *Tanacetum*, *Waldheimia* etc (Anon. 1997).

Nearly half of the 600 flowering plants recorded in Ladakh are reported to have medicinal value and 46 (85%) of its 54 rare or endangered plant species are medicinal plants (Kala 2001, See Table 7, Apex. 2). The rarity of these species is mainly due to the narrow range of their distribution, habitat loss and over-collection. (Kala, *ibid.*). Particularly at risk are endangered species endemic to the region such as *Saussurea spp.* Though the main areas of growth of medicinal plants in Ladakh, have been identified (Kardung La, Taglangla, Padum region, Suru valley, Sapi Nala etc), no specific measures for *in situ* protection have been taken so far. However research

institutions such as the Field Research Laboratory (FRL), a Leh based unit of the Defence Research and Development Organisation (DRDO), has started to develop nurseries for *ex situ* conservation.

Other, non medicinal plants including trees and bushes have also come under threat due to over-collection. Junipers (*Juniperus sp.*, which are mainly harvested for religious ceremonies and fuel, as well as Birch (*Betula utilis*) have thus disappeared from much of their range in Ladakh (Nubra, Khaltse, and Chilling –Zanskar road area).

Several other species of trees, in particular indigenous poplars such as *Populus euphratica* as well as bushes also appear to be threatened or rare (see Appendixes 9.1-2).

### 3.4 FAUNAL DIVERSITY

Owing to its unique geographical location across the main Himalayan chain and despite low biological productivity, Ladakh hosts a surprisingly diverse fauna, mainly Palearctic in origin, though also with Indo-Malayan elements. It is characterized by high rates of endemism in most groups: according to Mani (1974), over 70% of all species restricted to high elevation are endemic. Ladakh fauna also exhibits several interesting characteristics which have evolved as adaptations to the region extreme climatic conditions such as seasonal migration and hibernation, as well as, amongst mammals, thick fur, thick and bushy tails, large nasal cavities etc.(Chundawat et al.1994).

#### ***Mammals***

Ladakh together with neighbouring areas of Tibet is probably unique on a global scale for having preserved to this day the whole assemblage of its wild herbivores and predators along side their domesticated relatives (Humbert-Droz 2001).

Mammalian grazers range from the humble Royle's Vole, *Alticola roylei*, Mouse Hares, *Ochotona spp*, Woolly & Cape hares, *Lepus oistolus*, *L. capensis* and Marmots, *Marmota himalayana*, *M. caudata* to the majestic Great Tibetan sheep or Nayan, *Ovis ammon hodgsoni*, the largest of all wild sheep, the Kiang or Tibetan Wild Ass, *Equus kiang* and the Wild Yak, *Bos grunniens* (see Appendix 3).

In all 8 species of wild ungulates are present in the region, six of them globally threatened. The wild sheep & goats alone are represented by four species. The Trans-Himalayan region thus constitutes a key biodiversity hot spot for the *Caprinae* which represents an invaluable genetic potential for livestock improvement.

Predators include the diminutive Pale Weasel, *Mustela altaica*, the Stone Marten, *Martes foina*, the Otter, *Lutra lutra*, the Red fox, *Vulpes vulpes*, the rare Wild dog *Kuon alpinus*, the Tibetan Wolf, *Canis lupus chanku*, the Lynx, *Lynx isabellina* the rare Brown Bear *Ursus arctos* and the magnificent Snow Leopard, *Panthera uncia*..

#### *Ungulates*

The ungulates most under threat include the Tibetan Gazelle, on the verge of extinction with an estimated population of less than 50 in south eastern Ladakh, the Wild Yak with similar or even lower numbers in the eastern region of Chang Chenmo, and the Tibetan Antelope still present in summer in the same region and in the Aksai Chin region further North in very small numbers (estimated at less than 300). Similarly, no more than perhaps 200 Nyans or Tibetan Argali still survive in fragmented population in the Chang Tang (Bhatnagar et al. 2001, Chundawat et al. 1994, Fox 1991). The Urial, another threatened wild sheep, is restricted to the lower slopes and banks of the main river valleys (Shyok, Nubra and Indus). This habitat preference has led to its vulnerable status (total pop. est. at c.1300, Chundawat et al, 1999) as these areas are also the more heavily used for agriculture and human settlements. With a total population estimated at less than 2000, the Tibetan Wild Ass or Kiang is another threatened ungulate of Ladakh (Bhatnagar *ibid.*, Fox et al., 1991). The flat bottom valleys and high plateaux of the Chang Tang constitute its last and only stronghold in India. The Blue Sheep or Bharal and the Asiatic Ibex are the only wild ungulates still relatively common in the higher reaches of Ladakh. With estimated population of 11000 and 6000 respectively, they are not generally considered under threat though the Ibex whose more restricted distribution in the Trans-Himalaya does not extend beyond the Sutlej river, has been recently classified as vulnerable in India (Anon. 1998)

### *Carnivores*

Amongst the carnivores, the Snow Leopard is considered to be most under threat with sparse and continuous distribution throughout the region and a population roughly estimated at between 200-300 individuals. While the Snow Leopard prefers the rugged and rocky terrain of central Ladakh, where it can more easily stalk its prey, the Tibetan Wolf, is most common in the open valleys and high plateaux of Eastern Ladakh where it can run down its quarry. This habitat preference together with its year round predation on livestock brings it into frequent conflict with local villagers and herders (Mallon 1990). With apparently declining population estimated at ca.300, the Tibetan Wolf has recently been classified as vulnerable (Anon. 1998, Chundawat et al. 1994). Very little is known of the status of the Wild Dog globally vulnerable and with very few records in Ladakh. A small population of the threatened Brown Bear (no estimate available) still exists in the Suru and Zaskar valleys while the Lynx has managed to survive mainly where patches of undisturbed riverine scrubland, its preferred habitat, are still present. The shrubland at the confluence of the River Shyok and Nubra is one such rare area holding an estimated 10-12 Lynx. The Pallas cat, *Ocotolobus manul* is the rarest wild cat in the region while other small carnivores such as the Red Fox, Pale Weasel and Stone Marten are still fairly common. The Otter and the Stoat, *Mustela herminea* are rarer (Chundawat et al 1994, Mallon, 1990).

### *Lagomorphs, Rodents & other Groups*

At least 7 species of Lagomorphs are found in Ladakh including two hares and five mouse hares.

The Woolly Hare *Lepus oistolus* is widely distributed in Eastern and Central Ladakh but absent from Zaskar while the Cape Hare *Lepus capensis* occurs in the Nubra and Shyok Valleys (Mallon 1990).

Though the taxonomy of mouse hares is still a subject of debate (IUCN 1990), at least five generally recognized species, two of which may be endemic to Ladakh proper, are reported from the region: the Plateau Pika (Black-Lipped) *Ochotona curzoniae* and Ladakh Pika *O. ladakensis* appear to be sympatric plain dwelling species widespread in Eastern Ladakh. Royle's Pika *O. roylei* is a talus species found in rocky areas along the Northern side of the Great Himalaya. It is replaced in other areas including the Chang Tang by another talus species, the Large-Eared Pika *O. macrotis*. The fifth species *O. nubrica*, which is considered globally threatened, lives in dense riverine scrub along the Indus and Nubra (Chundawat et al., 1994, Humbert-Droz 2001, Pfister, 2000, Mallon 1990).

Large rodents of Ladakh include two species of Marmots with allopatric distribution: the Himalayan Marmot (*Marmota himalayana (bobak)*) occurs in abundance in the eastern plateau and other parts of Ladakh at high elevations while the Long-Tailed Marmot *Marmota caudata* appears to be restricted to the Zaskar Valley at altitudes not exceeding 4000m (Mallon, 1990). Reduction in number affecting both species has been reported in recent years in areas of high anthropogenic pressure such as road construction sites and popular camping grounds.

Other than the species commensal of man (House Rats and Mice), at least four small rodents have been reported from the region: the Yellow-Necked Field Mouse (*Apodemus flavicollis*), Ladakh Hamster, (*Cricetulus alticola*), Royle's Vole, *A. roylei* and Stoliczka's Mountain Vole, *A. Stolickanus*. However it is likely that other species are also present, especially amongst the *Cricetidae* (vole & hamster family) as the group as a whole has been little investigated (see Appendix 4).

Similarly, virtually nothing is known of the occurrence and possible distribution of bats (*Chiroptera*) and Insectivores in Ladakh.

### **Birds**

As is the case for higher plants and mammals, Ladakh bird diversity is impressive, with both Palearctic and Indo-Malayan elements and a range of behavioural adaptations to make best use of very limited but locally and seasonally abundant resources. Four main groups of birds can be distinguished in this respect (Pfister 2001):

- *The passage migrants*, the larger and most diverse group, use the grass and wetlands of Ladakh as key staging posts for feeding and resting in autumn and early spring as they migrate to and from their wintering ground in the Subcontinent and further. Almost half of the ca 170 species recorded during this period in central and eastern Ladakh fall in this category including a high proportion of water birds (ducks, waders, gulls & terns).
- *The summer visitors* migrate from the Indian plains or the Tibetan plateau in April May mostly to breed and spend an extended portion of the vegetation period in

Ladakh. This group, the second largest recorded during the period, comprises mainly of water birds and passerines (chats, swallows, warblers, larks, wagtails). Prominent amongst the breeding visitors are a four species, threatened or rare throughout their range: the Black-Necked Crane (vulnerable), Bar-Headed Goose (near – threatened), Ferruginous Pochard (*Athya nyroca*, vulnerable), Ibisbill (*Ibidorhyncha struthersii*, rare) (IUCN, 1996). Several species, ducks and geese in particular, have both summer visitors as well as passage migrant populations in Ladakh.

- *The resident birds*, a smaller group well adapted to Ladakh severe winter conditions include several restricted range species endemic to the Tibetan Plateau hence of special significance for conservation. The main species of this group are the Tibetan and Himalayan Snowcocks (*Tetraogallus tibetanus*, *T. himalayensis*), Tibetan Partridge (*Perdix hodgsoniae*), Little Owl (*Athene noctua*), Tibetan Sandgrouse (*Syrrhaptes tibetanus*), Desert Wheatear (*Oenanthe deserti*), Tibetan Lark (*Melanocorypha maxima*), Hume's Short Toed Lark (*Calandrella acutirostris*), Horned Lark (*Eremophila alpestris*), Tibetan & Plain-Backed Snow finch (*Montifringilla adamsi*, *M. blanfordi*) Brandt's Mountain Finch (*Leucosticte brandti*), Streaked & Great Rosefinch (*Carpodacus rubicilloides*, *C. rubicilla*). Resident birds also include several commensal and opportunistic species whose distribution is largely governed or favoured by human settlements such as the Rock Pigeon, Oriental Turtle dove, Common Raven, Black-Billed Magpie, Great Tit and Winter Wren (Singh et al.2001).

- *The winter visitors* represent the smallest group of Ladakh birds flying in from their Northern Palearctic breeding grounds in October – November and wintering mainly in Ladakh lower valleys (Pfister 2001) The Northern Lapwing (*Vanellus vanellus*) and the Dark-Throated Thrush (*Turdus ruficollis*) are two species belonging to this group.

According to recent checklists (Pfister 2002, Humbert-Droz 2003), Ladakh avifauna comprises of 344 bird species (including 32 species not observed since 1960) belonging to 148 genera and 40 families. If confirmed, this represents a considerable extension from previous inventories which gave a total of 225 species, 124 genera and 34 families (Chundawat et al. 1994). Families with the highest species diversity are the *Muscicapidae* (Thrushes, Flycatchers & Redstarts & Chats: 32 species), the *Sylviidae* (Whitethroats & Warblers: 25 sp.), the *Fringillidae* (Finches & Buntings: 24 sp.), the *Accipitridae* (Hawks: 23sp.), the *Scolopacidae* (Sandpipers, Snipes & Curlews: 23 sp.), the *Passeridae* (Sparrows, Wagtails, Pipits & Accentors: 22 sp.), and the *Anatidae* (Ducks & Geese: 15sp.). The greatest generic diversity is found amongst the Hawks (15) followed by the *Muscicapidae* (13) and the *Scolopacidae* (12).

Other than the rare and threatened species mentioned earlier, a few species endemic to the region and closely associated with riverine shrubland such as the Grey-Backed Shrike, *Tephronotus tephronotus*, Bluethroat, *Luscinia svecica*, Lesser Whitethroat, *Sylvia curruca* have seen their population dwindling as their habitat has shrunk in size due to the expansion of agriculture and tree plantation. These changes in land use have in turn favoured non native, invasive species such as the Long-tailed Shrike,

*Lanius Shah*, the Oriental Turtle Dove, *Streptotelia orientalis* and the Great Tit, *Parus major* whose population appear to be on the rise (Singh et al.2001).

### ***Amphibians & Reptiles***

Despite the inherent difficulty for animals which derive their heat from the environment (ectotherms) to survive in an extremely cold climate, at least 3 species of Amphibians (*Bufo* family) and 11 species of Reptiles have managed to adapt to the cold desert conditions of Ladakh (see Appendix 4). Though most species are restricted to lower elevations, some lizards namely the Toad Agamas *Phrynocephalus theobaldi*, *P. reticulatus* and the Skinks, *Scincella ladacensis* have been able to extend their altitudinal range to colonize the high plateaux of the Chang Tang where winter temperatures may fall below 40. Reptiles reported from Ladakh belong to 3 families of lizards (*Agamidae*, *Geckonidae*, and *Scincidae*) and one snake family (*Colubridae*) with 3 species each. Very little is known of their distribution and status. A survey conducted by the Wildlife Institute of India in the summers of 1999-2000, in the main regions of Ladakh (Suru, Zaskar, Indus & Nubra valleys, Chang Tang plateau) found only 7 species: one toad, *Bufo viridis*, 2 Geckos, *Laudakia himalayana*, *Cyrtodactylus stoliczkae*, 2 Toad Agamas, *Phrynocephalus theobaldi*, *P. reticulatus* 1 Skink, *Scincella ladacensis* and an unidentified snake of the *Colubridae* family (Vijaykumar et al., 2001).

### ***Fishes***

Very little is known of the ichthyofauna of Ladakh though recent surveys of the Wildlife Institute of India, whose results are yet unpublished, should help to throw some light on the subject. Some data is available on the fishes of the Chang Tang from WWF High Altitude Wetland Project: during summer surveys conducted in 1999-2000, Humbert- Droz (2001) collected 5 fish species, of which 4 belong to the Loach family (*Homalopteridae*) and one is a Cyprinoid (Carp family), *Schizopygopsis stoliczkae*, commonly found in the high altitude streams and rivers of Ladakh. Two of the Loaches are new records for Ladakh: *Triplophysa griffithi* collected in Tso Moriri and *T. Choprai* from the Muglab stream near Pangong Tso.

### ***Insects***

Despite their key role as indicators of biodiversity (insects alone represent c. 90% of the diversity documented in the animal kingdom) there is a general paucity of information on the insect fauna of Ladakh and the Trans-Himalayas in general. Recent surveys of the Wildlife Institute of India in different parts of Ladakh (Leh & Kargil areas, Chang Tang & Karakorum Wildlife Sanctuaries) found a total of ca 113 species belonging to 28 families and 7 orders: Coleoptera, Lepidoptera, Diptera, Odonata, Hymenoptera, Orthoptera and Plecoptera (see Appendix). A preliminary survey of benthic fauna, part of WWF Chang Tang Wetlands Conservation Project, identified 7 families of aquatic insects belonging to 5 orders (Ephemeroptera, Hemiptera, Trichoptera, Coleoptera and Diptera (Humbert-Droz 2001). In the same region, Maheswari (2000) found an astonishing 52 species of Chironomid (Diptera) in a single visit to Lake Tso Moriri. These results, if confirmed, could make the area unique and serve as an invaluable benchmark for future biodiversity and limnological

studies as Chironomid or blood worms are recognized as useful bio-indicators (Maheshwari, 2000, Gopal et al.2001).

### ***Other Invertebrate Fauna***

Other than insects, very little information exists on the invertebrate fauna of Ladakh and the Trans-Himalayas which remains the most undocumented component of the biodiversity of the region.

## **3.5 PROTECTED AREAS**

As part of the effort to protect ecosystems integrity and wild biodiversity, a system of Protected Areas (PAs) has been gradually put in place by the State and Sub-State authorities, starting with the designation of the 3350 km<sup>2</sup> Hemis National Park (NP) in 1981. At present some 9000 km<sup>2</sup> or 15% of Ladakh landmass has Protected Area status which include, other than Hemis NP, a number of smaller areas designated as wildlife or game reserves, a status inherited from British ruled India (Rodgers et al. 1988). In addition, two large Wildlife Sanctuaries (WS) have been notified though not delineated: the Karakorum WS (c. 5000 km<sup>2</sup>) in North Eastern Ladakh (Shyok – Nubra region) and the Chang Tang WS (c. 4000 km<sup>2</sup>) in the South East (See Appendix 6).

This seemingly large PA coverage is offset by the fact that Ladakh does not have any designated reserve forest that could act as buffers and that a major portion of Protected Areas (up to 60%) comprise of glaciers and rock faces devoid of vegetation and of little use to wildlife. Large PAs are required in the cold desert ecosystem (Ladakh has the largest PAs in the country) as much of the endangered mega fauna (Snow Leopard, Wild Ungulates) may undertake seasonal migrations) and need vast areas to maintain viable populations (Bhatnagar, 2001). Still, because of the lack of effective delineation and management, it is unclear whether some of the prime habitats of the most endangered species like the Tibetan Gazelle, Tibetan Antelope, Wild Yak, Black-Necked Crane are actually included in Ladakh designated PAs.

## **3.6 DOMESTICATED BIODIVERSITY**

### ***Crop Varieties***

The Western and Trans-Himalayas are considered a centre of evolution and diversification for a variety of wild crops, some of which were domesticated early in human history. In Ladakh these include fruit crops especially Apricot, *Prunus armeniaca*, Apple, *Pyrus malus*, Gooseberry, *Ribes ssp*, hardy legumes such as Wild Gram *Cicer microphyllum*, *Trigonella sp.*, Wild Pea, *Lathyrus sp.*, *Lepidium latifolium* (Ladakhi: Shanshu), Wild Barley, *Hordeum brevisubulatum*, Wild Onion and Garlic, *Alium ssp* (Cox et al. 1993, WWF-India, 1997).

Through a long process of adaptation and innovations, local farmers have selected and developed a number of land races of both indigenous and introduced crops. Over 70 indigenous varieties of apricot and 7 of apple have thus been documented in Ladakh. At least 10 local cultivars of wheat and as many or more of barley have been

reported from Ladakh. Several land races of lesser millets, radish, turnip, peas are also known (see Appendix 7).

Indigenous varieties and land races are well adapted to Ladakh conditions displaying early maturity, an important trait in view of the very short growing season, as well as resistance to drought, extreme cold, pests etc. Potential yields can be surprisingly high and local barley d for example compare favourably with other growth areas in the world (Anon.1998c).

However several local races, perhaps the majority of them, have become increasingly rare or extinct in the past decades, being displaced or replaced by high yielding varieties or exotics. For example, out of the 70 varieties of apricot indigenous to the region, only 10 are still widely cultivated, and at least 4 are on the verge of extinction (Dr. Dwivedi, FRL, pers. com.). Similarly, of the ten or so traditional varieties of wheat only 3 are still widely cultivated and at least two have apparently disappeared. Local varieties of lesser millets, radish and turnips (Swede) are much less in use now and some may already have become extinct (Tashi Tsetan, pers. com.). The traditional use of wild plants for human consumption also appears to have almost disappeared in Ladakh (Sonam Dawa, pers. comment). Many varieties and the indigenous knowledge associated with them are disappearing even before they have been properly documented. These losses are thus probably irremediable and represent a serious erosion of Ladakh domesticated biodiversity potential.

### ***Domestic Breeds***

As is the case for crop varieties, local domestic breeds of ungulates are closely related to their wild counterparts having in some cases (the yak, possibly also the Chumurti horse) directly evolved from wild ungulates endemic to Tibet or central Asia (Wild Yak, Przewalski Horse). The wild progenitors of the famous Changra or Pashmina Goat of Ladakh, as of most other goat breeds from Greece to Central Asia, are believed to be the Wild Goat of the palearctic, *Capra aegagrus* still present in the Kirthar range (Sindh) and possibly also the endangered Markhor, *Capra falconeri* now mainly confined to a few areas of the Pir Panjal range as well as Gilgit and Chitral. As mentioned earlier, the presence in the region of these wild relatives represents a huge genetic reservoir for potential improvements of local domestic breeds.

### ***Cattle breeds***

Amongst the large ruminants, the Yak *Bos grunniens* and its mostly infertile hybrids with local cattle (dzo-dzomo) are the most charismatic of Ladakh indigenous breeds. It is used for meat, fibre, fuel and transport while its hybrids are mainly kept for draught power (dzo) and milk production (dzomo). In Leh District, Yaks and hybrids currently represent c. 35 % of the cattle population while local cattle breeds account for 42 % and crossbreeds with Jersey cows, introduced over the past 30 years to boost milk production, 13 % (See Table 16, Appendix 8).

### ***Equines***

Ladakh main horse breeds are *the Zanskari*, a stocky 110-130 cm animal used primarily as a pack horse and *the Chumurti*, an equally small and hardy animal, bred

in Spiti, which is the favoured riding horse of the Chang Pas of Eastern Ladakh. The Chumurti, believed to have originated in Mongolia from a cross between the Arabian and the Przewalski Wild Horse, is unique in having an additional gait (five gaited horse) which is a lateral (instead of diagonal) trot making for very comfortable riding. Another breed, *the Haflinger* (110-140cm high), is an extremely strong horse, originating from a cross between the Arabian and Austrian mountain ponies and introduced in the region to carry heavy loads for the Armed Forces. Rarer breeds include *the Tibetan Horse*, very similar to the Chumurti but bigger (up to 150cm) which is reportedly used in small number by Chang Pas and Tibetan refugees and *the Yarkandi*, initially brought in by traders from central Asia which is still reported from the Karakorum region but whose status is unclear. As for other equines, little is known of the races of donkeys in Ladakh nor on the parentage of local mules though crossing between local donkeys and Zanskari horses is probably the more frequent (Braham 2002, Appendix 9.8).

The current population of horses, all breeds confounded amounts to 6400 and that of donkeys to 5600. According to the Animal Husbandry Department Statistics, between 1991 and 2000, the horse population shows a small increase (+14%) and donkeys an important decline (-22%). While increased urbanisation and mechanisation of transport during the period would presumably have lessened the need for pack animals across the board, donkeys mainly used in Ladakh for transport of goods in and around villages may have been the most affected. Horses, which are multi purpose animals, may on the other hand have benefited from increase in trekking tourism and military use during the period.

### *Camelidae*

Like the Yarkandi Horse, the Bactrian Camels of the Nubra Valley are a relict of the silk route trade era, when Leh and Ladakh were key staging posts between Kashmir, Yarkhand and Tibet. Further to the west, along the Karakorum highway, Bactrian or double humped camels are still found in significant numbers used as draught animals on the trade route to Kashgar. In Ladakh, starting from a few individuals left behind by Yarkandi traders when the border was definitely closed in 1962, a small mostly feral population has developed that roams freely in the tamarisk and Sea Buckthorn shrubland along the Shyok. Numbering about 130, these animals, though technically owned by local farmers, are no longer used as beasts of burden. They cause some damage to the natural shrubland as well as crops in the region and may require some husbandry measures to be taken by the local people and the Animal Husbandry Department (Bhatnagar 2001).

### *Caprinae*

Amongst the smaller ruminants, the *Changra or Pashmina Goat* is the most famous and numerous of Ladakh indigenous Caprinae breeds (pop.=156 000 representing 65% of Ladakh tot. goat pop., 39% of goats & sheep, Anon. 2001). Raised mainly in the high plateaux of Eastern Ladakh where it clearly dominate the herds, the Chang Ra or Northern Goat produces one of the highest quality pashm or undercoat down, worldwide with the finest fibre diameter (11-13 microns) and longest staple length

(>4cm). With an annual production of 100-500g per adult and 43000 kg overall, fetching 1000-1500 per kg, goat husbandry is the mainstay of the Chang Tang's economy (Tsewang 2002, Appendix 9.7). In view of the Changra unique qualities, no attempts have been made, at least in recent years, to "improve" the breed by importing exotic germ plasm. Rather, efforts of the Sheep Husbandry Department have been directed at selective breeding with a focus on production of white pashm, which fetches the highest price. The Department also promotes buck exchange programmes between different areas as herders families tend to preserve their own bucks which increase the risk of inbreeding (Angchuk, undated, Koul, 2002, Anon 1998c). While Changra goats are found throughout Ladakh, *the local non – pashmina breed or Malra* is only raised outside of the Chang Tang, mainly for meat and wool. The present (2001) Malra population of Leh District amounts to ca 80000 representing 33% of the total goat population of the District. In an effort to boost wool, meat and milk production of non Pashmina Goats, the Sheep Husbandry Department has been promoting from the nineteen eighties, cross-breeding with *Angora Goats* imported from Maharashtra and Texas as well as *Alpine Goats* from Switzerland and *Jakhrana Goats* from Rajasthan. The resulting cross breeds are still fairly limited in both number and percentage of the non pashmina goat population: 3600 Angora crosses (<5%), 2300 Alpine cross (<3%), totally 5900 (<8%) (See Table 16 Appendix 10 & Appendix 11).

Restricted to the Chang Tang where it is raised for its high quality wool and meat, *the Changluk or Northern Sheep*, is the best known and numerous (86000 in 2001) of Ladakh indigenous ovine. As is the case for the Changra goat, improvement efforts have focused on promoting selective breeding and ram exchange programmes between different parts of the Chang Tang. Cross – breeding efforts, mainly with high yielding Australian and Russian Merino Sheep, have been aimed instead at the non-descript *Malluk* sheep which is the common breed of the rest of Ladakh (pop.=59000, 2001 figure). There are at present 11700 *Merino crossbreed* in Leh District representing ca 17% of the sheep population outside of the Chang Tang. In addition to the Changluk and malluk, there is also a rare and little known local breed called *Purik* in Kargil District. The Purik (number unknown) is reportedly very efficient at utilizing the poor quality forage of the region and produces two lambs and clippings per year (Anon 1998c.)

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#### **4. THREATS TO BIODIVERSITY**

The preservation in Ladakh of the steppe wild fauna and flora even after several thousand years of human settlement, poses an intriguing question: Why should such diverse assemblages have survived almost intact unlike in most rangelands where pastoralism has sometimes been equated with wildlife decimation (Mishra 1999, Prins 1992)? The generally benign association of man with wildlife and aversion to the taking of life in traditional Buddhist societies may certainly have played an important role in this regard (Fox 1994). This though is equally true of the neighbouring Trans-Himalayan region of Lahul & Spiti where under comparable conditions, the wild herbivore assemblage for instance has much lower diversity with many species having disappeared in the recent past (Marmot, Great Tibetan sheep, Wild yak) or are missing altogether (Tibetan gazelle, Tibetan antelope, Kiang). Further comparison between the two regions however reveals major differences, most notably, the low density of both human and livestock populations prevalent in the traditional nomadic system of Eastern Ladakh compared to the higher stocking rates and human density characteristic of agro-pastoralist communities settled in Lahul & Spiti. It is thus likely that traditionally low human and livestock pressure, coupled with benevolent religious attitudes towards wildlife, are among the key factors responsible for the survival of Ladakh wild grazing communities along side their domesticated relatives.

However, in the recent past, along with dramatic rises in livestock population and other developments, several wild herbivores of the open plains, have become endangered some almost to the point of extinction. (Wild Yaks, Tibetan Gazelle, Tibetan Antelope). Mirroring this trend, other charismatic fauna (Snow Leopard, Brown Bear, Black – Necked Crane) and rare flora (medicinal plants) have come under growing threat. Several local crop varieties and valuable natural woodlands and shrubland have also been lost. The current precarious status of much of the wild biodiversity of Ladakh as well as some of its domesticated species and races are indicative of a growing degradation affecting part at least of the natural and agro ecosystems. Such degradation can be linked to the rapid changes and important though often unsustainable developments that Ladakh has been undergoing in the recent past.

#### **4.1 RECENT DEVELOPMENTS AFFECTING NATURAL RESOURCE USE & BIODIVERSITY**

Over the past half century, Ladakh has witnessed tremendous changes starting with India's independence, the subsequent wars with Pakistan and China which permanently closed access to central Asia and the rapid development of new lines of communication and trade with peninsular India and the rest of the world from the 60s onwards. During this period, Ladakh has moved from a mainly barter economy based on the caravan trade, pashmina sale and subsistence agriculture to a largely monetized economy influenced by employment opportunities offered by large Armed Forces contingents, a rapidly growing civil administration and a new industry, tourism, developing at an exponential rate. These momentous changes have affected every part of Ladakh, firstly the main development corridors along the Indus Valley and the Leh – Srinagar road but also the more remote areas of Zaskar and the Chang Tang (Fox 1994).

One of the varied social consequences brought about by these changes has been a gradual abandonment of polyandry and decreasing entry into monastic life, which were traditional systems amongst Trans-Himalayan Buddhist communities meant to help control population growth in a resource poor ecosystem. Adding to this the creation of new livelihood opportunities in Government, the Armed Forces, and the opening of Ladakh to the outside world, bringing in migrant workers and traders, it comes as no surprise that Ladakh is currently undergoing a demographic boom: Within the last 40 years, Leh District overall population has almost tripled (from 44000 in 1961 to 118000 in 2001), its urban population has increased seven fold (from 4000 to 28000) (Anon 2001b). The actual figures are much higher if one takes into account the substantial military presence in the region which has also increased during the period but is not recorded in District censuses.

This population explosion and concomitant socio-economic changes including accelerated urbanisation, increased reliance on salaried employment and tourism, higher standards of living, have first affected the Leh region and Ladakh main development corridors. However, their impact can be felt throughout the region as they affect rural as well as urban livelihoods and the overall pattern of natural resource use. These changes and associated activities like infrastructure development and Government development schemes are having a notable influence on traditional agropastoralist systems, including livestock rearing and cropping patterns, with a direct bearing on domesticated and wild biodiversity. They have also led to the introduction of new forms of land use like tourism with important impacts on natural resources and wildlife.

#### **4.2 IMPACTS OF LIVESTOCK POPULATION INCREASES ON BIODIVERSITY**

Ladakh livestock population increase mirrors that of its human population: in 25 years (1972 -1997), Leh District livestock numbers have more than doubled (from 142000 to 334000 i.e. 2.4 xs) the highest rise affecting sheep (2.6 xs) followed by goat (2.3x) and cattle (2.2x see Table 3). The picture is similar in Kargil District (Bhatnagar 2001). Other than the huge rise in Ladakh predominantly rural population, these

increases appear to have been prompted by various external factors including, Government schemes to boost wool, milk and meat production, higher demand and monetary value for these commodities from the tourism industry and the Armed Forces, increased availability of irrigated fodder etc.

Governmental efforts to increase livestock production also include cross-breeding programmes with high yielding exotic races of cattle and *Caprinae*. While cross-breeding of local goats with Angora and Swiss alpine races has met with very limited success (6000 i.e. <3% of Ladakh goats are cross-breeds), the numbers of sheep (local Maluk X Merino) and cattle (local races X Jersey) cross-breeds have risen rapidly and now represent 8% and 13% of their respective populations (Koul, 2002, Appendix 8)

Other than perhaps the rare Purik sheep breed, whose status is unclear, these population increases and introductions of exotic breeds do not appear to have had any negative effect on indigenous domesticated biodiversity till now. However, their impact on wild diversity and the ecosystem in general, though not directly documented nor quantified is likely to be substantial.

The most likely effect on wildlife of this more than twofold rise in livestock population is in the form of increased competition for scarce forage, leading in turn to over-grazing and habitat degradation (Bhatnagar 2001). In such scenario, wildlife, especially large ungulates are at a disadvantage as they lack the protection and supplementary feeding which may be provided to their domesticated relatives in times of scarcity. Other than evidence of vegetation and soil degradation along transhumance routes and around human settlements, one of the clearest sign that such factors are at play is the dramatic reduction in number and increasingly endangered status affecting virtually all wild ungulate species that use open grazing lands, which are areas of direct competition with livestock. This group include the Wild Yak, Tibetan Antelope and Gazelle, the two wild sheep of Ladakh, the Shapo or Urial & Nyan or Argali and even the Tibetan Wild Ass or Kiang, all of which are classified as globally vulnerable (the first 5 species) or threatened (Kiang, data deficient, IUCN 1996). By contrast wild ungulates like the Siberian Ibex and Blue Sheep, which inhabit more inaccessible, rocky and high elevation terrain, where competition with livestock is lower, still maintain comparatively important population in Ladakh and are not under serious threat either locally or globally. These habitat preferences also afford them better protection against hunting, which in any case appears to have seriously declined over the past thirty years (Fox 1991, Mallon, 1990).

Drastic rises in livestock population have also been linked to the increased occurrence of conflicts between humans and large carnivores, as the lack of wild prey may increase predation on domesticated ungulates (Mishra 1997). Reported losses to rural households in both numerical and monetary terms are substantial: thus in Hemis National Park, over a 14 month period (1997-1999), close to 500 domestic animals, primarily sheep and goats, were reportedly taken by wild predators, mainly wolves and snow leopards, representing a loss of 6 animals or ca 14000 Rs per household (Bhatnagar et al. 1999). Similar losses were reported in 16 villages of the Zaskar and Suru Valley over a period of 18 months in 1999-2000 (Jaypal, 2001). This high level of predation coupled with the difficulty for rural households to obtain limited

compensation from existing Wildlife Department schemes, has lessened their tolerance towards wild carnivores, leading to renewed persecution, including retaliatory killing of wolf in particular. This further contributes to the decline of Ladakh large predators, which are imperilled throughout their range (Chundawat et al. 1994).

### **4.3 IMPACTS ON BIODIVERSITY OF OTHER RECENT CHANGES IN AGRO-PASTORALIST SYSTEMS**

Recent changes in Ladakh traditional organic and sustainable farming pattern, in particular the introduction of modern crop production techniques are beginning to alter local cultivation and other land use practices. These changes are affecting domesticated biodiversity but also wildlife, though less directly.

The growing emphasis on high yielding and exotic varieties in current agro-development programmes in order to improve food production, appears to have led to increased rarity or disappearance of several land races of cereals, especially barley and wheat, as well as apricot, Ladakh main indigenous fruit crop. This has happened in the absence of any concerted effort aimed at documenting and preserving local germplasm or conducting adaptive research to develop location specific improved crop varieties (Mir, 2002, Tulachan 1999).

Other important recent changes include the introduction of cheap (subsidized) fertiliser and the cultivation of irrigated leguminous fodder. Lucerne or alfalfa (*Medicago sativa*) is now the second most important crop of Ladakh, representing over 20% of the total sown area (Mir, 2002). These changes are likely to have further implications on natural resource use hence on biodiversity. For example, increased quantity of chemical fertilisers will be required to boost production of high yielding crop varieties, thus also lessening, in the medium-long term, the importance of farm yard manure and of local varieties which can be grown on it alone (Tulachan 1999).

Similarly, increased production of leguminous fodder in western and central Ladakh is related to the huge rise in livestock numbers including that of exotic cross-breeds (merino sheep, jersey cows) which are more productive than local races but less able to exploit the sparse vegetation cover of Ladakh marginal grazing land. Some of these grasslands in particular remote summer pastures are not grazed to capacity prompting recommendations by rangeland experts to increase summer stocking rates and grazing periods in these areas (Richard 1999). However these marginal grasslands are also prime habitats of most of Ladakh wild ungulate fauna and their predators. Concerted attempts to increase livestock grazing in these areas are likely to further weaken wildlife already precarious status in the region. Actually, if the most endangered species including, the Nyan (Argali), Urial (Shapo), Tibetan Gazelle & Antelope and Wild Yak are to be saved from extinction in Ladakh, competition from livestock must be restricted to the current level, at the very minimum, ruling out any substantial rise in stocking rates and grazing pressure in their habitats.

### **4.4 IMPACTS OF TOURISM DEVELOPMENT ON NATURAL RESOURCES & BIODIVERSITY**

One of the important consequences of Ladakh gradual opening to the outside world from the 1960s onwards has been the rapid and considerable development of tourism, now a main industry in the region. With some 18000 to 20000 people visiting the region each year, tourism has become an important source of income, contributing in a major way to Ladakh economic development, especially in the Leh area and along the main transportation corridors (Leh- Manali & Leh Srinagar roads). However, owing to its scale and relative suddenness (no tourists were allowed into the region prior to 1970), its mostly uncontrolled nature and the inherent fragility of Ladakh desert ecosystem, tourism is having a major impact on Ladakh limited natural resources and biodiversity.

One of the characteristics of mountain tourism is a high degree of seasonality, which tends to concentrate its impact on the environment. This is especially true of high altitude ecosystems like Ladakh where tourist access is essentially restricted to the summer months, which is also the peak period of biological activity and breeding season for much of the bird and other fauna. Direct impacts are many, including wildlife disturbance, overgrazing due to influx of pack animals from outside the region, and garbage and faecal pollution around campsites (Humbert-Droz 2001).

*Wildlife disturbance and destruction*, wilful or not, is a serious threat closely associated with uncontrolled tourist access to areas of high biodiversity. Cases regularly reported in Ladakh include collection of rare plants, butterflies and other biota by tourists, chasing wild animals like Tibetan Wild Ass or Black-Necked Crane), intruding in water bird breeding territories, garbage dumping in marmot or mouse hare burrows, a widespread practice around popular campsites etc (B. M. Sharma, Pers. Com., Pfister 1998, WWF-India 2002). Such activities have obvious detrimental effects on biodiversity and may in some cases permanently remove wild species in particular rare and endangered ones from some of their prime habitats.

### **The sorry fate of Tso Moriri Tung Tung (Black-Necked Crane)**

I first travelled to Lake Tso Moriri in the summer of 1996. The region then just opened to outside visitors, we were perhaps a few hundreds to have taken this opportunity, travelling with donkeys and pack horses from the neighbouring Spiti Valley in Himachal Pradesh or by jeep from Manali or Leh. Stunned by the pristine environment and the diversity of birds and other wildlife, we did a first waterfowl count, repeated every year since, and were amazed to find over 800 Bar-Headed Geese, a breeding colony of 300 Brown-headed gulls, and 3 individuals of the endangered Black-Necked Cranes. The next summer we found 5 cranes but by 1998 their number had dropped to two (one pair). In August 1999, during peak tourist season, we observed, within 2 hours, the resident pair of cranes moving back and forth across Tso Moriri Southern wetland, over 2 km, to avoid being approached by two successive trekking groups. That summer, the number of visitors reached an estimated 2500, with tourist camps spilling over Tso Moriri Southern and Northern meadows and wetlands. Lake side pastures were further encroached by the construction of a residence for an important religious dignitary of the Chang Tang and the establishment of a semi-permanent Indo-Tibetan Border Police Camp below the village of Korzok, the only human settlement of the area. In 2000, a pair of crane attempted to establish a nest in Tso Moriri Northern wetland but lost its two eggs due to flooding and left the region. In 2001, with the number of visitors now reaching almost 4000 and increased military and para-military presence in the region, the visiting pair of crane was apparently chased off its feeding ground in the Northern wetland early in the season by a low flying helicopter. In 2002 no cranes were observed in the entire Tso Moriri region. The majority of other water birds breeding in Tso Moriri wetlands were also in decline. With a total world population estimated at less than 6000 birds and a maximum of 15 breeding pairs recorded in the region, the disappearance of the Tung Tung from Tso Moriri, if confirmed in the coming years, is a tragic loss for Ladakh (Humbert-Droz, 2001).

### *Overgrazing by pack animals*

Ladakh popularity as trekking destinations is introducing every season substantial numbers of pack animals into the region from areas as far a field as Kulu Manali and even Kinaur. These animals, which often outnumber local pack horses (recent surveys showed a 4/1 ratio in Tso Moriri region) are putting tremendous pressure on the few camps cum pastures available along the high routes during the short trekking season. Signs of overgrazing and trampling are in evidence in many such sites including development of nitrophilous vegetation like nettle and other unpalatable species. Pasture degradation is enhanced by the trekkers' tendency to set camp in the pasture themselves rather than on bare patches on their edge as is the custom of local people (Humbert-Droz 2001). Favoured trekking areas like Zanskar, the Gya Meeru region and Rupshu (the western part of the Chang Tang centred on Tso Moriri-Tso Kar) have good numbers of horses and donkeys that could be hired out to trekking groups, providing additional source of local income. Practical steps to develop such local capacity and reduce the impact of outside draught animals have been designed jointly with local communities as part of the BSAP process. (See Annex. 2, Chapter 8)

*Jeep safari*, another popular mode of tourist exploration in Ladakh, are equally disruptive (number of vehicles, noise) and intrusive ("off track" driving) (fig. 5 & 6). Soil compaction and deep barren tracks are a common sight around popular camping

sites accessible by roads. Impact on flood plain pasture is particularly severe in the Chang Tang, where in the absence of clearly demarcated tracks, drivers have opened new "highways" right through lake side meadows. Grassland may take years to recover. For example a single jeep track through 1m high grass, monitored in Tso Kar since 1999, still shows hardly any sign of vegetation (Humbert-Droz 2001). Such degradation is fairly localised, affecting mostly biodiversity rich areas like lake shore and riverine meadows, where many campsites are located. Its impact on domesticated and especially wild herbivores (marmots, hares, ungulates), which may be driven off the most impacted areas, cannot be underestimated.

*Increasing pollution levels* in areas of tourist concentration like trekking routes and campsites has become a problem, affecting both people and wildlife. In the absence of garbage disposal facilities, the practice of dumping garbage in streams and any depression including burrows, has become generalized. This facilitates dispersal in the main water bodies and the whole environment. Seasonal clean up operations as are organised by WWF, the Association of Ladakh Travel Agents and others are ad hoc and localised solutions that do not fundamentally tackle the problem of garbage dispersal. Faecal pollution of water sources has also been reported from popular tourist destinations like Korzok village near Lake Tso Moriri and camp sites in the Markha valley (Humbert-Droz 2001). Given the fact that many tourist groups do not have toilet facilities and are camping, in locally significant numbers near village springs, streams and lake shores, water pollution on a larger scale can be foreseen in the near future with potentially severe consequences for public health and the environment.

#### *Impact on the socio-cultural environment*

Less direct impact of tourism such as loss of cultural heritage, though equally important, is more difficult to evaluate, being part of the overall development process occurring in the region.

Known for its rich natural and cultural endowment, Ladakh has witnessed a rapidly growing trade in traditional artefacts, rare fossils etc. as soon as it opened up to tourism. Actively encouraged by tourists and collectors, some of whom come specifically to acquire, at cheap prices, various items of antique jewellery, furniture, woven goods... or barter them against their modern equivalent, this trade, plunder would be a better word, seems to have abated somewhat in recent years. In the absence of any controls, it is feared that the region's heritage, till recently well preserved, may already have been seriously impoverished with very little benefit to local communities. On the other hand what tangible financial benefits do accrue from tourism, tend to favour outsiders rather than locals as most of the equipment, supplies and workers required come from distant centres such as Leh, Manali, Simla and further, where the majority of tourist visits are organised. Locally, economic benefits are restricted to a very limited number of people (accommodation providers & restaurant owners, the few guides and horsemen hired on the spot) and may in course of time create new disparities within local communities (Humbert-Droz 2001).

Along with rapid moves towards a market economy and increased commercialisation of the local culture, there are also signs that like elsewhere in the Himalayas,

traditional social systems like polyandry which severely restricted population growth and tended to maintain ecosystem homeostasis, are now starting to break down (Mishra et al 1998). Thus it does appear that, apart from Ladakh main development corridors, the region and its people are getting a fairly bad deal out of tourism development at present, having to bear all of its negative effects including environmental degradation and cultural dislocation, while getting very little of its monetary benefits.

#### **4.5 IMPACT FROM ROAD AND OTHER INFRASTRUCTURE DEVELOPMENT**

The rapid development of a vast road network, due to Ladakh strategic importance and the need to provide access to all main settlements within the region, has come with an environmental cost, especially where routes traverse areas of high natural value. It is estimated that some 11 tons of wood are used for each kilometre of road being constructed in the Himalaya (Burman 1990). Most comes from local sources and is used for asphalt production and for cooking and heating by construction workers. These labourers live on the construction site and, to a large extent, off the resources of the land. Tree and bush cutting as well as wildlife poaching (marmots, water birds, fish) are thus common problems around such sites. Impacts are particularly severe in fragile and biodiversity rich areas like wetlands, riverine shrubland and areas of relict juniper forest where destruction of natural woodland and wildlife population decline have been reported. (Fox, 1994, Humbert-Droz, 2001, Sonam Dawa, Pers. Com.). These losses have been partly offset by tree plantation by private land owners and the Forest Department and wood production appears to have increased in the past decades especially in the Indus Valley. Still, such plantations comprising mostly of exotic willows and poplars, do not seem to have reduced biomass extraction in natural woodlands or shrubland and are actually often developed at their expense. Neither do they harbour the varied flora and fauna typical of natural woodlands.

Also linked with the accelerated pace of development and urbanisation, the increasing trend to build houses and roads inside command areas, is leading to severe losses in precious agricultural land, tree plantations and other domesticated biodiversity (Ahmed 2002, Appendix 9.15).

#### **4.6 IMPACTS OF THE ARMED FORCES ON BIODIVERSITY**

Ladakh increased strategical significance after independence and the regional wars that followed, has led to a substantial and continuous military presence in the region, with major effects on its resources. While the military has an overall positive influence on the economy, providing jobs, supply systems and increased demands for local commodities, its adverse impacts on the environment, especially fragile biodiversity areas, are also significant. Whereas by all accounts hunting by Armed Forces personnel has dramatically declined in the past decades (Fox 1991, Mallon 1990), the main threat appears to have now shifted from wildlife destruction to habitat degradation. The impacts of the Armed Forces are comparable to those of tourism and infrastructural development: land degradation, wildlife disturbance, and pollution but are probably more severe since the Forces presence extends much beyond that of tourists and construction workers or in some cases is permanent. Some threats are more specifically linked to military activities, including feral dog menace (stray dogs are commonly loosely attached to military camps and may prey on wildlife and young cattle once the camps move), development of firing ranges, low over flights and

boating in wetland areas (Humbert-Droz 2001). Overall the regular military presence in remote and border areas, which are also the only remaining habitats of Ladakh most threatened species (Tibetan Gazelle & Antelope, Wild Yak, Black-Necked Crane) represent both a challenge and a huge potential for conservation if some of the Forces resources can be harnessed for habitat and wildlife protection (Humbert-Droz, 2002).

## **5. MAJOR ACTORS IN BIODIVERSITY CONSERVATION, THEIR ROLES AND CURRENT INITIATIVES**

The unique biological diversity of Ladakh is the result of various evolutionary, ecological and historical factors specific to the region and its strategical biogeographical location. However its remarkable state of conservation to this day is the primary legacy of the people of Ladakh and their institutions and the result of their efforts to protect natural resources in the face of an ever accelerating pace of development.

### **5.1 LOCAL COMMUNITIES**

Rural communities are responsible for the current level of indigenous domesticated diversity and for allowing, with a generally benevolent attitude towards wildlife, a varied flora and fauna to co-exist with it. They have developed through a long process of experimentation and innovations a large number of local races of cereals, fruit crops, (e.g. over 70 apricot varieties) and domestic breeds (yak and hybrids, high altitude goat & sheep) uniquely adapted to Ladakh harsh agro-climatic conditions. Ladakh hosts amongst the highest cultivated areas on earth at over 4500m, where local communities have developed early maturity barley varieties in addition to their traditional pastoral activities. Rural communities have built up a traditional knowledge base on the use of wild plants as food and medicine. While the consumption of wild food plants and its knowledge is rapidly disappearing, the traditional science of medicinal plants (over 200 species recorded) appears to be well preserved due to their extensive use in the traditional Ladakhi and Tibetan systems of medicine.

In response to the extremes and vagaries of Ladakh climate, local agro-pastoralists have evolved complex and flexible food production systems which traditionally combine cultivation of several land races of cereal, fruit and vegetable crops with the rearing of different species and breeds of livestock.

Pastoralists of the Chang Tang have developed efficient pasture management systems involving varied herd composition, extensive exploitation and sharing of grazing resources and substantial seasonal migration.

### **Community Managed Grazing Reserves in the Chang Tang Wetlands**

One of the striking features of the Chang Tang is the network of wet meadows and fertile pastures traditionally maintained by Chang Pa pastoralists as off season (autumn and winter) grazing grounds. In sharp contrast with the often heavily grazed and low productivity range lands surrounding them, these areas, which form part of Eastern Ladakh wetlands, are the most important from a hydrological stand point and exhibit the highest diversity and abundance of wildlife. These pastures and wetlands play a vital role in the Chang Pa pastoral system, functioning in effect as managed grazing reserves.

The case of Tso Kar basin, a winter fodder reserve is exemplary: The highly efficient pasture management system used by Chang Pas in the area (no grazing from April to November, autumn haymaking and winter grazing & stall feeding) has made it possible for both an abundant and diverse livestock as well as wildlife populations to be maintained.

A total ban on grazing is enforced by local Chang Pa families who take turn to camp in the main pasture during the vegetation period both locals and visitors are allowed to graze pack animals for a maximum of 5 days. A fee (25 rupees per animal) is charged to visitors after an initial grace period of 1 day. Interestingly, visitors with jeeps are not charged despite the damage caused by their vehicles to fragile grassland... Similarly littering by tourist groups is not considered a problem as this, like increased jeep traffic, is a new phenomenon whose adverse impact is yet to be perceived by local people. (Humbert-Droz, 2001)

Recent initiatives have been taken by local communities in different parts of Ladakh to protect the ecosystems and biodiversity of their region, often in association with local or international NGOs:

- *The people of Tso Moriri Lake region*, through the Head Lama of their monastery and their elected councillor, have pledged the Tso Moriri wetland as a *Sacred Gift for a Living Planet*. The lake and its environs have recently come under threat from uncontrolled tourism activities, construction of a Para-military base and other infrastructural developments. The Alliance of Religions and Conservation (ARC) and the World Wide Fund for Nature, which are partners in this endeavour, have accepted the gift in November 2000, which involves a direct commitment of the local community for protection and sustainable management of the region (WWF 2002). [insert scanned Bhaktapur poster]
- As part of the BSAP process, local community representatives from the Markha valley and Wanla region in central Ladakh as well as the Chang Tang have agreed to form *local societies for biodiversity conservation and sustainable tourism management*. The Korzok (Chang Tang) Conservation Committee has gone one step further by registering itself as a Conservation Trust with the support of WWF in 2002. The trust mandate is to promote eco-friendly and community based forms of tourism and encourage local communities to conserve natural resources and biodiversity.

Similar self sustaining conservation societies are planned for other major wetlands of the Chang Tang (Tso Kar, Pangong Tso, Hanley) (WWF *ibid.*, Appendix 9.14).

- In a community based effort to reduce multiple killing by Snow Leopard and Wolves and mitigate human –wildlife conflicts, *villagers from four settlements situated in Hemis National Park* have constructed predator proof night corals to house all sheep and goats of the concerned villages. This programme which is initiated and supported by an international NGO, the Snow Leopard Conservancy (SLC), is due to be extended to other sheep & goat predation “hot spots” identified in the Protected Area and possibly also to similar areas in the Zaskar Valley (see Appendix 9.10).
- Women of the villages of Shey and Chushot located in the main Sea Buckthorn natural forest area along the bank of the Indus have formed a Society the *Indus Women Tsestalulu Society* to promote sustainable use of Sea Buckthorn in their region. With the support of Ladakh Ecological Development Group (LEDeG) and others, the Society is engaged in sustainable harvesting, processing and marketing of Sea Buckthorn berries as well as training women living in other Sea Buckthorn growing areas of Ladakh.

## 5.2 GOVERNMENT

### ***Ladakh Autonomous Hill Development Council (LAHDC)***

As the chief policy making and monitoring body for government development work in Ladakh (Leh District), the Council, with the Deputy Commissioner as its Chief Executive Officer, plays a key role in natural resource management. The Council was recently strengthened by the State Government with the granting of additional financial and executive powers in particular in the area of land management. A similar autonomous council is due to be formed within the current year in Kargil District. LAHDC main priorities are to improve local livelihoods through harmonious and sustainable agricultural, livestock rearing and urban development as well as fostering education, improved health care and transportation.

In keeping with its concern for environmental friendly and culturally sensitive forms of development, the Council is currently launching jointly with the State and Central Tourism Agencies an *initiative to promote eco-tourism in Ladakh*, the Chang Tang in particular. This initiative however also envisages the construction of wayside facilities along the Leh-Manali national highway and new link roads to Tso Moriri and Tso-Kar to attract more visitors to the region. This raises concerns over the adverse impact of such developments on the fragile ecosystems and biodiversity of the region. As mentioned earlier, similar constructions and rapid increase in tourist numbers in Tso Moriri have already led to significant degradation and biodiversity loss in recent years (WWF 2002).

### ***Line Departments***

#### ***Agriculture & Horticulture***

In an effort to improve rural livelihoods and boost production to meet the demands of a rapidly rising population and other sectors like the army and tourism, the Agriculture

and Horticulture Departments are widely promoting cultivation of high yielding and improved varieties, irrigated fodder and high value crops such as vegetables and fruit. Given the high nutrient requirement of these introduced varieties, the use of chemical fertilizers is encouraged through distribution at subsidized rates by the Cooperative Department. These efforts are resulting in important increases in production and diversity of introduced crop varieties in particular Lucerne (Alfalfa), naked barley (Grim), vegetables (at least 25 species, no of varieties unknown) and fruit (at least 8 species including different varieties of apricot (4), ) apple(6), grapes (3) (Tulachan 1999, Apendix 7). On the other hand, there is no concerted effort on the part of the Departments to preserve the germ plasm of the numerous local varieties of cereal and fruit crops and this, together with the growing emphasis on high yielding cultivars, is contributing to their increasingly precarious status. Several indigenous varieties are thus feared to have been lost or are on the verge of extinction, including several land races of barley (7), wheat (unknown number) and apricot (at least 4 varieties).

### *Animal & Sheep Husbandry*

As is the case for Agriculture and Horticulture, the Animal and Sheep Husbandry Departments have undertaken major efforts to increase production and quality mainly through selective mating of local breeds, cross-breeding with high yielding exotic races, fodder development programmes and improved veterinary services. These efforts have contributed to a rapid increase in livestock population which has more than doubled over the last 25 years and a concomitant rise in milk, wool and meat production. They have also led to the introduction of a few cross breeds, mainly Jersey X Local Cattle (13% of cattle population at present) and Merino sheep X Local Malluk (8% of sheep population outside the Chang Tang).

However there are concerns over the sustainability of these changes. These concerns relate chiefly to the relatively low rate of adoption of exotic cross-breeds, which may be due to their partial dependence on irrigated fodder and supplementary feeds, and more generally to the impact of increasing stocking rates on rangeland productivity and the maintenance of viable wildlife populations. Consequently current Departmental efforts appear to be geared more towards optimizing livestock quality rather than maximizing its populations and promoting genetic up gradation of local breeds rather than cross-breeding with exotic races ( Anon.2002, Appendix 8).

### *Forestry*

In efforts to meet the growing timber & fuel requirements of the region and promote soil conservation, the Forest Department is undertaking extensive afforestation programmes, mainly along river beds. These programmes focus on fast growing exotic varieties of willows and poplars as well as Sea Buckthorn, a widespread fruit bearing bush indigenous to Ladakh. These plantations (c. 1million saplings in the past 5 years in Leh district alone), often established at the expense of natural shrubland, have been effective in increasing wood production throughout Ladakh, together with trees grown on private land. Recently, the Department has also been paying increased attention to natural woodlands which are being rapidly degraded by road and infrastructure development, fuel collection, destructive methods of Sea Buckthorn

berry harvesting and expansion of crop cultivation. In this context, the Department has initiated moves to:

- identify natural forest areas and grant protected status to threatened wild Junipers as the emblem of Ladakh cold desert (see Appendix 9.2)
- establish High Altitude Medicinal Plants Conservatories with a first site identified in Kardung La between Leh and Nubra, and
- Prepare a policy for sustainable harvesting of Sea Buckthorn berries by local communities in areas of natural growth (Appendix 9.4).

### *Wildlife*

The main efforts of the Wildlife Department from the 1980s onwards have been directed at the establishment of a system of Protected Areas (Pas) in Ladakh (Leh & Kargil) and the conservation of threatened flora and fauna throughout the region. As a result, Ladakh now hosts the largest National Park in the Country (Hemis NP: 3500 km<sup>2</sup>) and a total protected area coverage of over 17,000 km<sup>2</sup> or nearly 30% of Ladakh landmass presently under J&K State administration (See Appendix 6). However much of the area, including the large Karakorum and Chang Tang Wildlife Sanctuaries, is not clearly delineated and contain a high percentage of land under ice, snow and rock faces of minimal value for wildlife. The Department has initiated efforts aimed at management planning for Hemis National Park with the support of the Wildlife Institute of India and others although the overall picture remains of a lack of management plans in Ladakh PAs.

Since the late 1990s, the Department has also been paying increased attention to the conservation of high altitude wetlands as biodiversity hot spots. For example, in 2000, the Wildlife and Tourism Departments succeeded in preventing a major car rally from traversing the Tso Moriri region. Perhaps more importantly, the Department has managed to protect a major wetland to the north of Tso Moriri by rerouting a new road under construction away from it and preventing access to tourist vehicles in the area. However the way in which this was achieved, i.e. the erection of a concrete based fence is debatable as this also impedes access and free movement of wildlife as well as traditional rights of access to local communities. Such fences have also been erected in other wetlands of the Chang Tang but this programme is currently under review due to its potential adverse impacts on wildlife (see Box below)

### **Wetland Conservation & Management**

A fundamental way in which wetlands differ from terrestrial reserves is that the most productive, hence key area for management is not located at the core but at the interface between land and water and thus supports species from both systems. The direct implication for management is that wetlands as transitional systems cannot be separated from adjacent terrestrial and aquatic systems. The entire basin and its catchments need to be taken into consideration and physical barriers for wetland protection such as fences are generally not possible as they impede exchanges and movement of wildlife between adjacent systems.

With wetland conservation as the primary objective, the Wildlife Department also has to tackle the issue of tourism in order to minimise impact in areas of concentration such as Tso Moriri and Tso Kar for instance. Like in other protected areas, this requires careful zonation of permitted uses with total protection of breeding and feeding areas of water birds and other fauna. However fencing and other physical barriers are impractical and even detrimental to wildlife in a wetland context. For example, decline in numbers of rock nesting duck species like Mergansers and Brahminy Ducks observed over the past 7 years in the North Western part of Tso Moriri, can be largely attributed to construction of an additional road along the lake shore followed by a concrete based fence built to protect the northern wetland of Peldo from encroachment by tourists groups. The fence also denies traditional right of access to local Chang Pa nomads who use it as a grazing reserve and migration route. Unlike intrusions by tourists groups and the armed forces who have been using the area as exercise ground, Chang Pas have minimal negative impact on wildlife since grazing is mainly restricted to the drier part of the wetland in autumn and winter, outside the avifauna breeding season. Indeed, like in nearby Tso Kar, this traditional use pattern is indirectly responsible for preservation of a diverse and abundant wildlife in the area. Such fences, also built by the Department in other wetlands of the

Chang Tang should be dismantled or altered in such a way as to enable movement of wildlife and access to Chang Pa and their animals though not to jeeps and other vehicles.

Rather than erecting physical barriers, management efforts need to focus on keeping campsites and other tourist facilities at safe distance from wetlands and raising visitor's awareness of their value and needs for protection. Likewise, structures such as bird watching hides and viewing points which can be provided for the benefit and education of visitors should be unobtrusive and located at sufficient distance from water birds and other wildlife concentration. Conspicuous structures such as the watch tower constructed on the edge of Tso Kar freshwater lake, are inadequate as they adversely affect wildlife (construction of the tower resulted in the departure of the resident breeding pair of Black-necked cranes with chicks), function as poles of attraction for visitors and disparage the natural beauty of the area.

(Humbert-Droz, 2001)

## *Tourism*

Current joint initiatives of the Tourism Department and LAHDC to develop eco-tourism in Ladakh, place a main focus on infrastructure development (way side and recreation facilities, improved access roads, wildlife view points). As seen earlier, such developments may have serious consequences on Ladakh resource poor ecosystems and fragile biodiversity areas like wetlands. These initiatives also include provisions for financial assistance for preservation of historical monuments, though not apparently for natural landscapes, and environmental protection of tourist areas (Anon 2002). Overall tourism management plans for eco-sensitive areas and involvement of local communities appear to be lacking. At field level, the Department has taken some concrete steps to mitigate adverse impact of tourism activities in such areas including the organisation of garbage clean up operations and prohibiting vehicle rallies biodiversity rich areas like Tso Moriri. However this latter effort has not been successful in the past 2 years when car and bike rallies have again taken place in bio-sensitive wetlands including Tso Moriri, Tso Kar and Hanley.

## *Construction Department (PWD)*

The Construction Department (PWD) is actively promoting the use of mitigating measures to minimize environmental impact of road and infrastructure development in biodiversity rich areas. These measures include bans on bio-mass extraction, provision of fuel to construction workers, replanting of trees, restrictions on new construction in agricultural land and replacement of such lost land. The Department together with Ladakh Ecological Development Group and others is also preparing guidelines for eco-friendly building construction founded on climatic parameters, use of solar energy and the traditional architecture of Ladakh (see Appendix 9.15).

## **5.3 ARMED FORCES**

With their significant and continuous presence in Ladakh including its most remote corners, the Armed Forces, both military and Para-military, have the potential to play a major role in eco-system and biodiversity conservation in Ladakh. Realising this and also the largely adverse impact that they have had on wildlife in the past (hunting, habitat degradation), Ladakh main Army Corps (14) has issued strict codes of conduct banning these activities. It has also established “eco-cells” in different parts of Ladakh to focus on environmental concerns and act as an interface with the main biodiversity actors in the region (Government, NGOs, and Research Institutions etc.) The Armed Forces have stepped up their interactions with these organisations through meetings & workshops and agreed to facilitate access to remote biodiversity rich areas where they are present (see Chapter 8, Annex. 2). A section of the recently built Military Hall of Fame in Leh has been devoted to the depiction Ladakh natural heritage.

## **5.4 NON-GOVERNMENTAL ORGANISATIONS**

Established twenty years ago, *Ladakh Ecological Development Group (LEDeG)* has become one of the most influential non-governmental organisations in the region with

a specific mandate to foster sustainable and ecologically sound development. LEDeG main focuses are the promotion of renewable energy and appropriate technologies, ecologically based agriculture, environmental education and women empowerment e.g. through the formation of self help groups. Recently, LEDeG has been taking important initiatives on different aspects of biodiversity protection, including:

- conservation & sustainable use of biological resources in particular, medicinal plants and Sea Buckthorn (*Hipophae* sp) (see Appendix 9.4) and
- integration of tourism with biodiversity conservation through the promotion of non - destructive forms of the industry such as community based and sustainable tourism (see Appendix 9.19).

The main mandate of *the Snow Leopard Conservancy (SLC)*, a Ladakh and US based NGO, is to protect wildlife through local community involvement and promote Snow Leopard conservation by changing local attitudes towards it and reducing human-wildlife conflicts. In line with these objectives, SLC has developed important initiatives aimed at reducing Snow Leopard predation on livestock and promoting alternative sources of livelihood for local people such as eco-tourism. As part of these initiatives, SLC is providing technical and financial support to local communities of Hemis National Park to render livestock corrals predator proof, train local herders to improve day-time guarding and promote environmental education for children, the future stewards of Ladakh wildlife. At the same time SLC is promoting skills training in community based tourism like home stays , wayside tent café with a special focus on local women. This programme is meant to enhance local incomes and reduce local dependency upon livestock thus also helping to alleviate grazing pressure in the region (See Appendixes 9. 10 & 9.17).

Starting in 1999, *WWF India*, with the support of WWF International, has been conducting a major initiative aimed at protecting the wetland ecosystems of the Chang Tang in particular Tso Moriri, Tso Kar and Pangong Tso. The main objective is to develop a strategy and action plan for conservation of the lakes and their rich biodiversity involving the local communities at every stage. One of the major successes of this initiative so far is the recent declaration of Tso Moriri as a wetland of international importance under the Ramsar convention, one of only 16 such sites in the country. Another is the establishment of a local Tso Moriri Conservation Trust actively engaged in protecting the lake environment (garbage management, protection of pastures and water bird habitat) and promoting eco-friendly forms of tourism (WWF 2002). Another main thrust of WWF activities in Ladakh are programmes aimed at building up conservation awareness of major biodiversity stake holders (administration, armed forces, the youth, and tourist & tour operators). This includes regular interactions, training programmes, publication of wildlife posters and pamphlets etc. WWF most recent initiative focuses on the introduction of a sustainable tourism certification scheme and developing pilot ecotourism packages together with the Snow Leopard Conservancy.(See Appendix 9.18)

The *Ladakh Amchi & Astro Sabha (LAAS)*, a State sponsored organisation, regroups the traditional medical practioners of Ladakh, or Amchis. As part of its activities, LAAS is engaged in sharing information amongst its members on the localities and

status of medicinal plants which form a major component of Ladakh flora and an essential part of its traditional system of medicine. LAAS has identified some 12 locations for *in situ* conservation including two priority sites in the Suru Valley and in the Kardung La area which have been proposed for protection by local communities (Community Conserved Areas) (See Appendix 9.6).

Several other NGOs are involved in environmental work in Ladakh with indirect links to biodiversity conservation. Most of them have taken an active part in the BSAP process and are listed in the Action Plan Chapter (see Chapter 8, Annex. 1).

## 5.5 RESEARCH INSTITUTIONS

The Leh based *Regional Agricultural Research Station (RARS)* of the *Sher-e-Kashmir University of Agriculture Sciences & Technology (SKUAST)* is researching various aspects of agricultural crop & livestock production in Ladakh. Some of its current initiatives are directly related to the conservation of domesticated but also wild biodiversity including:

- vegetation surveys and compilation of herbaria for different parts of Ladakh (Leh, Nubra, Kargil, Chang Tang)
- *ex situ* cultivation of indigenous shrub & trees at its recently established research farm arboretum (See Appendix 3.)

SKUAST-K, Shalimar, a unit of the university outside Ladakh, is due to develop a programme for germ plasm collection and preservation in the region with support from the National Bureau of Plant genetic Resources (ICAR) (Mir 2002, Appendix 9.6.2).

The *Field Research Laboratory (FRL)*, a unit of the Defence Research and Development Organisation (DRDO) based in Leh, is carrying out extensive research on the status and uses of the wild and domesticated plants of Ladakh. FRL current research programmes of direct relevance to biodiversity conservation include:

- field studies and ex-situ cultivation of medicinal plant species at its research farm
- propagation techniques and fruit processing of Sea Buckthorn
- identification and status of indigenous horticultural varieties (mainly apricot, apple), and development of improved fruit processing techniques

One of the main mandates of the *Wildlife Institute of India (WII)* is to promote biodiversity conservation through research, training & education and building up support for conservation from local communities. As part of a joint Project with the International Snow Leopard Trust and the US Fish & Wildlife Service, WII has established a field station in Leh (1999) from where it carries out research on various aspects of Ladakh biodiversity including the status and distribution of its flora and vertebrate & invertebrate fauna (Anon 2001). WII Ladakh programme further focuses on primary conservation issues such as the impact of human activities on biodiversity, emerging human - wildlife conflicts etc. It actively promotes local capacity building and improved management planning for Protected Areas through targeted training programmes, workshops etc. Another recent initiative of WII, jointly with IUCN and

ICIMOD, is aimed at developing appropriate rangeland management policies that balance the needs and aspirations of local herders' communities and wildlife conservation goals. Planned activities include studies on Chang Tang rangeland ecology and traditional management, possible trans-boundary collaboration with neighbouring regions of Tibet and promotion of community based eco-tourism (Anon 2002).

## **5.6 INDUSTRY**

### ***Tourism***

*Ladakh Tour Operators* and their association, the *Travel Agent Association of Ladakh (TAAL)* generally demonstrate an interest in protecting Ladakh natural & cultural heritage, which is at the basis of Ladakh success as a tourism destination. TAAL and several other representatives of the industry have participated in the series of workshops and initiatives organised on this theme by WWF, LEDeG, SLC, the Tourism Departments and others. TAAL has developed its own initiatives by adopting specific tourist routes for yearly garbage clean up operations. The tourism industry has reacted positively to eco-tourism initiatives put forward by different organisations, including WWF proposal to develop eco-routes and a sustainable tourism certification scheme for tour operators.

### ***Food Processing***

A private industrial fruit processing plant, the Leh Berry, has been recently (2001) set up to manufacture juice and oil extracted from Sea Buckthorn seeds. Berries are harvested by local people from areas of Sea Buckthorn (SBT) natural growth and sold by them to the industry at fairly low price (8 Rs per kg in 2002). While a Ladakhi women cooperative, the Indus Tsesta Lulu Society, is already active in berry collection and juice manufacturing on the local scale, Leh Berry currently enjoys a monopoly on industrial exploitation & processing in Ladakh. Concerns for the sustainable use of Sea Buckthorn as an indigenous biological resource, arise from the scale of the industry (a projected 6000 kiloliter yearly production), the destructive harvesting methods currently being used (beating the fruiting stems with heavy wooden sticks) the exploitation of the local harvesters and inequitable access to the resource for local communities. Furthermore in contrast with the industry which has access to state of the art methods developed by research Institutions like FRL, the local Cooperative involved in processing and marketing, the Tsesta Lulu Women Society, has received little technological and training support so far.

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## **6. GAP ANALYSIS**

In spite of the numerous and meaningful initiatives outlined in the previous chapter, several important gaps remain in the knowledge of Ladakh wild and domesticated biodiversity, the threats it is submitted to and the means for its long term protection.

### **6.1 GAPS IN KNOWLEDGE OF THE RANGE, DISTRIBUTION AND STATUS OF SPECIES & RACES DIVERSITY**

#### ***Wild species inventories***

Other than for a few higher taxa such as flowering plants and vertebrates, species inventories, which are a prerequisite for biodiversity conservation, are generally not available. Even for these higher taxonomic groups, inventory lists are often far from complete.

### ***Plants & Birds***

The number of Ladakh flowering plants vary widely according to authors from 611 (Kachroo, 1977), 700 (Chaurasia, 2000) to 750 (Chundawat et al 1994). Some recent estimates place this number considerably higher at c. 1000 (Dickore, 2002, Klimes, Pers. Com.). This underlines the need for further comprehensive inventories and mapping of Ladakh vegetation. Similarly, a recent unpublished bird checklist (Pfister 2002) indicates a total of 342 species versus earlier records of 225 (Chundawat et al., 1994). This requires further confirmation including details of the new records (location, date etc.).

Species inventories, and indeed any detailed information, concerning other taxonomic groups are almost totally lacking. These include micro-organisms, algae, fungi, mosses as well as protozoa and quasi all other invertebrate groups. Insect fauna is no exception with comprehensive species and even genera list still missing though systematic research work has now been initiated (Maheshwari, 2000, Uniyal, 2001).

Similarly, knowledge of *species distribution, status, habitat requirements and threats* is generally insufficient even for the relatively better known groups. This is of particular concern for endemic, rare and globally endangered species for which such information is critically needed to develop appropriate conservation plans.

### ***Baseline information on endangered or rare species***

Information on distribution, status, habitat requirements and threats is especially lacking in the case of the following species and species groups:

- Threatened or rare flowering plant species including medicinal plants species (see Appendix 2) and tree and shrub species (see Appendix 9.2).
- Globally threatened ungulate species, on the verge of extinction in Ladakh, in particular the Tibetan Gazelle, Tibetan Antelope, Wild Yak and Great Tibetan Sheep or Nyan. A case in point is the illegal trade in shatoosh, the highly prized Tibetan Antelope wool, which is known to take place but on which there is no reliable or quantified information.
- Little known, rare or threatened mammalian carnivores such as the Wild Dog (*Kuon alpinus*) globally vulnerable, the Brown Bear, probably on the verge of extinction in Ladakh, the Lynx, the Pallas Cat (*Ocotolobus manul*), the rarest wild cat of the region and the Otter
- The Ladakh and Nubra Pikas or Mouse hares, which are very little known species endemic to Ladakh.
- Little known and relatively rare birds characteristic of the region including endemic species such as the Tibetan Snowcock and Tibetan Partridge, and rare summer visitors and possible breeders like the Ferruginous Pochard, *Athya nyroca*, (globally vulnerable), the Ibisbill, *Ibidorhyncha struthersii* (possibly also resident in Ladakh) and the Black – Necked Grebe, *Podiceps nigricollis* (observed nesting in the Chang Tang lake of Tso Kar).

### ***Domesticated species and races***

There is no inventory nor any detailed information on the characteristics, status and distribution of local crop varieties and indigenous livestock breeds as most of the research and development work till now has been focussing on the introduction of high yielding and improved cultivars and cross-breeds. Exceptions are local fruit varieties, mainly apricots, thanks to the work of FRL on the subject and R&D work on the Changra or Pashmina goat by the Line Department and SKUAST prompted by the Changra economic importance. This lack of documentation is of grave concern and may be irreversible in some cases: many local races are deemed to be in a precarious state or may already have disappeared, including several varieties of barley, wheat and lesser millets as well as rare local breeds such as the Huniya and Purik Sheep and Yarkhand Horse. Essential knowledge on indigenous crops and breeds as well as on a number of wild plants traditionally used for food and other purposes, lie with local communities, their elders in particular. However, there has been no attempt to document such traditional knowledge till now.

## **6.2 GAPS IN KNOWLEDGE OF HABITAT, LANDSCAPE AND ECOSYSTEM DIVERSITY AND OF THE IMPACTS OF RECENT LAND USE CHANGES**

If inventories of species and races are few, information and studies at habitat, landscape or ecosystem level are even fewer. This information is crucially needed for the elaboration of any biodiversity conservation plan. This assumes particular importance at a time when the main threats affecting biodiversity appear to have shifted from biota destruction, through over collection and poaching, to overall environmental degradation and habitat destruction.

## ***Rangelands***

Despite the importance of Ladakh natural grasslands from the floristic diversity and agro-pastoral economic stand points, several key aspects of their ecology and use

### **Some main gaps in knowledge of grassland ecosystems**

- impact of livestock grazing on vegetation patterns, dynamics and plant succession
- trends in livestock and wild ungulates population size and composition
- patterns of pasture utilisation in space and time by domesticated & wild herbivores
- impact of recent increases in livestock population on wild ungulates and other wild fauna
- location, intensity and economic implications of human – wildlife conflicts arising from livestock predation by wild carnivores and from competition for grazing resources between domesticated & wild ungulates
- local pasture management systems including grazing reserves, seasonal migration patterns and herding practices
- livelihood systems and socio-economic profiles of local pastoral & agro-pastoral communities
- the effects on rangelands and their fauna of new forms of land use such as trekking & motorized tourism and Armed Forces establishments. Specific aspects needing to be better documented include the impacts of proliferating camping sites, grazing by pack animals “off track” driving and free outsiders’ access to wildlife habitats.
- the impact of road construction and other infrastructure development on fragile grassland and wildlife.

patterns are still poorly understood.

## ***Wetlands***

Despite their vital importance as reservoirs of freshwater and “hot spots” of diversity and productivity, Ladakh rivers, lakes & ponds and their adjoining wetlands are still poorly known. In the face of rapidly growing uses (agriculture, forestry, irrigation, tourism, armed forces) and attendant pollution risks, wetlands hydrological and ecological status need to be investigated and regularly monitored. Information is most needed in the case of fragile and bio-diverse wetlands located in the vicinity of human settlements and campsites as well as natural riverine woodland and shrubland.

### **Some key aspects of wetland ecosystems requiring documentation and monitoring**

- standard physico-chemical water quality parameters
- siltation and eutrophication rates
- primary productivity, micro fauna and especially macro benthic fauna, that can be used as bio-indicator for water quality determination, ichthyofauna
- mapping of littoral vegetation including riverine woodland and shrubland,
- water bird species diversity and population trends
- loss or degradation of moist sedge pasture and natural woody vegetation due to various uses like cultivation, plantation, irrigation, camping sites, roads and infrastructure development

Such investigations and monitoring could be based and expand upon the substantial work initiated over the past four years in some major wetlands of the region, the Chang Tang in particular, by WWF-India (WWF 2002, Humbert-Droz 2001) and the Wildlife Institute of India (Anon. 2001a).

### ***Agro-ecosystems***

The impact on species diversity and the agro-ecosystems themselves, of recent changes in farming practices, like increased reliance on high yielding varieties and cross-breeds, cultivated fodder and chemical fertilisers, are poorly documented. Resulting changes in cropping and grazing patterns, animal feed requirements and use of dung as organic fertiliser and fuel, need to be better understood as they may affect biodiversity. Some of the reported effects of these changes needing closer monitoring include:

- the displacement or disappearance of indigenous races,
- increased competition for productive summer pastures between cross-breeds with higher food requirements, and local breeds and wildlife
- lower utilisation of remote pastures and reduced bio-mass extraction (vegetation, dung) which may benefit wildlife.

### ***Impacts of recent socio-cultural changes***

The impacts on natural and cultural diversity of recent socio-cultural changes such as increasing standards of living and urbanisation, gradual abandonment of polyandry and reduced entry into monastic life need to be better understood. Very little is known of the effects these changes are having on gender relations and the status and roles of women. Key aspects like erosion of traditional knowledge pertaining to natural resources and diminishing interest in cultural and natural heritage, which may lead to further losses, need to be better documented...

## **6.3 GAPS IN AVAILABILITY AND EXCHANGE OF BIODIVERSITY INFORMATION**

Due to insufficient coordination between researchers, NGOs, concerned Departments, farming communities etc. there is a general lack in availability and exchange of existing biodiversity information, which translates, in turn, into an overall lack of awareness of the importance of biodiversity amongst the main stakeholders and the general public.

This deficiency is most evident in *school curricula* where for want of reliable and published information on local biodiversity, Ladakh youth is more likely to be taught about the wildlife and agro-ecosystems of the Indian plains and the Deccan than that of their own region.

The *Armed Forces*, a major stake holder in the region, are generally not aware of the precise location and status of Protected Areas and other vulnerable biodiversity areas like wetlands and natural woodlands for lack of information exchange mechanisms with concerned Departments, research institutions etc. The same is true of District Development Agencies which may undertake infrastructural work such as roads. In

biodiversity rich and fragile area for lack of knowledge of their protection status and conservation needs.

Other than a section of the military Hall of Fame which is to be devoted to wildlife, there is at present no *museum facility* in Ladakh depicting the unique biodiversity of the region.

Similarly, and in spite of the biodiversity convention which makes it mandatory for researchers to make a copy of their work, published or unpublished, available, there is no facility or institution in Ladakh acting as a repository of research findings concerning the region. This is of particular concern as Ladakh attracts many visitors who also do research in the region but whose results are not readily available for the benefit of Indian researchers and the general public.

#### **6.4 GAPS IN BIODIVERSITY CONSERVATION MANAGEMENT & ACTION**

##### ***Protected Areas***

Because of their large size and of the extensive pasture use characteristic of Ladakh agro-pastoralist system, most Protected Areas have been traditionally used by local people as grazing reserves including temporary shepherd settlements. These traditional uses and more recent ones by the tourism industry, the Armed Forces etc. have generally not been taken into consideration while selecting areas for protection which has been based essentially on the wildlife value of these areas. As a result the designation and management type selected for Protected Areas namely National Park and Wildlife Sanctuary, which allow for no or very limited extractive use and no industrial use, are often at great variance from actual land use. Important deficiencies in management and action derive from these contradictions:

- Ladakh major Protected Areas (PAs), which are the largest in the country (3000-5000km<sup>2</sup>), have not been clearly delineated as potential areas of conflict exist with local communities who use most parts of the reserves. This also means that all manner of development activities such as road and building construction, plantation of exotic species, tourism etc. do take place, which are not under the control of the Wildlife Department.
- These large and almost unmanageable areas have failed to protect Ladakh most endangered species such as the Tibetan Gazelle, Tibetan Antelope and Wild Yak whose population are now on the brink of extinction. Actually in some cases there appears to be a mismatch between threatened species distribution and PA coverage.
- Again owing to PAs size, inaccessibility and lack of manpower and funds, integrated Management Plans are not available, there is no clear cut zonation within the PAs nor boundaries around them and there is a lack of wildlife surveys and monitoring.
- For the same reasons, wildlife –human conflicts are difficult to handle for the authorities, compensation packages are low and difficult to implement.
- On the other hand Community Conserved Areas (CCAs) such as grazing reserves are not officially recognized mostly due to the absence of clear tenure rights.

### ***Biodiversity conservation outside Protected Areas***

Relict patches of *natural woodland*, Juniper “forest” in particular, have been identified by the Forest Department but have not been placed under any form of protection as yet. Natural riverine shrubland and woodlands on the other hand have not been systematically identified nor mapped which is of serious concern since these areas are increasingly encroached upon for plantation and cultivation.

There is a general and misguided emphasis on *ex-situ* rather than *in situ* conservation in both wild medicinal plants and local crop varieties protection programmes.

While the idea of developing High Altitude Medicinal Plants Conservatories in the best areas of natural growth has been mooted by the Forest Department and the Ladakh Amchi Astro Sabha, no such site has been established as yet. Efforts of research Institutions such as FRL focuses instead on the preservation of germplasm and cultivation of medicinal plants in nurseries.

The picture is similar for fruit crops in particular apricots where a few varieties preserved in nurseries are already on the verge of extinction in farmers orchards. The situation is worse for cereal crops where no concerted effort is being made to conserve local varieties either *in situ* or even *ex situ*. Similarly, other than the Changra or Pashmina goat there is no programme at present to conserve local breeds at the research or departmental levels.

### **6.5 INSUFFICIENT UNDERSTANDING OF THE INHERENT VALUE OF BIODIVERSITY AND OF THE IMPORTANCE OF SUSTAINABILITY IN BIOLOGICAL RESOURCE USE**

In spite of a generally benevolent attitude towards wildlife in Trans-Himalayan Buddhist society, there is *insufficient awareness and understanding of the intrinsic value of biodiversity*, especially amongst development agencies and policy makers. This is reflected in the precarious status of many of Ladakh wild species and local domesticated races. For instance, the presence in Ladakh rangelands of several species of wild ungulates even in small numbers, alongside their domesticated relatives, is often seen as a competitive threat that needs to be controlled rather than an indicator of a healthy environment. The Tibetan Ass or Kiang is a case in point: control measures have been requested as it is perceived by the Sheep & Animal Husbandry departments and some pastoralists as competing for forage with sheep and goat. This is unlikely as the Kiang’s diet being an equine would differ from that of *Caprinae*. However, more than the threat itself, what is important here is the perception of the threat, which is indicative of a loss of tolerance towards the Kiang and wildlife in general.

Similarly, the increasingly endangered status of large portions of Ladakh wild flora (over 20% of medicinal plants, most areas of natural woodland and shrubland including Sea Buckthorn) due to over collection, reclamation for forestry and agriculture etc., is indicative of an *overall lack of understanding and concern for sustainability in biological resource use* which is spread throughout society.

The overemphasis on high yielding varieties, crossbreeds and chemical fertilisers, which have already led to the displacement or disappearance of several local varieties & breeds, is reflective of a similar mindset amongst line agencies and agricultural

research institutions. This is compounded by a lack of adaptive research aimed at harnessing the genetic potential of highly adapted indigenous races (Tulachan, 1998, Mir 2002). This denotes a *lack of interest and knowledge of local races* which are generally portrayed as of inferior quality and low yield. In actual fact local varieties have a number of desirable traits for the extreme agro-climatic conditions of Ladakh such as early maturity, good potential yield and grain/straw ratio (barley), high sugar content (apricot) etc. (Tulachan, *ibid.*, Dwivedi Pers. Com.)

The general emphasis on tourism, in particular eco-tourism development, which has become the new development mantra of line agencies, NGOs and research institutions alike, also denotes a *lack of awareness and understanding of the serious impact that the fastest developing industry in the world can have on biodiversity and the socio-cultural fabric of society*. Though eco- and sustainable tourism are forms of the industry that respect the bio-cultural environment, the common vision of the main stakeholders remain to increase the flow of visitors to biodiversity rich and environmentally fragile areas such as the Chang Tang wetlands and Hemis National Park, develop ancillary infrastructure such as roads, way side facilities, hotels etc. and generally develop these areas as premier (eco-) tourism destinations (Anon..2002). If the example of Lake Tso Moriri opened to tourism less than 10 years ago, is any thing to go by, such development can have a severe impact on the biodiversity and fragile habitats of the region. As mentioned earlier tourism development in the area have resulted in pasture degradation and loss, loss of endangered species such as the Black-Necked Crane, decrease in other wildlife population, solid waste and water pollution (Mishra et al. 1998, Humbert-Droz 2001, WWF 2002).

## **6.6 GAPS IN POLICIES & IMPLEMENTATION OF LEGAL PROVISIONS TO PROTECT BIODIVERSITY**

Though several initiatives are being undertaken such as elaboration of policies on sustainable use of Sea Buckthorn (Forest Department), review of policies on compensation for livestock loss to wild predators (Wildlife Department), assessment of development programmes & policies (WWF-India), important gaps remain in both the availability and implementation of effective policies & regulations to protect biodiversity.

- There is presently no policy nor legal protection for the conservation of relict Juniper forests, natural woodland and shrubland situated outside the precincts of Protected Areas. This is a serious gap as these are the only types of naturally occurring woody vegetation of Ladakh. The same is true for critically important natural growth areas of medicinal plants.
- As seen above, there is neither stated policy nor programme for conservation and adaptive research concerning domesticated indigenous biodiversity, the changra or pashmina goat being an exception. Similarly, while current fodder development programmes are focussed on pasture irrigation and introduction of improved forage crops, there is a policy and programme gap regarding the protection of natural grasslands and propagation of indigenous drought tolerant species

- There is a lack of clear policies and enforcement of existing regulations regarding the execution of infrastructural work such as roads, tourist and military facilities in Protected Areas and other biodiversity rich areas. As a result such development takes place, without prior scrutiny or proper authorization, often in the most fragile zones and with dire consequences for biodiversity and the environment. For the same reason extractive uses such as biota and artefact collection and detrimental activities such as dumping of waste, free camping and vehicle rallies continue to take place without control. Neither is there proper control of illegal trade in wildlife products such as Tibetan Antelope shatoosh or sale of fossils.
- There is an absence of policy on trans-boundary collaboration for biodiversity protection between Ladakh and neighbouring Tibet. This is a critical gap since the border region harbours its most endangered species (Tibetan Antelope & Gazelle, Wild Yak, and Black-Necked Crane) which do not recognize human borders. Protected Areas exist on both sides of the border and could possibly be linked for the benefit of conservation if such collaborative policy comes into existence. Two years back, WWF International took the initiative of proposing Pangong Tso, the largest wetland of the region about a third of which is in Ladakh, for designation and protection as a Peace Lake. Follow up is still expected. Conservation and improvement of local breeds of sheep and goats through genetic exchange could also be positively affected by the advent of such policy. The recent workshop on sustainable livestock grazing and Conservation organised by the Wildlife Institute of India and ICIMOD has agreed to conduct a feasibility study on the subject.
- Biodiversity conservation strategies can only succeed, in Ladakh as elsewhere, if local communities are directly involved at every stage of the process. For this to happen, clear policies are required that enables and ensures their participation. A major requirement raised repeatedly by local representatives and supported by Ladakh Autonomous Hill Development Council is security of land tenure, which is conspicuous by its absence, in the Chang Tang in particular. Another policy requirement is to closely associate local communities to any decision on land use change and management occurring in their area. A case in point here is the designation and management of Protected Areas, including delineation, zonation, management categories etc. Bearing in mind the very precarious state of many wild plant and animal species, there is a need to strictly control or cease extractive use including grazing in certain key habitat to enable these species to recover. However for this to succeed, and as a matter of policy, local communities must be party to the decision, be involved in the management of such areas and be given some form of direct or indirect compensation if necessary. Some of these areas could actually be designated as Community Conserved Areas (CCAs) for which an appropriate policy framework needs to be designed.

## **6.7 GAPS IN INSTITUTIONAL & HUMAN CAPACITY BUILDING**

Although there is a multiplicity of organisations with a stake in biodiversity protection, there are important gaps in institutional & human capacity building at most levels (local communities, government agencies, and tourism industry) and a lack of co-ordination between stakeholders.

### ***Rural communities***

Rural communities have been the custodians of domesticated biodiversity and to an extent of wildlife also, throughout the ages and have in depth understanding of its value. However in the face of rapid developments and outside pressures affecting agricultural and pastoral production systems, they have in many cases been unable to protect these biodiversity assets. Community based organisations (CBOs) have now started to constitute themselves for this purpose in different parts of Ladakh (e.g. Women Tsestalulu (Sea Buckthorn) Society, Tso Moriri Conservation Trust, CBOs in Hemis National Park) thanks to the efforts of a strong environmentally oriented NGO sector in the region. However there has been little or no support for these local efforts on the part of concerned line & agricultural research agencies whose programmes remain heavily biased towards promotion of introduced and improved varieties through subsidies on seeds, fertiliser etc.

Though major efforts are underway on the part of different NGOs to develop local capacities for sustainable and community based tourism, there is still an overall lack of local guiding skills, especially a lack of nature guides with knowledge of wildlife and conservation needs, insufficient capacity for local pack animals management and care and virtually no local capacity for waste and garbage management. These deficiencies run counter to the objectives of eco-tourism and tend to accentuate adverse impacts in biodiversity rich areas where this form of tourism is concentrated.

### ***Government***

There is a multiplicity of agencies dealing with biodiversity protection at Government level (Forest, Wildlife, Agriculture & Horticulture, Animal & Sheep Husbandry, PWD etc.), often with insufficient awareness & training and overall lack of coordination.

*Ladakh Autonomous Hill Development Council (LAHDC)* which is expected to play a major policy making and coordinating role in environmental and biodiversity protection does not have an Executive Councillor with overall responsibility for these issues. Neither is there a facility within LAHDC or elsewhere that can serve as a repository for a biodiversity database and research findings.

*The Wildlife Department*, the main custodian of wild biodiversity within the Administration is grossly understaffed and under equipped for the task. With over 17000km<sup>2</sup> of Protected Areas to manage it has only three field vehicles, no field communication and insufficient enforcement equipment. In spite of its own effort and the support of research organisations such as the Wildlife Institute of India and NGOs like WWF, the Department does not have at present sufficient physical and human capacity to design and implement effective management plans for Ladakh Protected Areas nor protect wildlife outside their precincts. Management capacity is particularly lacking in the area of wetland protection, which is a major component of biodiversity conservation though, a relatively new endeavour in Ladakh.

While its major and successful efforts have been geared towards greening suitable areas of Ladakh with plantation of fast growing tree species, the *Forest Department* presently lacks human capacity to identify and protect effectively Ladakh natural woodlands and main medicinal plant growth areas. This is a critical deficiency as these areas are amongst the main repositories of wild floral diversity in Ladakh.

Similarly *agri-horticultural line agencies and research institutions* are currently ill equipped technically and in terms of trained staff, to identify and conserve local races and indigenous fodder species. As mentioned earlier, there is insufficient R&D capacity for adaptive research to develop improved races based on the utilisation of indigenous genetic traits.

Several agencies are involved in biodiversity protection and policing, often with overlapping duties (Forest, Wildlife, Police, Customs, Home (Indo Tibetan Border Force & Police), which may hamper enforcement. Their efforts have so far failed to bring to an end or effectively control poaching and illegal trade in animal and plant products or artefacts. On the other hand the Army, a major actor in the region especially on the borders, which could also play a decisive role in wildlife protection, has not been involved in this effort so far.

### ***NGOs***

There is an exceptionally strong environmentally minded NGO sector in Ladakh which represents a unique though not yet fully tapped opportunity for capacity building especially at Government level.

### ***Tourism Industry***

In spite of efforts made by NGOs and the tourism Department to build up the capacity of the Tourism sector for eco- and sustainable tourism in Ladakh, there is still an overall lack of environmental and conservation awareness amongst tour operators and their staff, an absence of generally accepted environmental code conduct on their part and virtually no control of their activities on the field. The major gaps lie in the absence of environmental self regulating mechanisms amongst tour operators themselves as well insufficient control & management capacity on the part of the authorities.

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## **7. MAIN STRATEGIES FOR BIODIVERSITY CONSERVATION**

Based on an analysis of the main gaps in knowledge and means detailed above, a concerted effort has been made by the main stakeholders and other major actors to elaborate a set of strategies and an action plan to promote immediate as well as longer term protection of biological diversity in Ladakh. The main strategies jointly developed in course of Ladakh BSAP process are presented below:

### ***Improve Biodiversity Knowledge Base***

- Build up the knowledge base of Ladakh biological diversity, its characteristics and status, current uses, the main threats it is submitted to and its conservation needs.
- Promote research & monitoring at various levels (Academia, GOs, NGOs, Local Communities) with a special focus on threatened habitats, species & races and traditional knowledge systems.

### ***Promote conservation and sustainable use of wild plants and domesticated crops & breeds***

- Promote conservation & sustainable use of biological resources, such as medicinal plants, wild fodder crops and Sea Buckthorn, through establishment of Community Conserved Areas and capacity building of local communities, women in particular, with involvement of all main stake holders (concerned Departments, NGOs, Research Institutions, Community Organisations, Industry)

- Promote protection of domesticated biodiversity (local crop varieties and breeds) through support to local farmers for in situ conservation as well as germ plasm preservation, adaptive research and selective breeding by concerned Departments, and Research Institutions

#### ***Enhance Protected Area Network & Promote Community Conserved Areas***

- Promote conservation of biodiversity rich areas such as natural grasslands and shrubland, wetlands and threatened species within them, through the enhancement of existing Protected Area (PAs) network and the establishment of Community Conserved Areas (CCAs) where local communities can develop a real stake in conservation:
- Promote sound management planning for PAs & CCAs, including adoption of co-management strategies through community empowerment as well as capacity building for the Wildlife Department in terms of human resources, skills and equipment.
- Promote the adoption of flexible PA categories such as Biosphere Reserves which allow for graded protection of different parts of the landscape and sustainable resource use in consonance with existing land use
- Rationalise PA boundaries focusing on prime habitats and threatened species distribution rather than on vast unmanageable areas

#### ***Reduce Threats and Impacts on Biodiversity***

- Enhance wildlife and habitat protection through control of extractive uses and effective prohibition of destructive uses such as encroachment on wildlife feeding & breeding territories, biota collection & poaching and off road driving.
- Minimize human-wildlife conflicts by building the capacity of local communities for improved livestock protection, enhancing alternative livelihoods opportunities and improving Wildlife Department compensation policy
- Develop a clear policy to strictly limit and control infrastructure development in biodiversity rich areas including natural grassland and shrubland, wetlands and agricultural land. Promote as part of this policy, the systematic use of Environmental Impact Assessment prior to any developmental intervention including introduction of exotic species & races in the environment.

#### ***Promote Sound Policies & Capacity Building for Biodiversity Protection***

- Encourage community based and eco-friendly forms of tourism as a means to minimize the impact of the industry on biodiversity and to promote greater community control as well as more equitable returns to local people
- Enhance biodiversity conservation and management capabilities through training & awareness programmes aimed at key stakeholders including youth and women folk, tour operators and staff as well as Development Agencies
- Promote collaboration with the Armed Forces for biodiversity conservation and monitoring

- Promote sound environmental policies, which acknowledge and strengthen the role played by local communities, women in particular, in biodiversity conservation. Promote as part of these policies, security of tenure for pastoral communities
- Promote institutional capacity building to foster coordination between the main stake holders, efficient enforcement of biodiversity protection and dissemination of information and research findings.

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Chapter 8 – Find separately in the Publications/Downloads section

## 9. CONCLUDING REMARKS

The Strategies & Actions presented in the previous chapters reflect the strong commitments made by the participants during the elaboration of the plan. The Action Plan is still a work in progress as no overall funding, implementing nor monitoring mechanism have been finalised as yet. The general consensus is that Ladakh Autonomous Hill Development Council (LAHDC) with the support of the Local Advisory Committee will coordinate execution of the plan and monitor progress. Most important however is that implementation is already under way with stake holders and other major actors pursuing the initiatives and programmes agreed upon with their own limited resources. This is a sign of the vitality of the process initiated by the BSAP which bodes well for the future and the long term conservation of bio-diversity in Ladakh.

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