OCCASIONAL REPORT NO. 13

LIVING AT THE EDGE

Rapid Survey for the Endangered Ladakh Urial (*Ovis vignei vignei*) in Leh District of Ladakh Trans-Himalaya

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Wildlife Trust of India

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

The David Shepherd Wildlife Foundation

The Wildlife Trust of India (WTI) is a non-profit conservation organization committed to initiate and catalyse actions that prevent destruction of India's wildlife and its habitat. In the long run, it aims to achieve, through proactive reforms in policy and management, an atmosphere conducive to conservation. WTI works through building partnerships and alliances and its strengths lie in its willingness to work with innovative conservation techniques like acquiring land for wildlife and rescue and rehabilitation.

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PREFACE

When WTI was formed, its work agenda revolved around the triumvirate species that form the mega-charismatic pantheon of Indian wildlife—the elephant, the tiger and the rhino. It was only after an year or two of this focus that other species started appearing on the horizon and in the eight years of diversification a group of rarely seen, mostly threatened and oft-ignored high-altitude species stands centre-stage. These are the mountain ungulates and WTI has been fortunate to work directly on two species—the Chiru or the Tibetan antelope and the Markhor and indirectly on two; the Nilgiri Tahr and the Urial. The last mentioned was one of the first forays that WTI took into the distribution and ecology of the species in collaboration with the Wildlife Institute of India.

This occasional report documents the work done by the author for her master's dissertation under the guidance of one of India's foremost mountain ecologists Dr. Yashveer Bhatnagar and was a one-off, discretionary grant given by WTI, with funds provided by the David Shepherd Wildlife Foundation.

Though not an in-depth study, a small focused scientific excursion, such as this, forms the basis for both longer term work and local conservation effort (the latter need not, as often happens, wait for longer term work to yield results).

WTI is both proud and happy to have entered into this collaboration with the Wildlife Institute of India and equally, because it supplements the work on other ungulate species that inhabit this fragile ecosystem of ours—the Himalayas.

Vivek Menon
Executive Director, WTI

ACKNOWLEDGEMENTS

We wish to thank the Wildlife Trust of India for supporting this project and paving the way for future studies on the endangered Ladakh urial (*Ovis vignei vignei*). This survey resulted in a six-month study which was based on the interactions between the urial and livestock in the Fotu la lok region, one of the potential study sites identified by this survey in Leh, Ladakh. The Wildlife Institute of India kindly provided the base camp, computer and other facilities.

We wish to express our gratitude to our wonderful friends in Ladakh who helped to make this survey possible. Tsewang Namgial accompanied and guided us during the survey and gave of his valuable time; Drs. T. Phuntsog, Ali, and Gupta at the Sheep Husbandry and Animal Husbandry Departments for providing information from government records as well as personal insights; the Wildlife Warden, Leh, Mr. Salim ul Haq for granting us permission and co-operating on this and other studies; Rinchen Wangchuk of the Snow Leopard Conservancy for his help and guidance; Snow Leopard Travels for arranging the travel details; Sangay, Jagdish and family at the WII base-camp in Leh for making us feel at home; and finally, the villagers of Nimmu, Basgo, Liker, Saspol, Alchi, Hemis-Shukhpachan, Khalsi, Nyarmu, Lamayuru, Chipskianchan, Potortse, Kanji and Miru for their co-operation and smiles.

A big thank you also to friends and faculty, especially Drs. Sathyakumar, Qamar Qureshi, Neeta Shah, Meera Anna Ommen, Rashid Raza, Advait Edgaonkar, N. M Ishwar, K. Ramesh, as well as the computer and GIS cell staff, especially Mr. Virender Sharma for extending their help.

EXECUTIVE SUMMARY

This survey was undertaken in 2002 to estimate the population in numbers and status, threats to the species, and to identify possible sites for further studies on the urial. Areas in the urial range along the River Indus known to have a relatively higher abundance of urial were chosen for the survey. These areas included Nimmu, Basgo, Liker, Saspol, Alchi, Hemis-Shukhpachan, Lamayuru, Fotu la lok, Nyarmu and Miru. Counts from vantage points and trail walks along ridgelines and valley bottoms were the main methods used for survey of the urial. Information was also collected, through semi-structured interviews and creation of resource use maps, about the human and livestock population in these areas and their dependence on the urial habitat. Potential sites for further studies on the urial were identified based on certain criteria, including the presence of a sizeable urial, human and livestock population in the area, proximity to a village that could serve as base camp and easy approachability of pastures from the village and of the village from the road.

1. The minimum population size of Ladakh urial could be between 700 and 800 animals.

The urial population in Ladakh was estimated to number around 690 (540-840) individuals. However, this information needs to be treated with caution as not all areas were sampled uniformly. Only the highest sightings from each area were used for density calculation, and only areas known to have relatively higher urial abundance were surveyed.

2. Among the areas surveyed, Fotu la lok- Nindum followed by Liker had the maximum urial density

The Fotu la lok-Nindum area (0.83 animals/km^2), followed by

Liker (0.81 animals /km^2), had the highest urial densities. Fotu la lok also had the largest number of urial seen (109 individuals). Nimmu (0.11 animals /km^2) and Nyarmu (0.12 animals /km^2) had the lowest urial densities.

3. **The overall density for the entire 1500 km^2 urial range in Ladakh was estimated as 0.46 animals/km^2**

4. **There is high competition for pasture resources between urial and livestock**
   The livestock population was highest in Nimmu (4030) and lowest in Nyarmu (850). Saspol had the largest human population (2500 individuals in 180 households), followed by Nimmu and Basgo (2000 individuals each). It was lowest in Nyarmu (50 individuals in 15 households).

5. **Almost all villages practiced agriculture to a great extent (85-90%) and pastoralism to a lesser but relatively significant extent (up to 75% and more)**

6. **Majority of the livestock holdings comprised of sheep-goat**
   Majority of the livestock holdings comprised of sheep-goat (76.8%), followed by zho-zhomos (crossbreeds of cows with yak and demo) (10.6%). Majority of the villages practiced agriculture followed by pastoralism, though some villages like Liker and Fotu la lok had more than 50% population engaged in 'other' occupations also.

7. **Habitat loss, degradation and resource competitions are biggest threats to the Ladakh urial**

8. Fotu la lok seemed to be the best area for further detailed studies on the urial, next best being Liker and Nimmu

Based on our findings, the following recommendations are put forth for wildlife conservation in general, and urial conservation in particular that are to be considered for carrying out any conservation action in Ladakh.

1. Information needs

- Initiate a detailed study on urial biology and ecology in Ladakh to track changes in the population numbers and structure and on interaction between urial and livestock.
- Quantify the seasonal pasture biomass removal in the urial range by the local human population and their livestock

2. Infrastructural support and departmental action

- Implement the ban on hunting.
- Provide better support facilities to the enforcement staff and enhance their skills.
- Educate the staff on the ecology and behaviour of common wild animals.
- Develop better public relations between the Wildlife department and other enforcement agencies.

3. Community-based action

- Reduce livestock and human dependence on pasture resources through use of improved, subsidized, eco-friendly technology
- Education of locals on the importance and need for conservation and their role and contribution to conservation.

1. INTRODUCTION

The Indian trans-Himalaya (Biogeographic province 1A) presents a unique montane habitat: the cold desert (Rodgers and Panwar, 1988). It is characterized by scrub vegetation and fauna that are uniquely adapted to the cold and arid conditions prevalent here. The wild fauna include several species of wild sheep and goat, such as the Asiatic ibex (*Capra ibex sibirica*), blue sheep or bharal (*Pseudois nayaur*), Tibetan argali (*Ovis ammon hodgsoni*) and Ladakh urial (*Ovis vignei vignei*), most of which are endangered or threatened. Little is known about the population status of, or threats acting on, many of these species. This is especially true for the endangered Ladakh urial (IUCN Red List 2000, CITES Appendix I, Indian Wildlife (Protection) Act Schedule I), a subspecies of wild sheep, locally known as 'Shapo' and endemic to the Ladakh trans-Himalaya.

The Ladakh urial (Family: Bovidae, Subfamily: Caprinae, Tribe: Caprini; henceforth 'urial') is listed as highly endangered in the IUCN Red List 2000 and is only now recovering from high hunting and other anthropogenic pressures (Mallon, 1983). In India, the urial occurs in the mountains of the Ladakh range, along the River Indus and along the reaches of the Shyok river where it meets the Indus (Mallon, 1983; Fox *et al.*, 1991; Chundawat and Qureshi, 1999) (Figure 1).

Its numbers have been estimated to be around 1000-1500 individuals by previous authors (Mallon, 1983 & 1991; Fox *et al*., 1991; Chundawat and Qureshi, 1999), occurring in scattered and small populations of not more than 150–200 individuals each. Except for a single population of < 50 individuals in the Hemis National Park, all other populations occur outside protected areas, especially in areas with high human density (Chundawat and Qureshi, 1999).

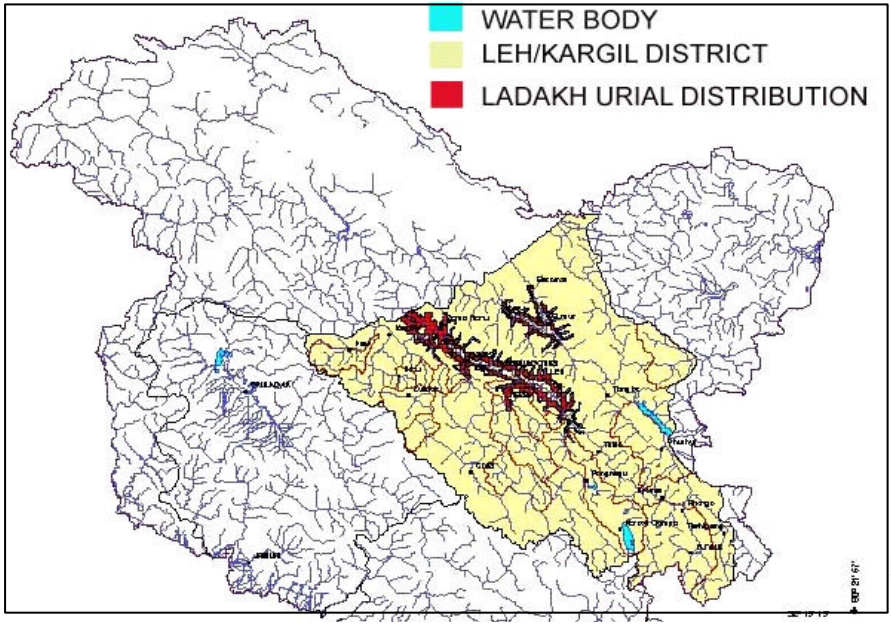

Figure 1: Distribution of Ladakh urial in Leh and Kargil districts
Source: Chundawat & Qureshi, 1999

Not much is known about the species, especially in terms of population status, structure and resource utilization, except that it prefers lower elevations along the alluvial flats of the river valleys. Unfortunately, this is also the region that is highly suitable and preferred for human habitation, agriculture and other developmental activities. This makes the urial highly vulnerable to hunting or poaching (Mallon, 1983; Fox *et al*., 1991; Shackleton, 1997; Chundawat and Qureshi, 1999) and to habitat loss. Livestock too, compete for the meagre forage that is available here in the resource-limiting period of winter, when they are brought back to the villages from their summer pastures at higher elevations. Thus, the species faces danger from both humans and their livestock, especially with the *i*ncreasing road access to the area (Mallon, 1983; Fox *et al*., 1991; Shackleton, 1997; Chundawat and Qureshi, 1999).

Apart from surveys conducted by Mallon (1983 & 1991) that focussed entirely on the urial, all other studies have been conducted as part of general mammal surveys in Ladakh (Fox *et al.*, 1991; Chundawat & Qureshi, 1999). There is thus, a dire need for more detailed studies on the species. However, in order to understand the ecology of the urial and apply appropriate conservation measures, information is required on the present status of the population and potential threats (past and present) acting on them.

For this purpose, a rapid survey was conducted in the month of June 2002, for a period of about 20 days, along the Indus river valley. Areas known to have a relatively higher abundance of urial based on previously published reports (Mallon, 1983; Shackleton, 1997; Chundawat and Qureshi, 1999) along the left bank of the Indus from Leh to Khalsi and on the right from the confluence of Zanskar and Indus rivers to Chipskianchan (Figure 2) were chosen for the survey. These included the following villages or blocks of villages:

- Nimmu-Basgo block–villages Nimmu and Basgo
- Alchi-Liker-Saspol block–villages Alchi, Liker and Saspol
- Hemis-Shukhpachan block–villages Hemis-Shukhpachan and Rizong
- Nyarmu
- Lamayuru block–villages Lamayuru and Wanla
- Fotu la lok block–Chipskianchan and Potortse
- Miru village

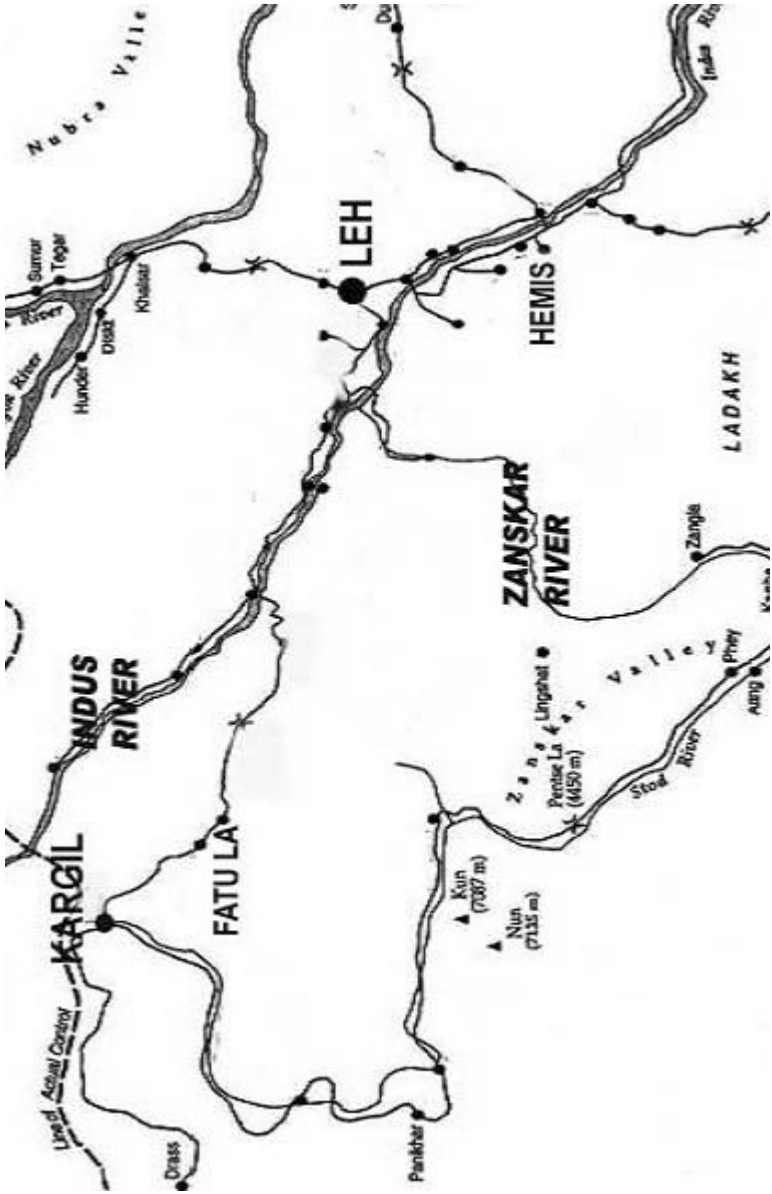

Figure 2: Map showing area surveyed along Indus River for Ladakh urial.

2. OBJECTIVES

1. To determine the present status of the urial in areas reported to have high abundance.
2. To gather information on the potential threats to the species in Ladakh
    - –History of hunting or other pressures such as competition, disease, developmental activities, etc. on the urial populations.
    - –Identification of present threats to the urial.
3. To understand the demography of the local communities in these areas and their dependence on urial habitat.
    - –Population densities of humans and their dependence on agriculture and pastoralism (and consequently urial habitat) for their livelihoods
    - –Livestock holding and grazing patterns
4. To identify a suitable site for a detailed study on possible inter action between urial and livestock

It is hoped that this information will add to baseline information already available to aid further intensive work on the species.

3. PROJECT AREA

Ladakh falls under the trans-Himalayan region (covering ca. 1,84,823 km^2) of the state of Jammu and Kashmir in India. Ladakh is a cold and arid high-desert, characterized by low rainfall and sparse, xerophytic vegetation, being in the rain-shadow part of the Himalayas. Temperatures are extremely low, especially in winter, ranging from -3 to -30°C. Both summer (rainfall) and winter (snow) precipitation is low, resulting in its char-

acteristic and unique fauna and flora, which are especially adapted to these extremes in conditions. Typically the densities of occurrence of fauna are relatively low in the region.

The study area lies in the western part of Ladakh (Figure. 2), downstream of the Indus and to the west of the capital city of Leh. It is bounded by the Ladakh range in the north and the Zanskar range in the south with elevations ranging from 2500 to 7600 m. The biggest river of the region, the Indus and its catchments are characterised by great expanses of alluvial fans, which form an ideal habitat for the Ladakh urial.

3.1 Vegetation

The vegetation of the region is classified as Dry Alpine Scrub (Champion and Seth, 1968) and is characterized by species like *Caragana spp.*, *Lonicera spp.*, *Artemisia spp*. etc. that are highly adapted to the prevalent arid and cold conditions. Thus, most plants have a cushion-like or woolly structure, bear thorns or spines and are usually prostrate forms. There are patches of moist scrub (*Myricaria spp*., *Salix spp.*, and other species) along the rivers, streams and water channels. The floral diversity of Ladakh includes over 600 species of flowering plants, most of which belong to families Asteraceae and Brassicaceae. Several species of medicinal plants are also found here.

3.2 Fauna

The faunal diversity of the region is influenced by Palaearctic, Mediterranean and Chinese elements (Das, 1966). Their physiological adaptations to the prevalent cold and arid conditions in the region include thick fur, thick and bushy tails, large nasal cavity, winter hibernation, and seasonal and local migrations.

The bird diversity includes about 225 species and communities characterised by many threatened migratory birds that come here for breeding, including bar-headed goose and black-necked crane.

About 15 species of the mammals of the area are listed in Schedules I and II of the Indian Wildlife (Protection) Act and several others fall under the high conservation category of the IUCN-Redlist. These include nine species of ungulates, several species of carnivores, and small mammals. The major fauna of the study area include blue sheep or bharal or 'sna' (*Pseudois nayaur nayaur*), Asiatic ibex or 'skin' (*Capra ibex siberica*), Ladakh urial or 'shapo' (*Ovis vignei vignei*), Tibetan argali or 'nayan' (*Ovis ammon hodgsoni*), snow leopard (*Uncia uncia*), Tibetan wolf (*Canis lupus chanku*), wild dog (*Cuon alpinus*) and lynx (*Lynx isabellina*).

3.3 Local Population

The main occupation of the people in the region is agriculture along with pastoralism. There is usually only one growing season (April–September), with the main crop grown being barley or wheat. However, many areas towards western Ladakh, beyond Khalsi district, have two growing seasons: April–June and July–September. Vegetables are grown in greenhouses and apricots and walnuts also form an important part of the agricultural produce of the region.

Species of livestock kept by the local population include sheep, goats, cows, yaks, demos (female yak), zho-zhomos (hybrid yaks), donkeys and a few horses. Most livestock are taken to pastures at high altitudes (4500–5000 m) in summer, and brought down to lower pastures around the villages or stall-fed in winter. Yaks, however, are seldom brought down, even in winter.

4. METHODS

The survey was completed in a period of 20 days, from mid-June to early July 2002 and areas/villages along the urial distribution range were visited. It was conducted downstream of the River Indus, from Leh to Chipskianchan, a stretch of about 150 kms covering 10 villages in five blocks. At least one whole day was devoted per village so as to conduct fixed or vantage point counts or walks along monitoring trails (Jackson and Hunter, 1996) to look for the animals in both early morning and early evening hours. Semi-structured interviews of the locals were carried out in the intervening periods.

The following methods were used to gather relevant information:

1. Estimation of urial abundance:
   - Semi-structured interviews with locals and village headmen.
   - Direct sightings from fixed (vantage) points and along monitoring trails (Jackson and Hunter, 1996). The counts were made from a vantage point on a particular ridgeline in each area (total 12 points) or along monitoring trails that allowed maximum visibility (total 9 trails).

Observations were carried out using 16-40x spotting-scope and 7x40 binoculars, from 0700/0730 to 1000/1030 hrs and 1600/1630 to1830/1900 hrs. Once animals were sighted, information was collected on their numbers, herd size, age, sex, elevation, aspect, slope and time of sighting. Aging and sexing methods used were based on those suggested by Schaller (1977). GPS location and elevation of the vantage point were also recorded. An index of sighting efficiency for urial was calculated for each area as the ratio of the number of urial seen and the effort spent in an area (Table.1)

2. Potential and past threats to the species:
   - Semi-structured interviews conducted with locals to determine
     i) Hunting pressures on urial: past and present
     ii) Pressure on the urial habitat from humans, livestock grazing, wild predators and developmental activities.
   - Information on disease transmission between livestock and urial: collected from wildlife and animal husbandry departments.

Data from semi-structured interviews of the local communities in each survey block was used, to list out the various threats and the extent to which they could be acting on the urial population. Based on this information, each area was first rated according to the extent of each threat and then on the overall disturbance that the local urial population faced from these threats (Table 5).

3. Demography of the local communities and their dependence on urial habitat:
   - Semi-structured interviews with locals were the main source of information.

4. Livestock holding and grazing patterns of livestock:
   - Interviews with locals.
   - Resource use maps- developed for each village with the help of the village headman and other village elders to identify the summer and winter pastures of livestock; areas of wild animal distribution; location of water resources, roads, etc. in the area.

Government records were available district-wise and not village-wise in published statistical data books and hence were not used in this study.

5. Identification of a suitable site for future studies on urial and its interaction with livestock:

- The site should have an urial population of at least 80—100 individuals.
- A significant population of sympatric livestock species should be present.
- Conditions like accessibility of the site through roads, availability of local transport, local assistants, proximity to a village or guesthouse that can serve as base camp, etc.

5. RESULTS

5.1 Status of the Ladakh Urial Population

Thirty-three urial groups with a total of 231 individuals were seen in a total effort of 62.5 hours, covering 12 vantage points, 9 monitoring trails totalling an area of ca. 243 km^2 during the entire survey (Table 1). Of these, 115 individuals could be classified according to their age. Of the 115, 72% were adults, 2.6% sub-adults, 1.7% yearlings and 23.5% lambs. Eighty seven individuals were classified by sex and 69% were adult females, 1% sub-adult females, 26% adult males, 2% sub-adult males and 1% yearling males (Appendix II).

The numbers of urial groups and individuals, average group sizes, density and index of sighting efficiency was largest in Fotu la lok, followed by Liker (Table1). Nyarmu had the lowest index of sighting efficiency, followed by Basgo, which also had the lowest number of urial groups and individuals. Nimmu had the lowest density as well as average group size of urial.

Other areas found to be important, with respect to urial numbers and groups seen, were Hemis-Shukhpachan, and Liker in terms of urial density and average group sizes. The former area is contiguous with Rizong

area, which was found to have a sizeable population by Fox *et al.* (1991) and Chundawat & Qureshi (1999).

Area Visited	**No. of groups Seen (G)**	**No. of animals (N)**	**Average group size (N/G)**	**Effort (E) (hours)**	**Index of sighting efficiency (N/E)**
Fotu la lok	9	109	12.1	11	9.9
Liker	2	15	7.5	3	5.0
Lamayuru	5	27	5.4	7	3.9
Alchi	2	17	8.5	5	3.4
Nimmu	3	11	3.7	3.5	3.1
Saspol	2	9	4.5	3.5	2.6
Hemis-Shukhpachan	7	31	4.4	13	2.4
Basgo	1	4	4.0	3.5	1.1
Nyarmu	2	8	4.0	13	0.6
Total	**33**	**231**		**62.5**	
Mean	**3.3**	**23.1**		**6.3**	**4.3**

Table 1: Results of the survey for Ladakh urial (*Ovis vignei vignei)* conducted in Western Ladakh in summer (June-July) 2002

It is interesting to note that the urial population in the Fotu la-Nindum area, which had been reported to have disappeared almost two decades ago (Mallon, 1983), reappeared a few years later and continues to occur there (Fox *et al.*, 1991). This 'rediscovered' population was then found to be one of the largest local urial populations in Ladakh, another decade later by Chundawat and Qureshi (1999). The present survey too, found the Fotu la population to be one of the largest in the study area along the Indus river valley.

The density of urial for each block was calculated taking into consideration only the largest sighting from each area. This gave an estimate of the minimum number of urial in an area (minimum density), as this figure would not be less than the maximum number of individuals seen in that area. Fotu la lok area showed the highest density of urial (0.83 animals /km^2) during this survey, followed by Liker (0.81 animals/km^2). Nimmu (0.11 animals/km^2) and Nyarmu (0.12 animals/km^2) (Table 2). A mean density for the entire area surveyed was then calculated and this was extrapolated to the entire urial range of 1500 km^2 to obtain the 'minimum' population estimate of urial in Ladakh. The mean density was 0.46 (0.10) urial per km^2 while the total population in its present range of ca. 1500 km^2 was estimated to be about 690 (540–840) urial (Table 2).

Village/Block*	**Area(sq. km)**	**Ladakh-urial nos**	**Ladakh-urial density**
Fotu la lok	40	33	0.83
Liker	17.33	14	0.81
Alchi	25.86	16	0.62
Hemis-Shukhpachan	18.48	11	0.60
Lamayuru	20.44	8	0.39
Basgo	21.67	4	0.18
Nyarmu	40.19	5	0.12
Nimmu	54.72	6	0.11
Total	**238.69**	**97**	

Table 2: Density of Ladakh urial (*Ovis vignei vignei*) in areas surveyed based on highest record for a day from each area.
(*Since area surveyed in Saspol was quite small, figures for the same have been dropped from this analysis)
Mean density per km^2 =0.46 (0.10)
Population Estimate (over 1500 km^2 range)=690 (540 to 840) individuals

However, caution is advocated while interpreting this result as the density estimates here use the maximum number of animals seen, in areas known to have higher abundance of urial. This means that other areas not surveyed may actually have much lower densities than the extrapolated mean density.

Based on these results, the status of the Ladakh urial population in Ladakh could tentatively be said to be "precarious". There is no dispute in the fact that there has been a definite increase in their numbers from the total population of 700 reported by Mallon (1983) for the whole of Ladakh. This increase had been documented by Mallon (1991), Fox *et al*. (1991), and Chundawat & Qureshi (1999). However, it is disturbing to note that while Mallon (1991) and Fox *et al*.(1991) reported a total urial population of 1000-1500 in Ladakh in 1991, a definite increase from the figures of almost a decade ago, the survey by Chundawat and Qureshi (1999) almost another decade later estimated the total number to be around 1300–1400 individuals. This showed that the population remained more or less stable through a whole decade.

The present survey suggests the total urial population in Ladakh to be around 700–800 individuals or less. According to Chundawat and Qureshi (1999), the urial population showed a declining trend. Taking the results of the present survey with caution, we suggest that the population is a declining one and immediate measures need to be undertaken to protect the same. Therefore, it is imperative to carry out an intensive and rigorous survey for the Ladakh urial exclusively, throughout its range, identify and quantify areas of local decline or increase, and the threats acting on the population.

5.2 Demography of the Local Communities and their Livestock, and their Dependence on Ladakh Urial Habitat

Ladakh has, over the years, seen an increase in its human as well as the attendant livestock populations, with Mallon (1983) reporting an increase by almost 17% in the former for the decade between 1961 and 1971. Most of this increase has been associated with the opening up of the region to the army and other outsiders during the border conflicts of 1948 and 1962. Information on the increase in the human population since that period could not be obtained for the purpose of this report. However, we have attempted to document the current human population in the areas surveyed based on interviews with locals and village headmen. Government records, unfortunately, could not be obtained for each village and were available only for the district of Leh as a whole.

The areas (in km^2) surveyed for urial presence did not correspond to the actual areas (in km^2) occupied by a particular block or village. Hence, human and livestock population density of a block or village has not been calculated and only the total numbers reported from each area are used here.

Saspol had the largest human population of 2500 individuals in 180 households, followed by Nimmu (2000 individuals in 160 households) and Basgo (2000 individuals in 200 households) (Table 3). Nyarmu had the lowest human with 50 individuals in 15 households, followed by Fotu la lok with 90 individuals in 15 households.

All households practiced both agriculture and pastoralism in Fotu la lok and Nyarmu (Table 3). Although all households in Alchi and Liker practiced agriculture, only about 85-90% herded livestock. On the whole, almost all villages practiced agriculture to a great extent (85-90%) and

pastoralism to a lesser but relatively significant extent (up to 75% and more). The villages surveyed mostly practiced settled agriculture, i.e. unlike the nomadic pastoralists of eastern Ladakh, they owned land which they cultivated and lived on. A majority of them would also herd livestock (though holdings would be much smaller than those of the nomadic pastoralists) to meet their needs for wool and meat.

Villages surveyed	**No. of households**	**Total population**	**Occupation (% households engaged in)**		
			Agriculture	Pastoralism	Others*
Saspol	180	2500	95	85	50
Nimmu	160	2000	90	75	10
Basgo	200	2000	95	85	5
Liker	150	1200	100	90	70
Alchi	120	800	100	85	30
Hemis-Shukhpachan	132	700	80	80	20
Fotu la lok	15	90	100	100	50
Nyarmu	15	50	100	100	30
Total	972	9340			

Table 3: Human population and dependence on agriculture and pastoralism in areas surveyed for Ladakh urial (*Ovis vignei vignei*) based on information from semi-structured interviews with locals.
*Includes tourism related activities like guides, hotels and guest-houses, taxi services, military service, and others

Interestingly, almost 70% households in Liker and 50% each in Saspol and Fotu la lok indulged in 'other' occupations (Table 3). In Liker, these mainly included tourism-related activities as it is home to one of the older, more famous monasteries in Ladakh and has several tourist camping

grounds and other facilities. Saspol is the only village, apart from Leh and Khaltse in Leh district, to house a bank and primary health centre, which along with the primary school provide employment to a number of villagers. Fotu la lok is close to the town of Kargil, which lies on the disputed border between India and Pakistan. Hence, several people from this village serve in the army or drive donkeys to run supplies between Kargil and the army's border outposts. Besides this, several households in all the villages have at least one member serving in the army or in the road construction division of the army (In the GREF division of the BRO to be exact).

Of all the livestock, sheep and goat were the most abundant in all areas, followed by cross-bred cattle and zho-zhomos (Table 4). Interviews with locals revealed that there is a downward trend in the herding of sheep and goat in recent years, due largely to the inability (through lack of labour) to herd them on to pastures and lack of readily available fodder. Unlike Eastern Ladakh, which comprises of large tracts of rolling, high altitude pastures, Western Ladakh is more rugged and has fewer pastures, most of which are located at altitudes greater than 4000 m. This makes herding livestock, especially sheep and goat, a labour-intensive proposition. With few new opportunities of income generation (such as military service, tourism-related jobs, taxi services, and construction work), lesser people, especially among the younger generation, are opting for increasing their present sheep and goat herds.

There has, however, not been much decline in the number of large, hoofed-stock, such as cattle, zho-zhomos and yak-demos. This is mainly due to the fact that yak-demos and zhos do not need to be tended and can be left on the pastures to fend for themselves, being brought down only in winter.

Village surveyed	**% Yak/Demo**	**% Zho/Zhomo**	**% Cross-bred Cattle**	**% Sheep & Goat**	**% Donkey**	**% Horse**	**Total (approx.)**	**Grazing duration**	**Stall-feeding duration**
Nimmu	-*	12.4	7.5	79.4	0.7	-	4030	Jun-Aug	Sep-May
Basgo	-	20.6	28.8	49.4	1.2	-	2430	May-Sep	Sep-May
Hemis-Shukhpachan	2.8	8.4	11.2	75.6	2.0	**	3573	Throughout	Sep-May
Liker	4.1	12.4	0.8	82.7	-	-	2420	Jun-Aug	Sep-May
Saspol	**	6.3	8.4	83.7	1.6	**	2400	May-Sep	Sep-May
Alchi	0.5	5.9	4.6	85.1	3.9	-	1530	May-Sep	Oct-Apr
						0.2 (0.3)		Throughout	Oct-Apr
Fotu la lok	3.3 (5.0)	2.1 (3.5)	0(0)	90.5 (88.4)	3.9 (2.8)	0.2 (0.3)	608 (1415)		
Nyarmu	0.7	4.7	4.7	86.4	3.5	-	850	May-Sep	Oct-Apr
Total	**1.3 (1.5)**	**10.6 (10.4)**	**9.7 (9.3)**	**76.8 (77.2)**	**1.6 (1.6)**	**** (**)**	**17,841 (18,648)**		

Table 4: Livestock holdings and grazing patterns of the villages surveyed for Ladakh urial (*Ovis vignei vignei*) based on information from semi-structured interviews with locals.
* Figures not available
** Values > 0.1
Figures in parentheses include livestock of Fotu la lok and those brought in from Lamayuru in summer
Figures outside parentheses indicate livestock of all the hamlets in Fotu la lok and not just of Chipskianchan and Potortse, as they share common grazing grounds.

The cattle and zhomos can be stall-fed and hence, require less attention and labour than sheep and goat. Though there had been a decline in number of donkeys and horses, the former are still numerous in Ladakh due to their ability to carry loads, manure, grain, etc. and because of their use in carrying supplies for the army to inaccessible outposts. Horses were mainly used for travelling in the past, but the advent of public transportation has made them redundant in most places.

All livestock, except cattle and zhomos, are herded onto the high altitude (summer) pastures, between April and May and left there for rest of the season. They are brought back to the villages at the onset of winter (usually November) and then herded onto lower (winter) pastures nearer to the villages, on a daily basis. In many areas, yak-demos and horses are left on the pasture even in early winter, and brought down only in times of snow (Hemis-Shukhpachan and Fotu la lok). During winter, all livestock are stall-fed at least once a day, and twice a day when the ground is snow-covered and the animals can not be grazed. In all villages, pasture biomass is removed for stall-feeding. Hay from crops grown in the fields, vegetable wastes and sometimes barley flour is also used. Villages like Nimmu also use alfalfa grown in the fields.

Data from the resource maps drawn by villagers (Appendix III), showing locations of the various pastures used by livestock and those used by urial, showed that both livestock and urial used the same pastures and that their seasons of use also overlapped to a great extent (Figure 3). Figure 3 also shows that the pastures were available for exclusive use by urial only for a very short period of time (December to January in winter, and April and October in summer). Thus, urial could be facing competition for these pasture resources from livestock, not only on a spatial but also a temporal scale. Apart from this, pasture biomass is also removed

from the same areas for stall-feeding. This removal coupled with the possible degradation of pasture through excessive livestock grazing, could also lead to possible competition between livestock and urial.

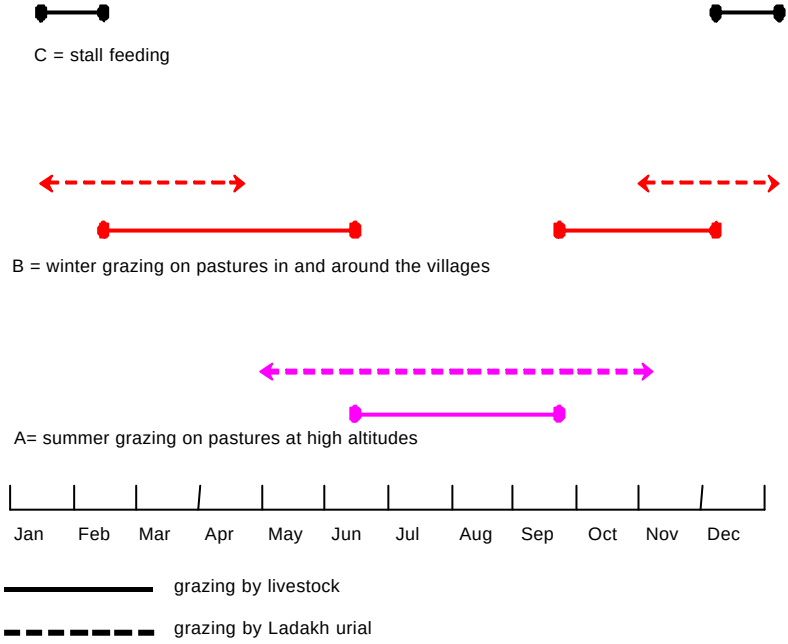

Figure 3: Generalized annual livestock grazing cycle of villages surveyed for Ladakh urial (*Ovis vignei vignei*) based on information from semi-structured interviews with locals

However, detailed studies of urial habitat use and dietary preferences are required to understand how increasing livestock grazing pressures are affecting the urial. For this, a suitable study site must be identified. Detailed studies are also required on the socio-economic conditions of the people in the region and their livestock holding patterns. This would also help identify areas that require immediate management action (such as regulation of grazing and other pressures on the pastures), active con-

servation efforts for the urial, and where the urial population can be maintained at least for the present.

5.3 Potential Threats to the Ladakh Urial

The presence of large human and livestock populations in urial habitat was used as an indicator of the level and kind of threat posed to the urial in the surveyed areas (Table 5). Livestock and human presence could lead to possible direct competition through interference (inhibit urial from utilization of shared resources) or indirect competition through utilization (and hence, limiting availability) of common resources. The various kinds of disturbances assessed for each site in and around the habitat of urial, were:

5.3.1 Humans and Livestock

Disturbance in the form of livestock and human presence was greatest in Nimmu and Basgo, followed by Liker and Saspol.

5.3.2 Hunting or Poaching

Although hunting had greatly reduced from past levels, it is still a considerable threat in Fotu la lok due to its proximity to the hunting communities from Kargil district and easy accessibility from the highway. For a species whose local populations do not seem to number more than 50–100 individuals, even low-level hunting can be a major cause for concern.

5.3.3 Developmental activities

Pressures from other human activities, like developmental projects (including military camps, highways, proposed hydel power projects) and human habitation were greatest in Nimmu, Basgo and Alchi. These posed a serious threat to urial habitat in the form of degradation of the area, constant road traffic and direct human presence.

5.3.4 Disease

Livestock could act as a source of disease for the urial and although the concerned departments did not corroborate reports of Foot and Mouth

Disease (FMD) in urial from Saspol and Alchi, no tests have been performed to rule out this possibility.

The overall disturbance level was highest in Nimmu, Basgo and Saspol, lowest in Nyarmu and medium in other areas. The potential for competition between urial and livestock for resources such as food and habitat, seem to be higher in Nimmu and Basgo, while Fotu la lok faces continuing threat from hunting or poaching activities.

5.4 Selection of potential site for a detailed study

For a detailed study on urial habitat use, diet preferences and interactions with livestock, a suitable site needed to be selected that fulfilled necessary conditions that aid in successful execution of field work.

Fotu la lok had the largest group sizes, index of sighting efficiency (Table 1), and larger density of urial followed by Liker. Nimmu and Hemis-Shukhpachan had the highest abundance of sympatric cattle while Fotu la lok had lower numbers of the same. In terms of size of study area, and logistics (including accessibility of the sites via roads, availability of local transport, local assistants, proximity to a village or guesthouse that can serve as base camp, etc.) Nimmu village had a sizeable human and livestock population and was close to Leh. However, it was quite far from the pastures used by urial to allow easy access on foot. Alchi and Liker apart from the above problems also had logistic problems involving a place to stay. Fotu la lok was situated near the high pastures used by urial, had a sizeable livestock and urial population, was adjacent to Lamayuru, was easily accessible from the highway, and the village of Potortse offered accommodation as well as assistants. Based on all the above criteria for selection, Fotu la lok seemed to be the best area for further detailed studies on the urial, followed by Liker and Nimmu.

6. DISCUSSION

The Ladakh urial had, in the past, occupied vast tracts of relatively open, low-altitude terrain along the main valleys of the Indus and Shyok rivers (Lydekker and Dollman, 1985; Ranjitsinh, 1981; Schaller, 1977; Roberts, 1977). Their historical distribution in Ladakh included the area around Gya-Miru as the eastern most distribution and the areas up to Pakistan-occupied-Kashmir. Though the urial's present distribution range covers much the same extent, its populations within this range have been drastically reduced. Thus, urial are now scattered over a wide area but in small populations of between 30 and 200 individuals. During this and previous surveys (Ranjitsinh, 1981; Mallon, 1983; Fox *et al*., 1991; Chundawat and Qureshi, 1999), very few areas were found to have populations of more than 50 individuals. Those that did included parts of Rizong, Khalsi, Fotu la-Nindum area and Lamayuru.

Urial have always been found to occur in areas close to human habitation (Lydekker and Dollman, 1985; Ranjitsingh, 1981; Schaller, 1977; Roberts, 1977; Mallon, 1983; Fox *et al*.,1991; Chundawat and Qureshi, 1999). This is because the rolling, gentle slopes preferred by them are mainly to be found along the river valleys, which are also preferred sites for human settlement and agriculture (Lydekker and Dollman, 1985; Ranjitsingh, 1981; Mallon, 1983; Fox *et al*.,1991; Chundawat and Qureshi, 1999). Hence, they have been exposed to high pressures of hunting for meat and trophy, unlike the Ibex (*Capra ibex sibirica*) and bharal (*Pseudois nayaur*), which live in more rugged areas, high up in more remote mountains. The heavy military presence in the area after the wars in 1948, 1962 and the 1970s, has put additional pressure on the urial. Incidents of indiscriminate hunting for sport and meat by the personnel stationed in the area have been reported by various sources,

especially in the period preceding the 1980s (Ranjitsinh, 1981; Mallon, 1983; Fox *et al*., 1991). Apart from these, hunting by other officials, sportsmen and traditional hunters from Kargil district have also added to the pressures.

From past surveys (Fox *et al*., 1991; Chundawat and Qureshi, 1999), it seems that the urial population had definitely increased from the 700 individuals of two decades ago (Mallon, 1983) to 1000–1500 individuals but that their population growth trend was a declining one. Looking at this fluctuation in urial numbers, we suggest that the urial population had been held well below its potential. However, the generally low human and livestock populations (compared to other parts of the country), and consequent lower competition for the sparse food and water resources available here have meant that the urial population could maintain their numbers. The ban on hunting of urial by the government of Jammu and Kashmir in 1984 further helped the population to recover (Mallon, 1983, Fox *et al*., 1991; Chundawat and Qureshi, 1999).

However, increasing pressure from human activities and livestock and the continuing, though lowered, threat from poaching is still threatening this endangered population. The present, possibly declining trend of population growth, therefore, threatens to escalate with the increase in human and livestock populations in Ladakh (Mallon, 1983, Bhatnagar and Wangchuk, 2001) in recent times. The already scarce pastures have been reportedly undergoing gradual degradation in quality through overgrazing (Fox *et al*.,1991). Thus, competition for these scarce resources is only going to increase in the future. With supplementary feed available to livestock, the above situation would not seem as threatening to them as for the urial and other wild herbivores, for whom the pastures are the only source of nourishment. Thus, it would seem likely that in a scenario of

possible competition for these resources between urial and livestock, the urial could be out competed. The effects of this competition would then be reflected in the urial population as lowered fecundity, and lamb and adult male survival (Clutton-Brock *et al*., 1988; Schoener, 1977). This would mean disaster for this endemic subspecies already reduced to a discontinuous, fragmented population of probably less than 1000 individuals in its entire range. Hence, appropriate measures need to be undertaken immediately for the conservation of one of the oldest living wild sheep in the world (Schaller, 1977).

Apart from the need for an intensive survey to estimate the present numbers and regular monitoring to quantify population growth trends, there is an urgent need to know more about the species' ecology and the threats that might be acting on it. Therefore, it is important to monitor the status and structure of the urial population, urial habitat use and diet preferences, and interactions with livestock and humans. It would also be interesting to investigate the trends in urial population growth and structure with respect to the changing human and livestock populations, in different areas in their distribution range in Ladakh, and to identify the possible reasons for local increase or decrease in urial populations.

Due to time constraint, only a few selected sites (known from previous reports to have a higher abundance) along the distribution range of the urial were surveyed. Of these, Rizong was not sampled due to logistic constraints while Miru could not be sampled adequately and locals interviewed here reported that the urial population is of 20–25 individuals. Hence, these areas were dropped from the survey.

The paucity of time, the short and rapid nature of the survey and the travel time involved between different areas meant that no trail or vantage

point could be replicated. Therefore, the results may be biased with respect to the particular day or time when a trail or point was used, and other errors associated with non-replicated surveys. However, this survey was the first of its kind after almost two decades, focusing entirely on the Ladakh urial. Hence, any information it yields would be useful for future monitoring programs or studies on the urial.

7. RECOMMENDATIONS

Ladakh has limited arable land, pasture, food and water resources that are shared between man, livestock and wild animals alike. These pockets of precious resources are the areas actually utilized by all wild animals in Ladakh even though they might occur over a larger area. Thus, while it would be impossible to declare all these large areas inhabited by wild animals as protected, it would be equally difficult to do so for the small pockets of resource-rich land that are used by them, because of the human and livestock populations that also depend on these resources. Hence, the best alternative (and possibly the only one) would be to involve the people in the active protection of not only these resources, but also the wildlife that depend on them.

Therefore, conservation measures suggested here carry the underlying implication that the people living in close contact with the wild animals are the primary stakeholders in any conservation and management action adopted for these animals. This means that there is need for better understanding of the socio-economic aspects of the local populace and their livelihood options with respect to use of pasture resources. There is also a need for detailed studies on the wild animals themselves and their relationship with the people and their livestock. The major conservation

action recommendations, for the Ladakh urial particularly, and wildlife in general, could be summarized under the following broad categories:

7.1 Information Needs

The conservation of any species requires not only information on its ecology but also the socio-economic status, livestock holding patterns and economic dependence of the people on natural resources living in its distribution range. Hence, we recommend the following for developing conservation measures for the Ladakh urial:

i). Regular monitoring of the urial population in Ladakh to track changes in the population numbers and structure, as an indication of continuing threats acting on them and the impact of any management action undertaken.

ii). Quantification of seasonal pasture biomass removal in the urial range by the local human population and their livestock.

c. Initiating detailed studies on interactions between urial and livestock to better understand the relationship between the two groups and how one affects the other.

iii). Initiating detailed study on urial biology and ecology to be able to undertake conservation action appropriate to the species.

7.2 Infrastructural Support and Departmental Action

Many of the conservation programmes to be implemented by the various departments concerned remain unimplemented mainly due to lack of infrastructure and personnel support. The following recommendations hope to help build the necessary foundation for carrying out basic protection activities in the field:

i). Strict implementation of the ban on hunting.

ii). Better support facilities and skill enhancement of the enforcement staff, including:

Increasing the number of field staff for better patrolling the vast areas that form wildlife habitat in Ladakh and for better and regular monitoring of wildlife populations.

Provision of better remuneration to field staff commensurate with the extent of their work and the risks and hardship involved therein.

Provision of other facilities such as housing, education, etc. for field staff to better motivate them towards their duties.

Educate the staff on the ecology and behaviour of common wild animals and provide training on methods of census and monitoring of their populations.

Better mobility in the form of vehicles for transport of personnel.

Provision of weapons and weapons training to field personnel to better tackle poachers and offenders

iii). Cultivate well-paid informants to keep track of offenders of wildlife laws and trade policies as well as regulations on pasture use

iv). Develop better public relations between the Wildlife department and other enforcement agencies and locals so that they can work in tandem towards conservation action.

7.3 Community-Based Conservation Actions

Finally, as stated above, in a country where most of the human population is still dependent on the natural resources for their livelihoods and daily needs, all conservation actions needs to be implemented with the full co-operation and understanding of the communities concerned. Hence, we recommend:

i). Active involvement of the local people in the conservation of urial and urial habitat

ii). Education of locals on the importance and need for conservation action and their contribution to the same.

iii). Reduction of livestock and human dependence on pasture resources through use of improved, subsidized, eco-friendly technology.

Thus, it is obvious that only a comprehensive approach as outlined above can help conserve not only the Ladakh urial and other wild fauna, but also the precious natural resources on which both humans and animals depend in Ladakh.

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Appendix I

THE LADAKH URIAL

Wild sheep have a wide distribution range across the globe, from North America to Eurasia. These include the Marco polo sheep, big-horned sheep, argali, urial, blue sheep, etc. The urial (*Ovis orientalis*) forms one of the species in this group, and is traditionally classified as having nine different subspecies: Mouflon (*O. o. musimon* in France and Italy), Armenian sheep (*O. o. gmelini* inTurkey, Iran, Iraq, etc.), *O. o. arkal* (North-east Iran and parts of Russia), Laristan urial (*O. o. laristanica* in Iran), Esfastan muflon (*O. o. isphahanica* in Iran), Cyprian urial (*O. o. ophion* in Cyprus), Afghan urial (*O. o. cycloceros* in Afganistan, Iran, Baluchistan, NWFP, Sind, Turkmenistan, Punjab urial (*O. o.punjabiensis* in Pakistan) and Ladakh urial (*O. o. vignei* in Ladakh) (Shackleton, 1997). However, the urials have now been given a separate species status from that of the Mouflon and are now classified as Ovis vignei, with the Ladakh urial being *O. v. vignei.*

The urials have a stout but not heavily muscled body and long, light-boned legs. This allows them to run away from predators as fast as possible, over the gently undulating terrain that they seem to prefer. Their coat colour varies according to species, from chestnut brown to black of *O. o. musimon* to reddish buff in *O. o. arkal* to a pale fawn in desert species. All the sub-species are characterised by a distinctive, large, throat ruff in males, which maybe white in *O. o. arkal* and black in others. The face is often grey or whitish; the undersides and lower legs are also white. There is a dark flank stripe and a grey wedge of hair extending upwards and downwards from the knee. Western races have a distinct white rump patch which is narrower in the eastern races. Females lack both ruff and saddle patch and have a paler pelage (Schaller, 1977). The

Ladakh urial has a rich chestnut red coat colour in males and a paler, greyish one in females. The white rump patch is quite prominent though not very wide.

The urial may have heteronym or homonym horns. The Ladakh urial has heteronym (tips converging toward back of neck) horns but some individuals may have homonym or sickle-shaped horns. The horns of the Ladakh urial rise more steeply from the head and are more corrugated than that of the Punjab urial. Females have very short horns (Schaller, 1977).

Urial is found in mostly cold and arid regions, mostly occupying open, treeless areas. However, past history indicates that these animals inhabited woodlands but due to loss of these habitats, adapted to life in treeless, barren terrain They are usually found at low altitudes but the Ladakh urial has been seen at 4200m also (Schaller, 1977).

Appendix II

Total number of groups and individuals of Ladakh Urial (*Ovis vignei vignei*) seen during survey conducted in Western Ladakh (June 2002 to July 2002) and their age-sex composition.

Area Visited	**No. of groups**	**No. of animals per group**	**Total no. of animals**	**Age and Sex Composition**
Nimmu	3	2	11	1AF, 1LU
		3		2AM, 1SM
		6		6AF(?)
Basgo	1	4	4	3AF, 1SF
Hemis-Shukhpachan	7	11	31	11AF(?)
		2		1AM, 1AF
		3		3AM
		9		9AM
		3		3AF
		2		2AF
		1		1AM
Liker	2	14	15	5AF, 4AM, 2L, AU
		1		1AM
Saspol	2	2	9	1AF, 1Y
		7		6AF, 1L
Alchi	2	1	17	1AF(?)
		16		16AM(?)
Fotu la lok	9	21	109	16AF, 5L
		6		4AF, 2L
		7		4AF, 3L
		19		13AF(?), 6L
		5		5AF(?)
		33		U
		1		U
		2		2AM
		15		15AF(?)

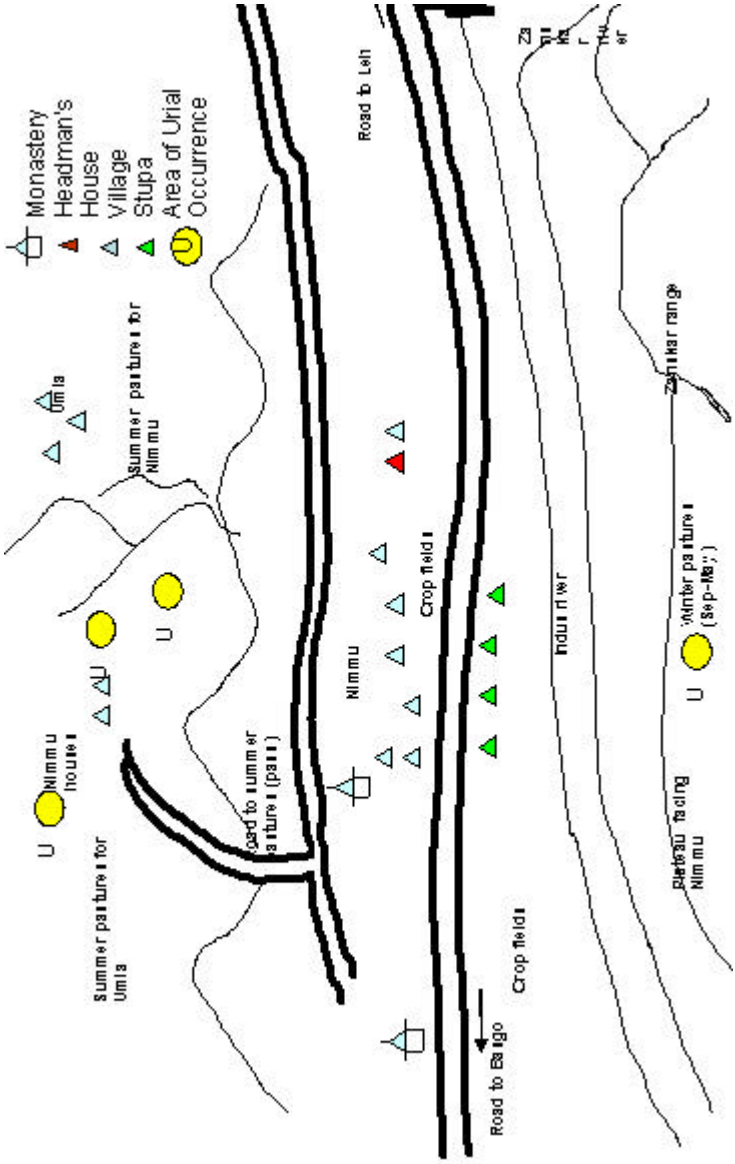
Area Visited	**No. of groups**	**No. of animals per group**	**Total no. of animals**	**Age and Sex Composition**
Lamayuru	5	7	27	4AF, 3L
		1		1Y(?) M
		5		3AF, 2L
		8		U
		6		6AM(?)
Nyarmu	2	3	8	3M(?)
		5		3AF, 1SM, 1L

? doubtful; (A) adult; (S) sub-adult; (Y) yearling; (L) lamb; (F) female; (M) male; (U) unknown

Appendix III

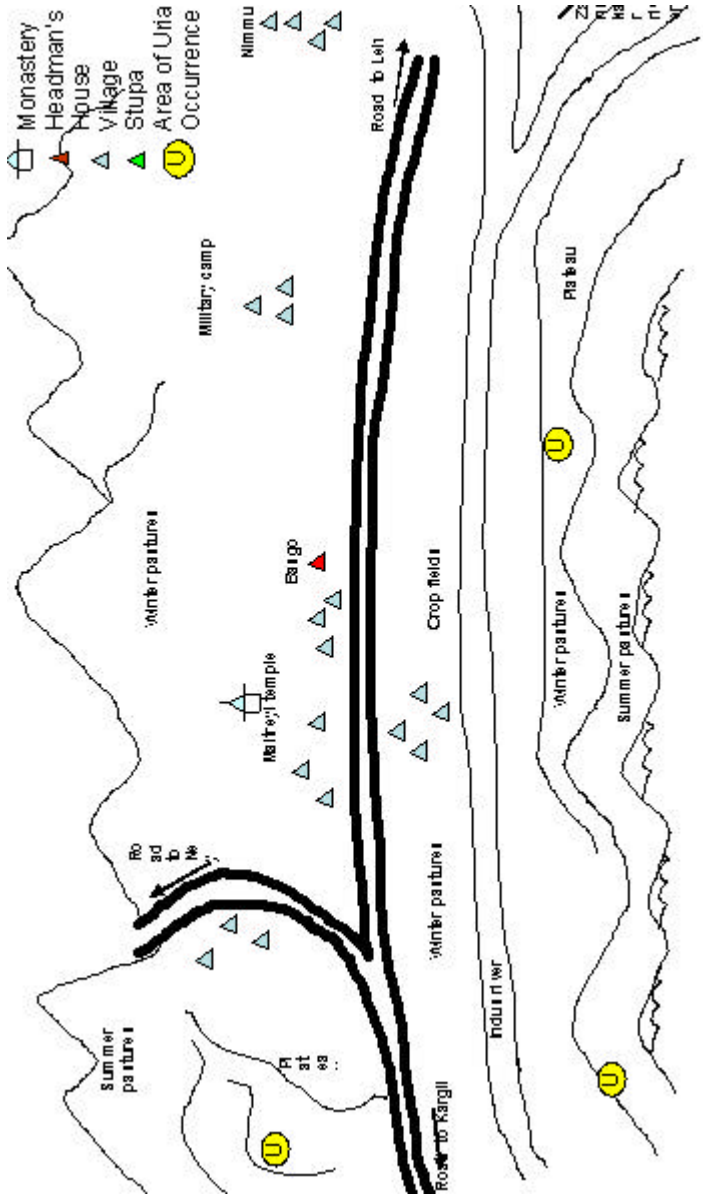
Resource Use Maps for Areas Visited in Ladakh- Nimmu ;

Drawn by or based on semi-structured interviews of local villagers)

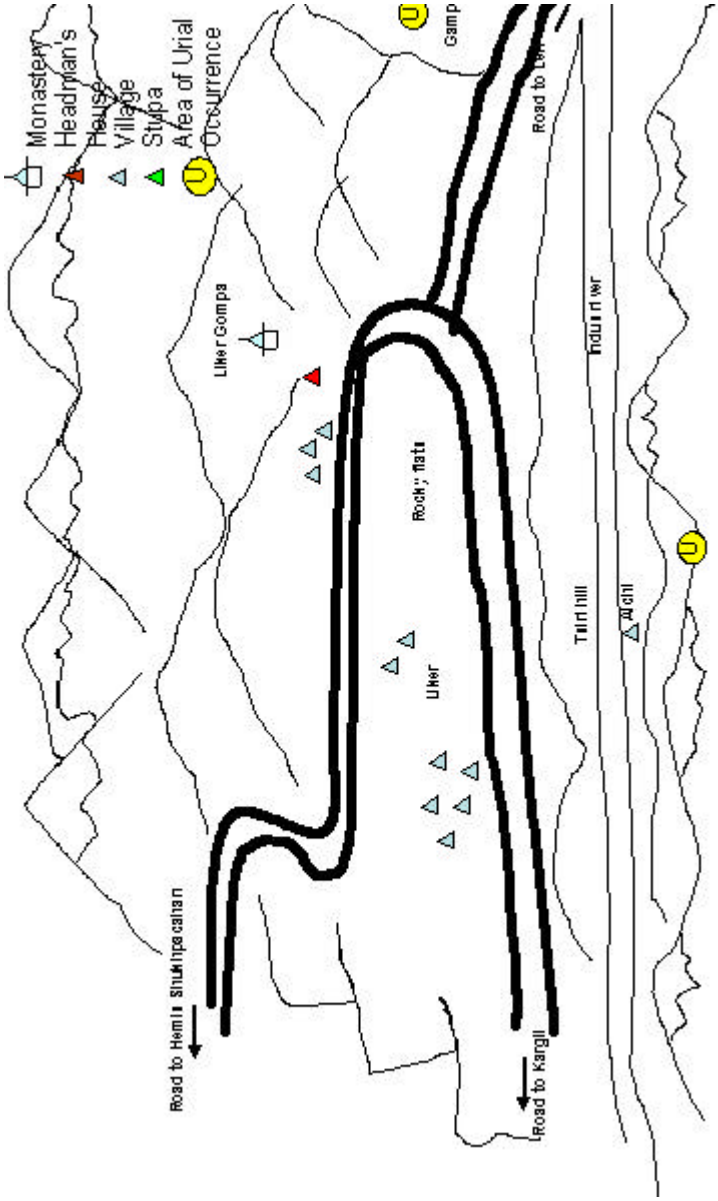


Resource Use Maps for Areas Visited in Ladakh- Basgo

(Drawn by or based on semi-structured interviews of local villagers (June-July 2002)

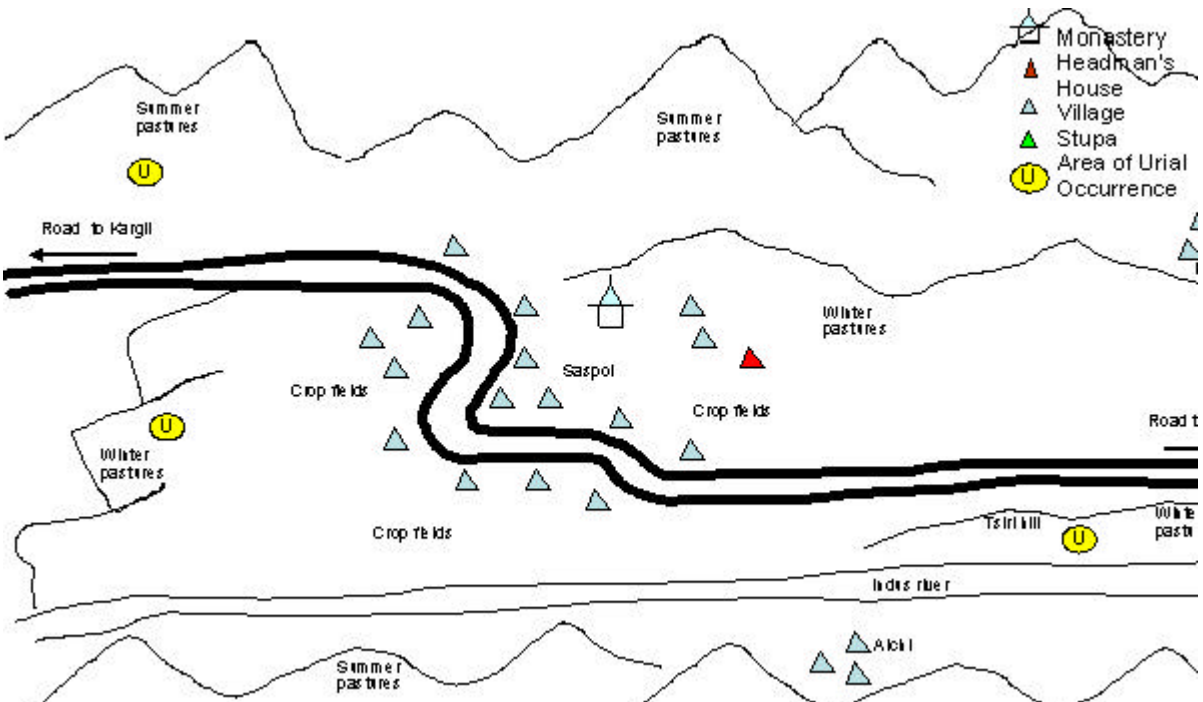


Resource Use Maps for Areas Visited in Ladakh- Liker
(Drawn by or based on semi-structured interviews of local villagers)



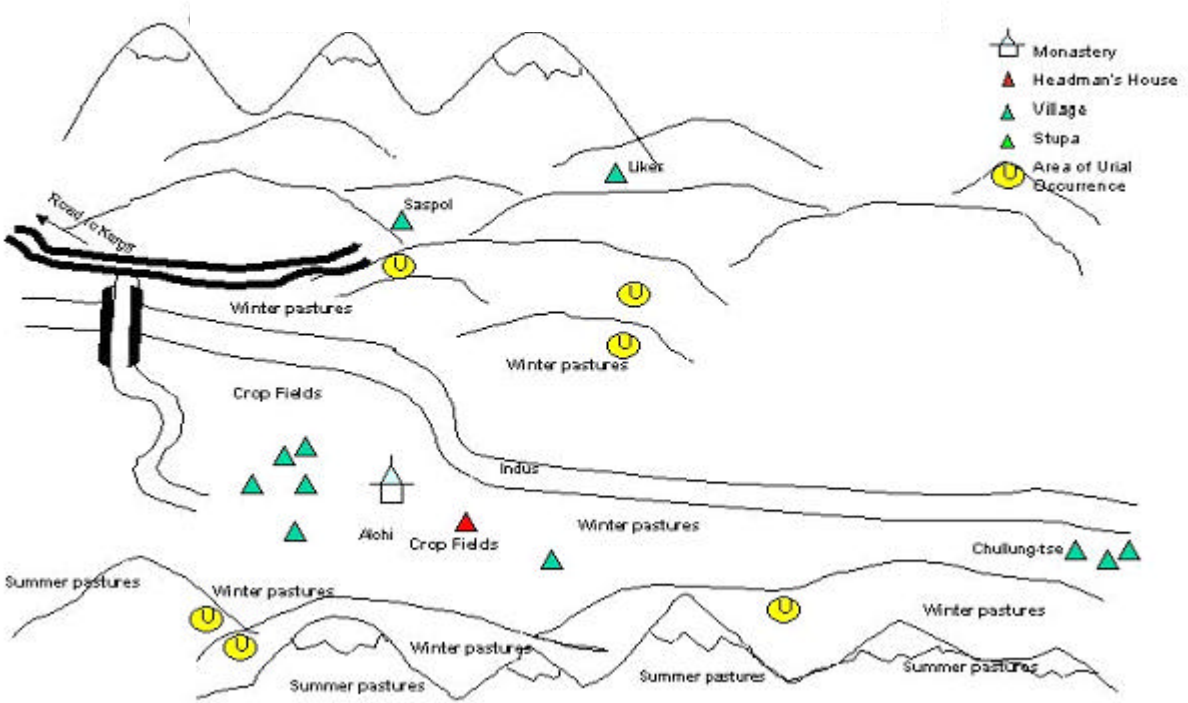
Resource Use Maps for Areas Visited in Ladakh- Saspol

(Drawn by or based on semi-structured interviews of local villagers)

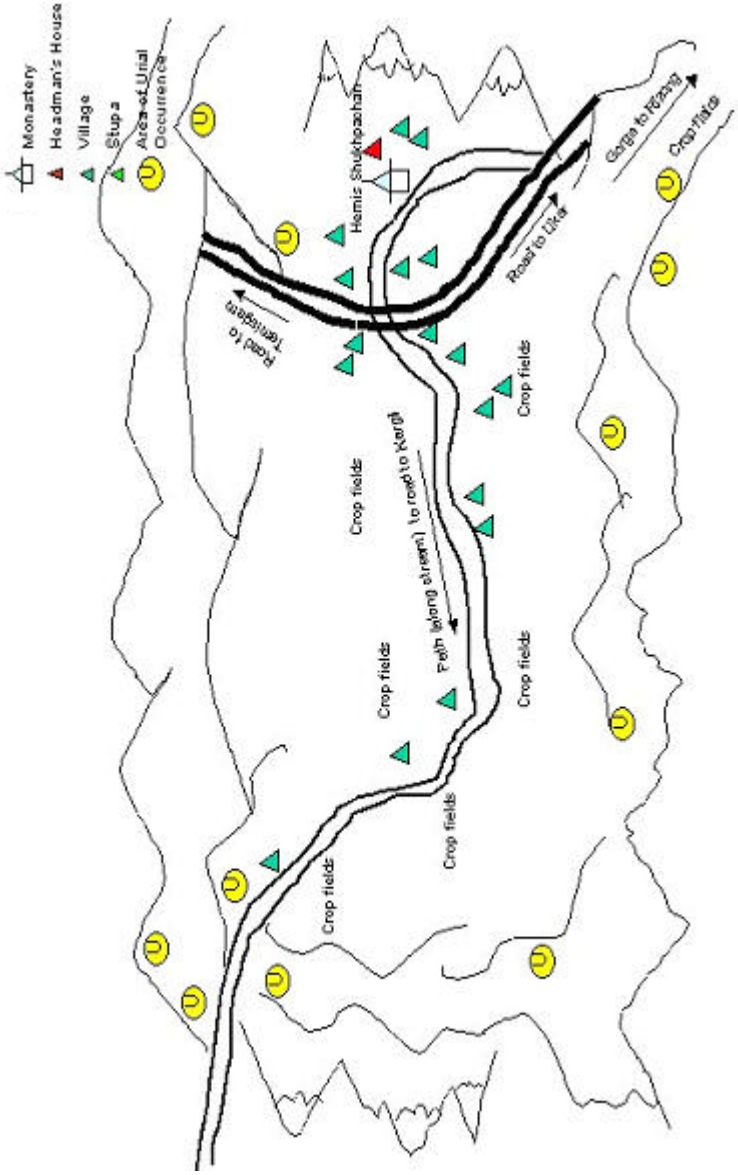


Resource Use Maps for Areas Visited in Ladakh- Alchi

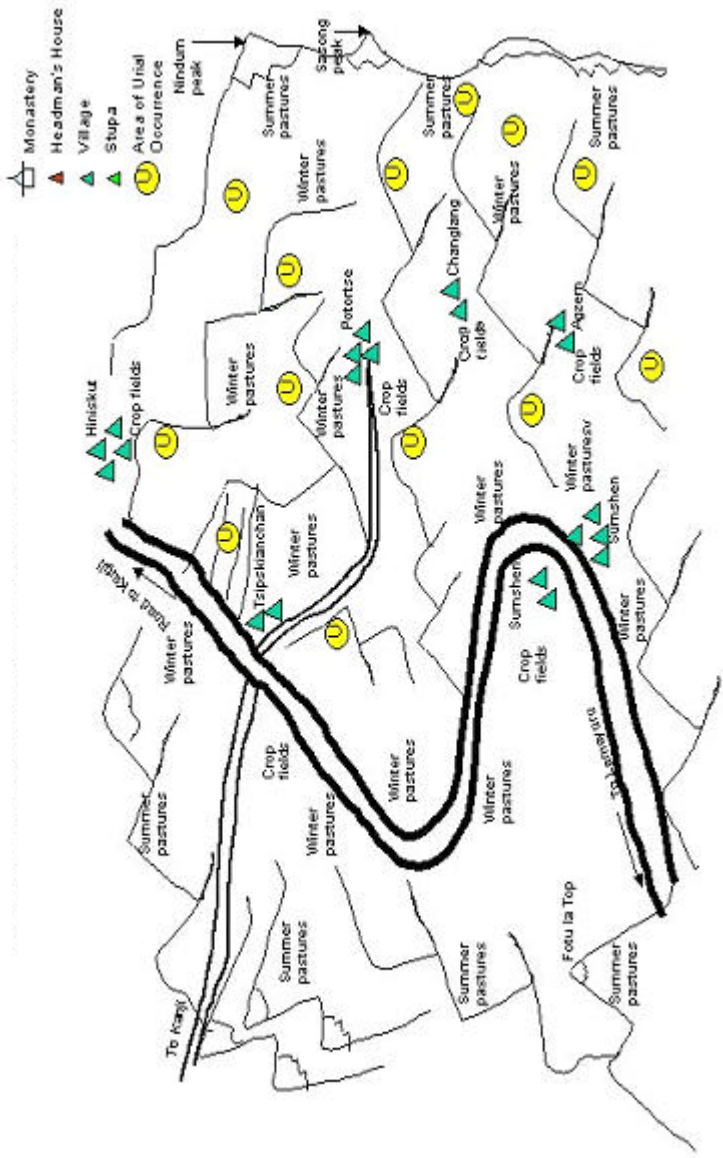
(Drawn by or based on semi-structured interviews of local villagers)



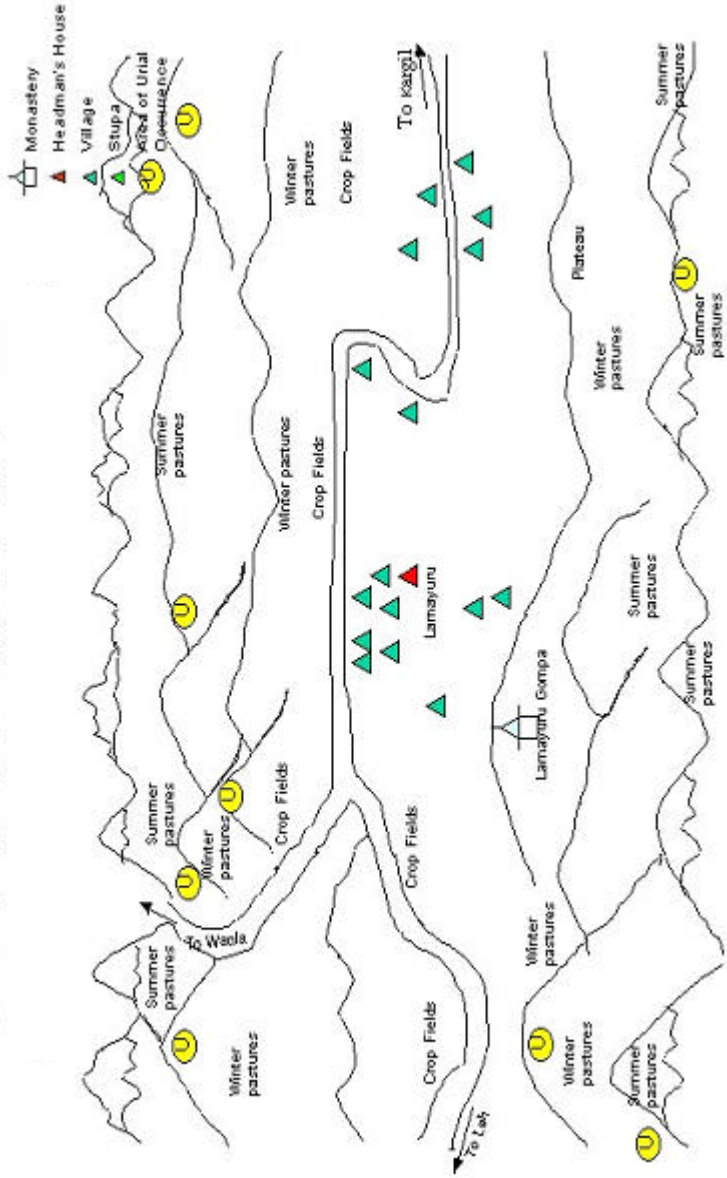
Resource Use Maps for Areas Visited in Ladakh- Hemis-Shukhpachan
(Drawn by or based on semi-structured interviews of local villagers)



Resource Use Maps for Areas Visited in Ladakh- Fotu la lok
(Drawn by or based on semi-structured interviews of local villagers)



Resource Use Maps for Areas Visited in Ladakh- Lamayuru
(Drawn by or based on semi-structured interviews of local villagers)



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The endangered Ladakh Urial has to compete with livestock for pasture resources in the Leh district of Ladakh Trans-Himalaya. A rapid survey estimated their numbers at being between 700 and 800 animals that faced threats, such as habitat loss and degradation in addition to resource competition.

Wildlife Trust of India

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