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A HIGH-ALTITUDE WILDLIFE SURVEY OF THE HONGU VALLEY

WITH SPECIAL EMPHASIS ON SNOW LEOPARD

by

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SUMMARY

The remote and uninhabited upper Hongu basin was thoroughly surveyed for wildlife, particularly snow leopard and large ungulates, in November 1986. No sign of either were found, although the valley offers potential habitat.

The survey indicated the grasslands were being fundamentally influenced by the grazing of livestock owned by a few Gurung families from Nerpa. Although tahr inhabit the inaccessible lower gorge, they are absent from upper alpine grasslands, a habitat used year-round in other parts of Nepal. The excessive numbers of livestock and disturbance during the brief summer period the valley is used by man precludes tahr habitation. Absence of snow leopard is attributed to an imbalanced prey base and human disturbance. There is no ecological reason why livestock, tahr, snow leopard and man cannot share the same valley. The primary requirements for this are reducing and controlling livestock grazing, encouraging return of the Himalayan tahr to provide a reliable year-round food source, and above all, involving affected families in the planning process. To this end, a number of specific recommendations have been made regarding future research, park boundaries and land-use activities.

The survey focussed on the snow leopard as a sensitive keystone species of the high Himalayan alpine zone. By protecting and managing for this carnivore, one ensures that a wide range of other plants and animals are also protected. Preserving biological diversity has been acknowledged as being one of the greatest challenges facing man as he seeks to meet his basic needs. The integration of conservation with development must receive the highest priority, if future generations are to experience a quality environment. Systematic evaluation of habitat and management options are key steps in the process.

By entertaining the proposal to increase the size of the Sagarmatha National Park, His Majesty's Government is making a sound investment for the future. The fact that fresh snow leopard sign was found in the nearby Dudh Kosi valley of the park augers well for the future, because the species has long thought to have been extirpated from the area. There is little doubt of the importance of recent increases in tahr and musk deer numbers in permitting snow leopard use. The reader is referred to the report titled, " A Survey of Sagarmatha National Park for the Endangered Snow Leopard" by Gary Ahlborn and Rodney Jackson, 1987 for further information.

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1. INTRODUCTION

There are few places as remote or hard of access in eastern Nepal as the high-altitude portion of the Hongu Khola. There are no villages above 10,000 feet, due to topographic and climatic limitations. The upper Hongu basin is approachable by only precipitous high altitude routes and is judged to be amongst the last remaining wilderness areas in eastern Nepal.

No trails penetrate the precipitous cliffs of the lower gorge. Rai villagers at the downstream mouth of the Hongu Gorge report it takes 5 days for experienced shikaris to cover distances of about 15 km. Primary access to the valley is from the west via the Mera La, or from the east via the Kal Pokhari Danda. The valley is isolated from adjacent areas beginning in early November until nearly the middle of June because of deep snow on the glaciers at the head of passes.

Because of its isolation and lack of human habitation, the Hongu basin was considered to be ideal habitat for the endangered snow leopard, a high mountain predator renown throughout the world for its rarity and its secretiveness. Over the last decade trekkers had repeatedly reported seeing snow leopard or their sign in the Hongu, in sharp contrast to nearby Everest (Sagarmatha) National Park where the last sighting considered as "reliable" was made in the early seventies (Jackson, 1979). There was, however, no way to assess the reliability of these reports because field techniques for detecting this carnivore had not yet been developed.

The first radio-telemetry study of snow leopard was undertaken by the authors in association with the Department of National Parks and Wildlife Conservation, beginning in 1982. A means for detecting the presence of snow leopards was developed as part of the 4 & 1/2 year research program. Against this background, the "Heart of the Himalayas Conservation Programme" requested a survey to determine whether the species indeed occurred in the upper Hongu Valley.

Access by foot into the upper Hongu Valley so late in the year by proved both unwise and impossible because of deep snow on the passes and unpredictable weather. Furthermore, the tight field schedule did not allow for the extra month it would take to walk in and out of the Hongu Valley. A helicopter of His Majesty's Government dropped us off with nearly 4 weeks of food and supplies at about 4,200 m, at the confluence of the Urpa Stream with the Hongu River. A pick-up occurred 3 weeks later, on November 25, 1986. We then undertook a survey of the Sagarmatha National Park.

This report summarizes the survey's findings and makes preliminary recommendations. The detailed scientific data of the survey will be incorporated into forthcoming publications addressing survey techniques and snow leopard conservation in Nepal. The reader is urged to consult the companion report on a similar survey that we conducted immediately following this study (see Ahlborn and Jackson, 1987).

2. SURVEY OBJECTIVES

(1) Determine whether snow leopards and large ungulates occur in the Upper Hongu Valley.

(2) Conduct a preliminary survey of the area's high altitude fauna, with special emphasis on rare species.

(3) Identify human activities of significance that may affect the areas' wildlife and recommend ways of maximizing co-existence between man and his environment.

(4) Recommend further research needs.

3. THE STUDY AREA

Topography

Considered to be one of the most remote valleys in Eastern Nepal, the Hongu Valley is surrounded by numerous peaks exceeding elevations of 6,000 m. With its headwaters along the southern slopes of Baruntse peak (7,220 m) and the well-known massif of Ama Dablam (6,856 m), the river flows almost due south for about 40 km until it turns south-west toward its confluence with the Inukla (Hinku) khola; both then feed into the Dudh Kosi due east of Salleri.

Best characterized as a wide U-shaped glacial valley, the Hongu Valley is bordered by precipitous peaks with numerous, and often large glaciers, some of which reach down to the valley floor. Peaks of significance in the upper Hongu are Chamlang (7,290 m), Chonku Chuli (6,809 m), Kantega (6,809 m), Peak 41 (6,654 m), Mera (6,437 m) and Naulekh (6,529 m). Although very narrow in its lower reaches, the Hongu Valley is surprisingly wide along its middle section. Above Urpa, at about 4,200 m the valley features extensive rolling grassy slopes, flanked by almost vertical peaks and cliffs. Even in this section several glaciers (such as those flowing off Chamlang) reach nearly to the valley floor.

The upper reaches, above 5,000 m, are a world of rock, glacier and moraine with very little vegetation and potential to support wildlife. This section is known as Panch Pokhari, because of the 5 glacial lakes present.

Vegetation Types and Wildlife Habitats

Several basic vegetation types, based on life-form rather than dominant species, were distinguished. These intermingled to a large degree, depending upon such factors as elevation, aspect, soil depth and moisture. Thus, it was frequently difficult to even distinguish between shrubland and grassland types. Extensive grasslands are found in the almost rolling topography of the upper basin, between elevations of some 4,100 and about 5,000 m; the total area of grassland and alpine scrub exceeds 25 km sq. The lower limit of grassland is situated at Urpa, with an elevation of 4,200 m. Downstream the valley narrows considerably and becomes heavily forested (pine and oak), especially at elevations below 3,500 m. Communities in this reach are species rich, especially in terms of shrubs and herbs.

Elevations of the vegetated, alpine portion of the valley surveyed ranged from about 4,100 m to around 5,500 m.

Alpine grassland: This vegetation type is dominated by a sedge, and is best developed on less steep slopes with well-profiled soils. Grassy sites are well interspersed with areas supporting a low shrub cover (see below) and areas where members of the Ranunculaceae appear to dominate (usually sites heavily disturbed by livestock grazing and trampling). Mesic conditions of the valley are indicated by a well-developed moss layer that is prevalent in less heavily impacted sites. Another indicator of the heavy precipitation the valley receives was the mat of grasses, sedges, shrub and wildflowers growing on the top of many boulders.

Alpine shrub: This community is dominated by low shrubs (usually 0.5 m or less in height), primarily bush cinquefoil (Potentilla fructicosa), and monotypic stands of semi-prostrate rhododendron (R. lepidotum or R. nivale). The evergreen shrublet Cassiope is also widespread. At higher elevations areas of scrub intergrade with grassland; shrub-dominated areas were seen up to 4,950 m. The present distribution of shrubland probably reflects the pervasive influence of man, and such modifying factors as livestock browsing and burning. The best developed stands of shrubland occur on cooler, moist north-facing slopes, along steep slopes bordering drainages and on cliff ledges inaccessible to man and livestock. Large stands of Juniperus indica and J. recurva have been burnt by shepherds seeking firewood.

Barren areas: Most of the land below 4,700 m or so is covered by vegetation, reflecting a high annual precipitation. Barren areas (sites with less than 10% plant cover), occur primarily above 5,000 m up to the zone of permanent snow and ice. At lower elevations, barren areas are found in association with landslides, the steep edges of water-courses, and along those steep upland slopes disturbed by domestic livestock.

Access

The following passes constitute the main routes into the valley:

- Mera La (5,415 m) from the west (Hinku valley)
- Kal Pokhari Danda (4,390 m) north of Kemba La, from the east (Arun)

In addition, there are a number of passes at the head of the valley that are used by mountaineers or the occasional trekking group. They can only be traversed by groups that are equipped for technical ice climbing and severe weather conditions. These are:

- Amphu Labtsa (5,780 m) from the upper Imja Khola of the Khumbu in the Chhukung area above Dingboche. This is an avalanche prone route leading to the Panch Pokhri area over the Amphu glacier.

- Mingbo La (5,817 m) from the lower Imja Khola near Pangboche, which traverses the Nare and Hinku Nup glaciers across a shoulder of Ama Dablang.

- West Col (6,135 m), which provides access to the Lower Barun Glacier via the Hinku Glacier, or the main Barun Glacier via Sherpani Col (6,110 m) as well.

Land-use

The upper Hongu Valley is neither cultivated nor permanently inhabited by man. The primary use involves summer grazing of large herds of sheep and a few chauris or yaks during the monsoon and very early fall. The pastures (kharkas) are controlled by the Kulunge Rais who live in villages situated at the downstream entrance to the Hongu gorge, at elevations of around 3,000 m. One of the Rai clan groups at Chhemsing-Chheskam leased the primary grazing areas above Urpa to the Gurungs of Nerpa (McDougal, 1979). The lease, valid for a period of 20 years, was made in the mid-sixties. In addition, some yaks are brought by Sherpa families to the upper reaches of the Hongu (above Chamlang), with others being taken to small high altitude pastures in Watelma Dranka, a tributary located immediately above the gorge section. The central section is too steep and heavily forested for grazing animals. Since the access passes are so high, livestock can only be moved in and out for a few months of the year, from about late June through early October.

Other human activities that probably occur in the area are the collection of medicinal herbs and presumably hunting of wildlife. The valley is visited by the occasional trekking group or climbing party, especially during the months of October and November.

4. METHODS

The following techniques were used to assess the wildlife:

(1) Systematic searches (along pre-defined transects) of key topographic features (such as well-defined ridgelines, cliffs and stream confluences) for sign of snow leopard, including scrapes, feces, tracks (pugmarks) and scentings.

(2) Wide-ranging searches (incidental observations) for the sign of snow leopard and potential prey species such as tahr, domestic livestock, small rodents and large game-birds.

(3) Application of a habitat suitability model (Jackson and Ahlborn 1984) to determine the potential of the area to support snow leopard over the long-term.

In addition, important environmental parameters were sampled in order to characterize the available habitat. We maintained lists of the bird and mammal species encountered, and recorded incidental observations on such aspects as land-use, habitat types and vegetation.

As the survey was undertaken in late fall, information on the avifauna and plants in the area is obviously very incomplete. Seasonal lateness was the main factor accounting for the fact that we sighted no reptiles during the survey.

For a detailed account of the methods used see Jackson and Ahlborn (1986) and Ahlborn and Jackson (in press).

5. FINDINGS:

The area intensively surveyed totalled more than 50 square kilometers, of which about a half was grass or shrub covered. It encompassed those sections of the Hongu between elevations of 4,000 m (a point about 1.25 km below the Urpa temporary encampment) and 5,200 m (at a point opposite and slightly upstream of Chamlang Peak). This constitutes about 70% of the length of the upper Hongu, and the bulk of the area most likely to support alpine wildlife. Figure 1 indicates the survey area and location of the snow leopard sign transects.

(1) No evidence of use by snow leopard was found despite an intensive search.

We searched all likely parts of the Upper valley between elevations of 4,200 and 5,200 m (and along a 10 km stretch) for snow leopard sign. A total of 39 transects, ranging in length from 130 - 990 m, and comprising a combined distance of 21.4 km were run. The average length of a transect was 560 m and they were situated between elevations of 4,132 and 5,070 m, along slopes that ranged between about 5 and 56 degrees. The primary objective was to locate and run transects along topographic features most often used for travelling by snow leopards (and consequently most likely to be marked), according to detailed information gathered from radio-tagged snow leopards in the Langu Valley of west Nepal. In

addition numerous other areas were checked for incidental sign, and all major trails in the valley were walked, often at intervals of a few days. No sign was found that could be attributed to snow leopard.

Snow leopards mark most intensively during the mating season between late December and early April. Thus much sign could have been destroyed by the monsoon rains. However, the likelihood of finding at least a few scrapes under overhanging rocks (which are protected from the elements and favored by leopards for resting and marking at) is high. Also, one would expect to find at least the odd scat.

While the absence of snow leopard cannot be proven -- for it is conceivable that sign could have been missed -- we believe it very unlikely that snow leopard currently inhabit the Hongu Valley. For one thing, there is insufficient prey to support even a single cat year-round, and the area is heavily disturbed by people and their livestock during the summer. Other adverse factors in terms of snow leopard habitation are described below.

Results of the habitat sampling and model application will be published in a forthcoming paper.

(2) The alpine portions of the Hongu Valley are heavily used by domestic livestock during the monsoon.

Despite no permanent human habitations, the upper Hongu Valley is obviously heavily impacted by man. Throughout the seemingly lush grasslands above 4,100 m we found abundant evidence of heavy summer-time use by grazing animals, in particular sheep. Although no livestock or people were in the valley during the survey (sign suggested they had departed about a month earlier), the following observations indicate large herds of sheep and some yaks and cross-breeds use the upper Hongu seasonally:

- Grass cover had been closely cropped and more palatable grasses appeared to have been largely replaced by a variety of forbs and herbaceous plant species. This trend was especially evident in the more gently sloping areas near temporary encampments (holding areas).

- Hedging or pruning of shrubs due to heavy browsing pressure was evident in many parts of the valley; in places, the herbaceous plants had been almost completely consumed by domestic stock.

- Stands of prostrate juniper have been burned and killed to provide a source of firewood.

- Numerous livestock trails traversed the entire valley and there were dozens of crude stone shelters (goths) to house the Gurung shepherds, as they moved about the area. Several abandoned shelters were located on narrow grassy ledges above cliffs, an index of heavy use to which the area is put. Thick layers of fecal pellets covered the soil surface in the immediate vicinity of all shelters that showed sign of having been used in recent years; vegetation in these sites was particularly altered.

- Ample evidence of soil erosion and recent landsliding or slumping existed, especially in the steeper side-drainages that occur along the length of the Hongu valley. We believe much of this activity can be attributed to the heavy trampling by sheep, the removal of ground cover and the burning of shrubland by people in an effort to increase the amount of forage available.

(2) No evidence was found to indicate the upper valley is used by wild ungulates, such as the Himalayan tahr or bharal (blue sheep).

Despite a concerted effort, we could find no evidence that the high elevation grasslands and associated cliffs are used by any native ungulate species. Besides examining areas where livestock penetrated, we also visited sites inaccessible to them. No pellets, tracks, bedding sites, or skin or skeletal remains were found in the expansive, rolling grasslands and cliff areas above 4,000 m.

As the lower, very precipitous portions of the Hongu are known to support Himalayan tahr (Hemitragus jemlahicus), one would expect to find at least their sign along the cliffs and steep gullies that border the grasslands of the upper Hongu. In the Himalaya, tahr are known to range from the temperate to the alpine zones, or between elevations of about 1,500 and 5,200 m. While they are found in a variety of habitats, from juniper - caragana - rhododendron scrub to oak and pine forest and alpine grassland, tahr are rarely found far from cliffs, especially where disturbed by man. Schaller (1977) considered them to be the "quintessential goat". For information on their habitat preferences, see Schaller (1977), Green (1978) and Shah (in prep).

Cliffs, steep-sided gullies and rocky morainal deposits occur along both edges of the Hongu Valley for much of its length; in several places the valley widens out considerably and is best described as "rolling uplands", but even here there are cliffs within several kilometers. The Langtang tahr were reported to graze more than they browsed (Green 1978). Thus the upper Hongu appears to provide suitable forage for tahr. The Hongu's higher elevations and greater potential for more enduring winter ground snow cover could limit tahr use during winter, as compared to alpine habitat used by the species in Langtang. Even if deep snow precludes winter use -- and we have no evidence that the entire area is snow-bound -- one would expect some tahr at least to move up during monsoon months to utilize the abundant forage resources.

In Langtang National Park, substantial numbers of tahr spend the entire year living in or near alpine grassland, above elevations of 3,500 m (Green 1978), while those in Sagarmatha National Park travel distances of at least 7 miles in summer to reach high elevation pastures less heavily used by domestic stock (Mingma Norbu Sherpa, pers. comm.). These pastures are many miles from the nearest forest. During winter the tahr descend to about 11,000 feet, seeking shelter along forested slopes, particularly those with a southern aspect (places where snow melts rapidly and temperatures are generally much milder than slopes with more northerly aspects). The use of tree habitats may be related to the animal's need for thermal cover (used to ameliorate the effects of adverse weather conditions), although tahr in Langtang remain on grassy or shrubby cliffs year-round.

At least 10% of the alpine area surveyed could provide winter habitat for tahr, even during severe winters. These sites consist of steep south-facing slopes (that shed snow and promote a more rapid snow-melt than other aspects or landforms), but with sufficient feeding and escape cover. It is unlikely that winter snow-cover explains the absence of Himalayan tahr from the upper Hongu. There are no natural barriers to prevent tahr from dispersing up the valley, from the population concentrations in the lower gorge. However, they would be very vulnerable to human disturbance, and we strongly suspect that the large numbers of livestock and people in the valley during the summer is the primary factor precluding tahr occupation of the high elevation grasslands or cliff habitat. While the cliffs provide adequate escape cover from typical mammalian predators as wolf and snow leopard, the tahr would find it difficult to escape from humans determined to displace them in favor of livestock.

Superficially at least, the upper Hongu represents more suitable habitat for blue sheep or bharal (Pseudois nayaur) than tahr. Bharal live above the timberline and show a strong preference for moderately to steeply rolling terrain broken by cliffs and sharply defined ridges, gullies or drainages. They feed on grasses, forbs and low shrubs growing on the rolling hills, retreating to cliffs in times of danger. Although bharal are essentially restricted to the Tibetan Plateau, they have penetrated the Himalaya in many places (particularly in West Nepal and India), by moving through river gorges that penetrate the higher massifs.

While we do not know if bharal historically occurred in the valley, several factors would tend to suggest otherwise. Animals would find it difficult to penetrate the high ranges bordering both sides of the valley, and an exceptionally severe winter could conceivably eliminate or drastically reduce numbers --

critical in a founder population; furthermore, bharal would be as vulnerable to human disturbance as tahr. Except for Tibet, the nearest known bharal populations are in the Lapche Kang (Rolwaling), some 70 km west and the Kanchenjunga, nearly 100 km to the east.

(3) The prey base of the upper Hongu Valley is insufficient to support resident or even transient snow leopards during all seasons of the year.

The biomass of the Hongu consists largely of migrant livestock that occupy the area for only a few months of the year. Game birds, like the Tibetan snow cock (Tetraogallus tibetanus) or snow partridge (Lerwa lerwa) are relatively scarce. The only numerically abundant "native" herbivores are small rodents, pikas (Ochotona roylei) and especially voles (probably Alticola spp), who appear better able to exploit habitat disturbed by livestock. Such food items are obviously unsuitable for a large predator like the snow leopard to subsist upon, as indicated below. Equally important, any cat attempting to live off domestic sheep would be the target of intensive searches by the angry owners, who would either chase it from the area or kill it. At the very best, a snow leopard would be able to subsist in the Hongu only during the few months that domestic sheep are present.

In the Langu Valley, Jackson and Ahlborn (1984) estimated that an adult male snow leopard would require about 20 - 30 bharal (weighing an average of about 60 kg) per annum. The requirements of a female raising cubs would be greater, particularly after the cubs are travelling with their mother (between ages of about 3 and 18 months). These authors estimated that a population of about 150 - 230 bharal would be required to support one adult snow leopard, given the existing age and sex composition of the Langu herds and an overall harvesting rate of 13% of the standing crop.

Attempts to subsist off pikas and voles would be ecologically unwise: simply to equal the amount of meat provided by the average bharal, a cat would have to consume at least 1,125 voles or 164 pikas! Placed in another perspective, captive snow leopards are fed 1.3 - 2.0 kg of meat per day; this feeding rate is equivalent to a daily intake of at least 30 voles or 5 pikas.

No information has been published on the density of voles or pikas in the Himalaya. Smith et al. (1986) reported densities of over 100 animals per hectare during the peak period of the year (June - July) for the extremely social black-lipped pika (Ochotona curzoniae) of the Qinghai-Xizang Plateau in China. These authors studied a population characterized by discontinuous pockets and locally high concentrations of animals that inhabited highly productive, flat grasslands. Home range size was estimated at about 1,113 m sq. Like the North American species (O. princeps), the Himalayan pikas (for example O. royalei) are unsocial and presumably occur at similar densities (8 - 15 per hectare). However, given the characteristically spotty distribution of pikas, a cat would have to cover a relatively large area and harvest a relatively large percentage of the pikas present to be able to subsist upon them. The energy expended in searching for pika enclaves and then catching individuals from an increasingly wary population would likely exceed calorific input. Even more importantly, pikas are only available to snow leopard during those seasons that they were active above ground. Pikas spend the winter in protective rock-piles, subsisting off vegetation cached during the summer and fall. A strategy of relying upon large game birds as the principal prey item is likely to be equally uncertain, as they are unlikely to provide sufficient biomass to support such a large predator. As far as snow leopards are concerned, small prey items like pikas and game birds seem to serve as "snacks" between the main subsistence meals provided by bharal, tahr or other large ungulates.

The only mammalian predator of significance in the Hongu is the red fox, Vulpes vulpes. Their fresh tracks and feces were regularly found throughout the valley. A few large feces were collected, that could belong to the wolf (Canis lupus), or more likely the domestic dog. A large canid would not have a much easier time making a living than a snow leopard, and one would expect the wolf to turn out to be an occasional visitor to the valley. In general, the terrain is more suited to this coursing predator than

to snow leopard, which slowly stalks its prey by making use of rock or vegetative cover to get close enough for a final rush.

(4) The Hongu Valley is strongly isolated from other population pockets of snow leopard.

The upper Hongu is not located close to any dense leopard populations. There are few passes leading into the valley, and only "determined" individuals would attempt to cross the high glaciers and snowfields separating the upper Hongu from adjacent habitat in the Khumbu or Arun. Then, having crossed in, the cat would have to find sufficient prey.

Few of the surrounding areas have been adequately checked for snow leopard presence. We found strong evidence that the cat has recently visited the Gokyo area of the Sagarmatha National Park, about 25 km to the northwest. Reliable sightings of the cat in this park have not been made for at least 10 years, and the species was thought to be extirpated from the Everest area. The relatively dense and permanent prey base of the Sagarmatha National Park is not coincidental to the likely presence of snow leopard there. Due to protective measures afforded by the Department of National Parks and Wildlife Conservation and a virtual cessation of hunting by local residents, numbers of tahr and musk deer have increased dramatically in recent years. For more information see the report titled, "A survey for snow leopard in the Sagarmatha National Park", submitted to the Department of National Parks and Wildlife Conservation.

Given continued protection, and assuming no adverse sentiment or action on the part of Sherpas residing in the Park, we would expect a small snow leopard population to establish itself in the area over the next decade. This could serve as a founder population for the Hongu, assuming similar changes occur there as well.

(5) There is suitable habitat for snow leopard in the Hongu Valley.

The upper Hongu Valley provides limited habitat from a landform view-point. Studies elsewhere have indicated that snow leopards show a strong preference for cliffs, steep slopes, and barren sites (Jackson and Ahlborn, 1986; Fox et al. 1986).

In the Hongu, small pockets of cliff and other broken terrain are interspersed with expansive tracts of even slopes. The greater the interspersion of broken areas with grassy, even-sloped terrain, the more suitable it is for snow leopard and their prey.

Our search was concentrated in habitat elements known to be preferred by snow leopard for marking. The Hongu differs from the Langu largely in terms of the having fewer cliffs, more smoothly-sloping terrain, and a lower degree of interspersion between the two basic types of landform.

In terms of vegetation, the Hongu valley contains substantially more alpine grassland than the Langu, which is sparsely vegetated.

In general, the Hongu appears more suited to wolf than snow leopard, as mentioned above. Some researchers have suggested that snow leopards and wolf could co-exist only if there were sufficient broken area to provide cover for the snow leopard.

(6) Species richness of the alpine zone in the Hongu is likely to be depressed as a result of human impact.

Evidence obtained during the present survey suggests that the alpine zone of the Hongu Valley is too disturbed by man to presently support unusually diverse bird or invertebrate faunas, as exists in the Arun forest ecosystem.

This does not mean the upper Hongu is "worthless" from a biological viewpoint. For one thing, the substantial expanse of alpine grassland and scrub is unusual for the region. Investigations may show that there are numerous species of medicinal plants in the area, which are a rapidly declining resource throughout the Himalaya. Furthermore, by lowering grazing pressures, many species now rare would be expected to increase in abundance leading to an increase in species richness over time.

The sighting of the rare Tibet owlet was of particular interest. It indicates that this Tibetan species has penetrated more mesic high-elevation habitat. Previous records were from the arid and semi-arid Mustang and Dolpo regions of Nepal.

6. RECOMMENDATIONS

(1) A summer-time interview and field survey should be conducted as soon as possible to assess the extent of livestock use and to seek acceptable ways of reducing the numbers of livestock over time, or even possibly eliminating such use patterns.

It is our impression that grazing patterns are approaching a point where continued use at present levels is very likely to result in adverse, possibly permanent environmental degradation, including erosion and landsliding along drainage edges. The economic and social impact of reducing or eliminating domestic stock from all or parts of the upper Hongu may be minimal, since few families appear to be involved in the lease-holds. Furthermore, these are due to expire soon according to McDougal (1979).

It is strongly recommended that the options for future management of the high-altitude grasslands should be thoroughly explored at this critical juncture in time. It may be politically feasible, for example, to progressively reduce the number of sheep over the next 5 - 10 years, then to eliminate the practice once alternative forms of employment are available to the affected families. Outright purchase of the leases may be the cheapest option over the long-term. The Gurung lease-holders live many miles from the pastures, and strong arguments could be made that it is in the best interest of the villagers living in the Hongu's watershed that the numbers of sheep be regulated. At the very least the herds should be maintained within carrying capacity, to prevent undesirable environmental degradation such as soil erosion and downstream flooding.

As indicated, reduction or elimination of grazing would benefit wild ungulates and may permit snow leopard to eventually inhabit the valley.

(2) A summer inventory of birds, mammals, reptiles, invertebrates and plants should be undertaken in conjunction with the livestock survey.

We were unable to provide much information on the other wildlife of the upper Hongu: the survey was conducted during the season of least use by avifauna and at a time when almost no plants could be identified to species level. Furthermore, no small mammal trapping and collecting was undertaken.

(3) A Landsat-based habitat map should be generated.

This would prove invaluable in future surveys and in long-term management and protection of the Hongu and adjacent areas.

There is no reason why a habitat map could not be relatively inexpensively and easily generated, given the few habitat types present. Steep slopes and cliffs would affect spectral separation, but good topographic maps exist for identifying the location of features such as cliffs, moraine and major landslides. A map indicating the location and extent of rangelands in the basin could be used as a basis for delineating grazing zones and the monitoring of impacts over time.

(4) The southern boundaries of the proposed addition should be placed as far down the Hongu Gorge as practical.

This is recommended in order to encompass more of the relatively pristine forests of the inaccessible parts of the Hongu Gorge, and to afford better protection to the herds of tahr that inhabit the cliffs in this reach. These animals provide the founder herd for future occupation (hopefully natural) of the upper portions of the valley.

The middle portion of the Hongu Gorge is unlikely to receive strong pressure from villagers seeking to expand their fields or fuelwood supplies, in view of the extremely steep slopes, limited southerly aspects and very difficult access. Along much of the lower gorge, there appears to be only a very narrow alpine grassland band and that is probably largely inaccessible to livestock. Exceptions are the larger tributaries identified as Sogowa and Mangan, and Watelma Dranka on the 1979 Schneider map series. Special rights for current users may be necessary to mitigate for changes on land ownership.

It should be stressed that this part of the Hongu seems to be very significant in terms of local tahr populations. Relatively low elevations, steep slopes, presence of some warmer southerly aspects, and an abundance of cliffs add up to good tahr habitat, especially during very harsh winters when deep snows can affect tahr numbers for years to come.

(5) Unlike the Barun, mountaineering does not appear to be a major environmental problem at the present time.

There is little juniper or other shrub in the valley, and therefore little fuelwood or deforestation problems. Expeditions have, however, left a large amount of litter behind.

7. SIGNIFICANCE OF THE HONGU BASIN'S ALPINE HABITATS

The vast grasslands and associated habitats of the upper Hongu valley are worthy of special protective measures for the following reasons:

(1) Alpine grassland habitat in the Himalaya is intrinsically fragile and sensitive to human impact.
(2) This habitat type has been greatly modified and degraded throughout the Himalaya as a result of unregulated domestic stock grazing.
(3) There are very few pastures in eastern Nepal as large as this that lack permanent human habitation, and could exemplify pristine alpine conditions once rehabilitated. This would occur with minimal social or economic cost.
(4) This area could provide significant habitat for large ungulates like the Himalayan tahr. With sufficient large prey, snow leopard could be expected to "return".

(5) Once degraded, it would be both difficult and extremely expensive to re-create pristine conditions. The Hongu appears to be at the watershed in terms of human impact.

8. USING THE SNOW LEOPARD AS A KEYSTONE SPECIES:

Conservation Biology has been defined as the science of "Scarcity and Diversity", with the primary problems of maintaining the vigor of specific target species (usually keystone species like the snow leopard), identifying the numbers and composition of a "minimum viable population", minimizing the far-reaching effects of habitat fragmentation, maximizing species diversity, integrating human activities within limits imposed by "real-world" ecological processes, and promoting the establishment of ecologically sensitive management institutions and plans (Soule, 1986).

Keystone species are defined as those that play a prominent role in a community or that serve as a sensitive biological barometer to change. The snow leopard, occupying the apex of the alpine food pyramid (with man), is characterized by a need for relatively large home ranges, an abundant supply of large prey animals (herbivores), and a low tolerance for disturbing factors such as hunting (of itself or its prey), overgrazing by livestock (which complete with wild animals like the tahr for forage), or excessive human activity. The axiom that "where there are snow leopard, the alpine habitat is in good shape" generally holds true. By protecting and managing for this carnivore, one ensures that a wide range of other plants and animals are also protected i.e. biological diversity.

The systematic evaluation of habitats and areas is a crucial step in the planning process. Wildlife biologists have increasingly recognised the need to develop standardized methods for inventory and evaluation (Usher, 1986). Basic information needs are:

(1) Information on animal (and plant) diversity and distribution.
(2) Habitat definition and life history requirements.
(3) Species habitat relationship models.
(4) Habitat availability and quality (inventory).
(5) Habitat location.
(6) Habitat responses to alternative management (land-use) practices.
(7) A decision-making system that facilitates selecting the best land-use practice based on preferred resource objectives.

While these may appear to be long-term goals, we highly recommend that the process be initiated immediately in planning for the "Heart of the Himalayas Conservation Programme". Wildlife of the proposed Tibetan (Chinese) and Nepalese parks should not be viewed in isolation. It is hoped that the park authorities will designate the snow leopard as a species of special importance, and co-operatively manage populations in the region as a single, integrated unit.

9. CONCLUSIONS

The Hongu grasslands represent only a portion of the wide biological diversity contained in the mountains encompassed by the Heart of the Himalayas Project. The World Conservation Strategy formulated by IUCN and other agencies called biological diversity "both a matter of insurance and investment .....a buffer against harmful environmental change and as the raw material for much scientific and industrial innovation, and a matter of moral principal". By entertaining the proposal to increase the size of the Sagarmatha management unit, His Majesty's Government is making a sound investment for the future.

This survey suggested that the grasslands of the upper Hongu are being fundamentally influenced by livestock of relatively few families. In our opinion, the absence of tahr from the upper valley is the result of excessive livestock numbers and disturbance during the brief summer period the area is used by man. The absence of snow leopard can be attributed to an imbalanced prey base and human disturbance. There is no ecological reason why livestock, tahr, snow leopard and man cannot share the same valley: the primary requirements for this to occur are:

(1) Involve the lease-holders and lessees in the planning process at the earliest opportunity, in order to obtain their cooperation,
(2) Reduce the numbers of livestock using the valley over time,
(3) Regulate grazing patterns and ensure sensitive sites are protected from grazing until they recover sufficiently, and
(4) Seek means of encouraging tahr use of the grasslands.

These actions require further information: interviews and field surveys during the summer are the only means of filling the data gaps identified above.

Beside the biological reasons for rehabilitating the wildlife of the Hongu Valley, there are other reasons to be considered in encouraging snow leopard to return. The snow leopard stands as an internationally renowned symbol of the high Himalaya, and a sensitive barometer of a healthy alpine ecosystem.

The fact that fresh snow leopard sign was found in the nearby Dudh Kosi valley of Sagarmatha National Park augers well for the future, because the species was long thought to have been extirpated from the area. There is little doubt of the role played by the recent increase in tahr and musk deer numbers in permitting snow leopard use of the parkland.

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APPENDIX

List of Bird Species Observed (4 - 25 November, 1986)

Common Name	Scientific Name
Upland buteo	Buteo hemilasius
Himalayan griffon	Gyps himalayensis
Lammergeier	Gypaetus barbatus
Hen harrier	Circus cyaneus
Pied harrier	C. melanoleucos
Eurasian kestrel	Falco tinnunclus
Tibetan snowcock	Tetraogallus tibetanus
Snow partridge	Lerwa lerwa
Solitary snipe	Capella solitaria
Snow pigeon	Columba leuconota
Tibet owlet	Athene noctua
Red-billed chough	Pyrrhocorax pyrrhocorax
Yellow-billed chough	P. graculus
Raven	Corvus corax
Grandala	Grandala coalicolor
Black redstart	Phoenicurus ochruros
Guldenstadt's redstart	P. erythrogaster
White-throated redstart	P. schisticeps
Winter wren	Troglodytes troglodytes*
White-throated dipper	Cinclus cinclus
Brown dipper	C. pallasii
Alpine accentor	Prunella collaris
Rufous-breasted accentor	P. strophiata
Himalayan goldfinch	Carduelis carduelis
Red-breasted rose finch*	Propyrrhula subhimachala
Rock bunting	Emberiza cia

* Several species of rose finch were seen, but not identified.

List of Plants Observed (above 4,200 m only)

The following list indicates plants observed during the survey. Given the time of year, we were not able to identify most to species level. A question mark indicates an uncertain record. A small collection of grasses is being presently identified.

Ranunculaceae:

Aconitum
Aquilegia
Ranunculus
Anenome

Papavereraceae

Meconopsis

Cruciferae

Draba
Erysimum

Violaceae

Viola

Caryophyllaceae

Arenaria
Stellaria
Silene

Tamaricaceae

Myricaria

Geraniaceae

Geranium

Leguminosae

Trifolium
Thermopsis
Astragulus

Rosaceae

Cotoneaster ? microphyllus
Fragaria
Potentilla fructicosa

Saxifragaceae

Saxifraga

Crassulaceae

Sedum

Umbelliferae

Heracleum

Dipsacaceae

Morina

Compositae

Anaphalis
Cirsium
Aster
Tanacetum
Senecio
Saussurea
Cirsium ?
Crepis

Ericaceae

Cassiope ? fastigiata
Rhododendron lepidotum
R. nivale

Primulaceae

Androsace
Primula

Gentianceae

Gentiana

Boraginaceae

Arnebia

Scrophulariaceae

Lagotis
Pedicularis

Labiateae

Phlomis
Ajuga ?

Polygonaceae

Bistorta
Rheum
Rumex

Cupressaceae

Juniperus indica
J. recurva

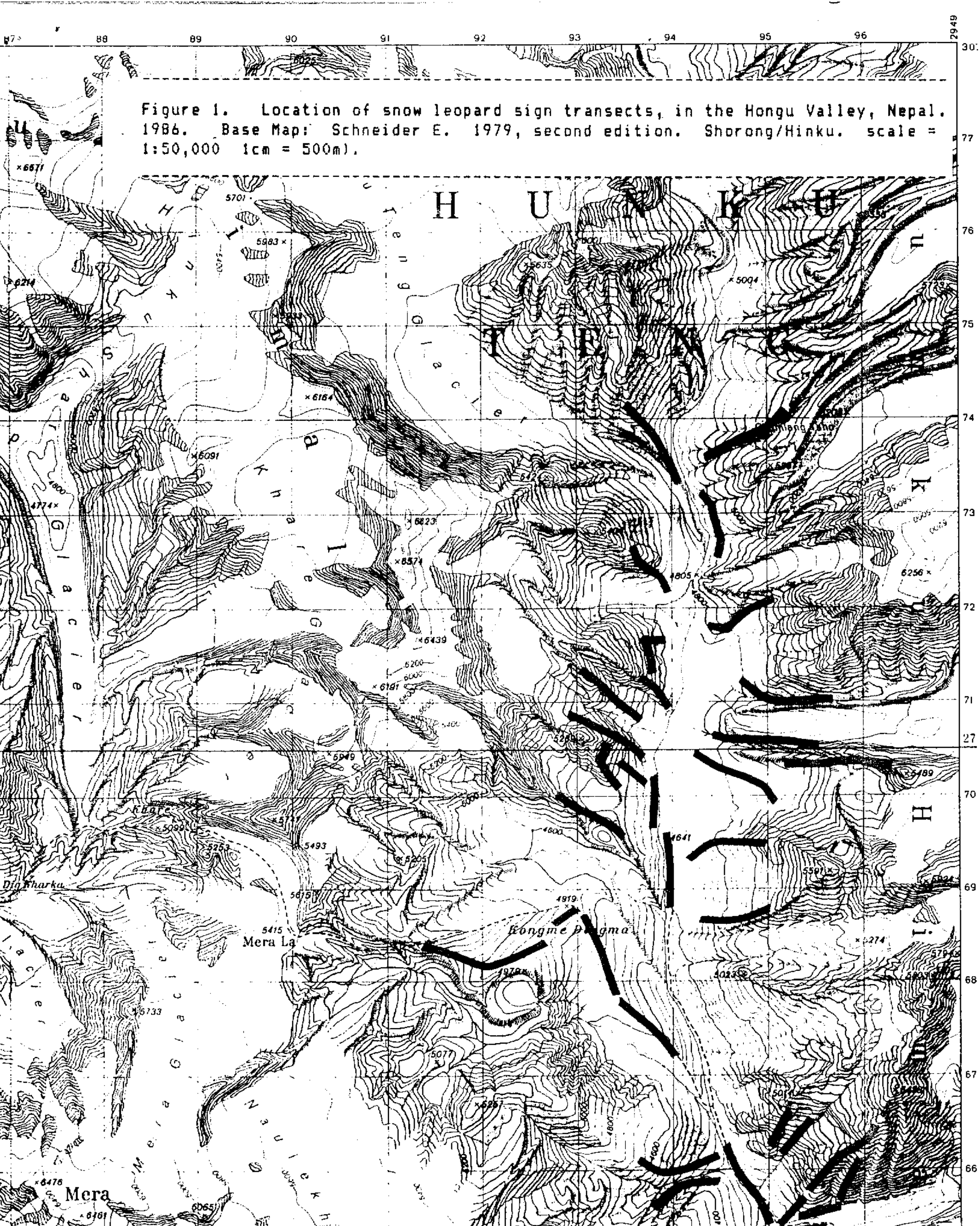

Figure 1. Location of snow leopard sign transects, in the Hongu Valley, Nepal. 1986. Base Map: Schneider E. 1979, second edition. Shorong/Hinku. scale = 1:50,000 1cm = 500m).