A Petition to List the Tibetan Antelope (*Pantholops hodgsonii*) as an Endangered Species Pursuant to the U. S. Endangered Species Act of 1973

Submitted by:

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I. SPECIES INFORMATION

1. Classification and Nomenclature

A. Species or intraspecific taxon

1. Scientific Name: *Pantholops hodgsonii* (Hodgson 1834).

2. Pertinent synonyms: Tibetan antelope (Schaller 1998), chiru (Macdonald 1985; Schaller 1998).

3. Common name(s): Tibetan antelope (Schaller 1998), chiru (Schaller 1998).

4. Taxon codes: N/A.

5. Size of genus: 1 species.

B. Family Classification

1. Family Name: Bovidae.

The chiru was originally placed in the subfamily Antilopinae based on morphological descriptions and similarities with some gazelles, such as the presence of inguinal glands (inflatable bags in the nostrils) and horns restricted to the males (Sterndale 1884 cited in Schaller 1998; Macdonald 1985). However, on the basis of skull characteristics (Pilgrim 1939) and recent morphological and molecular work, researchers conclude that the chiru is most closely allied to the goats and other members in the subfamily Caprinae (Gentry 1992; Gatesy et al. 1997).

2. Present Legal or other formal status

A. International

The Tibetan antelope was listed as an Appendix II species under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 1975; it was moved to Appendix I in 1979. The only reservation ever held on the species was taken by Switzerland in 1979.

On 27 October 1998, Switzerland withdrew its reservation, entered on 8 June 1979, pursuant to Article XV, paragraph 3, with respect to *Pantholops hodgsonii* in Appendix I of the Conference.

The chiru is listed as ‘‘Vulnerable’’ (A1c) in the 1996 International Union for the Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Animals. Regional Survey and Action Plans are developed under the auspices of the IUCN Antelope Specialist Group.

B. National (all nations cited below are members of CITES)

1. China

The chiru is listed as a Class 1 protected species under the Law of the People's Republic of China on the Protection of Wildlife (1989), prohibiting all killing except on special permit from the central government.

2. India

Chiru are listed on Schedule I of the Wildlife Protection Act (1972), prohibiting hunting and trade.

3. Nepal

Chiru are listed as an endangered species under Schedule I of Nepal's National Parks and Wildlife Conservation Act (1973) (Wright and Kumar 1997).

C. State

1. State of Jammu and Kashmir (India)

Chiru are listed on Schedule II of The Jammu and Kashmir Wild Life Protection Act (1978) [*sic*]. Trade in chiru is permitted. This is highly significant, since the actual weaving of shahtoosh occurs in the vicinity of Srinagar in the state of Jammu and Kashmir.

3. Description

A. General

All chiru share two small but distinctive morphological features. The muzzle is concave and blunt and the tip is enlarged due to the presence of a walnut-sized bulge on each side of the nostril. This bulge is an enlargement of the nasal passage. The coloration of this bulge varies with geographic locations of chiru populations. The chiru lacks preorbital, pedal or other glands except for large inguinal glands in the groins of both sexes. The glands in the adult males have an opening 5 cm long and a pouch 6 cm deep lined with a waxy, yellow exudate. Chiru have their full adult dentition at about 2.5 years of age.

B. Females and Calves

Adult females are approximately 74 cm tall at the shoulder and average 26 kg (Schaller 1998). They lack horns, unlike female caprids. Their coat is fawn-colored, almost pinkish, often with rust brown on the nape, blending to a whitish underside. A pale white area encircles the tip of the muzzle and the eyes. The top of the muzzle and front of the legs are grayish. Young are colored the same as the females.

C. Males —Adults

Adult males have a shoulder height of 83 cm and weigh about 40 kg (Schaller 1998). The distinct antelope-like lyre-shaped horns are slender, black, and have 15-20 ridges along the front two-thirds of their length; they rise almost vertically from the head and the smooth tips point forward. Horns reach a length of 50 cm by 2.5 years of age.

Adult males have dense and woolly coats, with hairs 4-6 cm long on the neck and body. The summer pelage is reddish-fawn with light gray and brown tones grading to white on the underside. A diffuse white rump patch is almost hidden beneath the 13-14 cm-long tail. The ventral side of the tail has long white hairs. The face and the front of the legs are dark gray. In general the male looks drab, however, in late October, prior to the rut, males acquire a winter pelage. The face is black as is the front of the legs, the black markings on the forelegs curving toward the shoulder and the black on the hind legs extending back to trace the margin of the rump patch. Body color is predominantly light gray and tan with conspicuous white underside from chin to belly. Males that are 4.5 years and older exhibit this nuptial pelage.

D. Males —Yearlings

At 16 months of age, yearling males weigh about as much as adult females. Horns are 23-29 cm long, reaching 30-33 cm at 18 months and over 40 cm at 24 months. Sub-adult males do not display the marked color changes between summer and winter pelage.

E. Photographs

Figure 1. Adult male chiru (©George Schaller).

Figure 2. Adult male chiru (©George Schaller).

4. Significance of the taxon

A. Natural

The Tibetan antelope is the only genus of large mammal endemic to the Tibetan Plateau. Miller and Schaller (1997) have observed that ‘‘The chiru is the keystone species for the Chang Tang ecosystem ....’’ The species is uniquely adapted to the high elevations and dry climate of the Plateau, ranging from about 98º E, westward to Ladakh in India. The sexes segregate almost completely during the spring and early summer (May and June), when adult females and their female offspring migrate north to certain calving grounds and return south by late July or early August, covering distances as long as 300 km each way. Seasonal migrations by chiru constitute a critical aspect of the species’ ecology and help to define the ecosystem as a whole. Yet, data on migration patterns remain fragmentary.

B. Human

Schaller (1998) articulates the great aesthetic value of the species. He writes ‘‘ Although I became a naturalist to satisfy my curiosity and for the pleasure of new insights, such as this glimpse into the chiru’s past, I also seek emotional involvement with the animals themselves. My days with chiru on this high and windy plain provided both. Once I walked among the chiru and sat down immobile, an inanimate hump. The animals soon ignored me. All around me chiru males bellowed their challenges and pursued each other into the blinding light of the horizon; all around me chiru danced on the tawny grass in their ritual of renewal. I sat at the

center of this consecrated space, quietly celebrating the harmonious balance of a fleeting moment.''

In Schaller (1998, p. 41), an historical reference by Rawling (1905) notes that:

''Almost from my feet away to the north and east, as far as the eye could reach, were thousands upon thousands of doe antelope with their young. The mothers were mostly feeding, while the young ones were either lying down and resting, or being urged on by their mothers. All had their heads turned towards the west, and were travelling slowly in that direction, presumably in search of the fresh young grass springing up in the higher western tablelands.

Everyone in camp turned out to see this beautiful sight, and tried, with varying results, to estimate the number of animals in view. This was found very difficult, however, more particularly as we could see in the extreme distance a continuous stream of fresh herds steadily approaching; they could not have been less than 15,000 or 20,000 visible at one time.''

5. Geographical Distribution

A. Geographical range

The geographical range of the chiru extends 1,600 km across the Tibetan Plateau between the eastern limit near Ngoring Hu (China, 98º E) and the western limit in Ladakh (India).

The Tibetan Plateau is about 950,000 square miles in size and includes most of the Chinese province of Qinghai, the northwestern part of Sichuan Province, the southwestern part of Gansu Province, and the southern border areas of Xinjiang Uygur Autonomous Region, and all of Xizang (Tibet Autonomous Region) (Schaller 1993). In Xinjiang's Tula Valley, chiru frequent elevations as low as 3250 m, but most of their range lies above 4,000 m, and on the Depsand Plain in northern Ladakh, they can be found as high as 5,500 m (Roosevelt and Roosevelt 1926).

B. Precise occurrence(s)

Schaller (1998) indicated that the abundance and distribution of chiru in an area depend on the migratory patterns of a particular population. Chiru can be considered as both: 1) resident, making only local movements; and, 2) migratory, where animals may travel up to 250-300 km between summer and winter ranges. In addition, males and females are sexually segregated during portions of the year. Areas therefore may be devoid of chiru in one season and full of them the next. Precise occurrences are therefore limited to documented evidence of chiru as either seasonal residents or migrants. No adequate chiru census has been done, but locations of fragmented populations and areas of concentration are known to some extent.

1. Populations currently or recently known extant

a. Qinghai

Qinghai covers 720,000 km^2 of the northeastern part of the Tibetan Plateau. Chiru reach their eastern limit near Ngoring Hu, where they are rare (Kaji 1985, in Schaller 1998). During a winter survey east of the Lhasa-Golmud road in 1985 Schaller (1998) found chiru to be scarce, but they were moderately abundant west of the road.

Resident populations of chiru are found in Yeniugou (Wild Yak Valley) within the Kun Lun Mountains where they also gave birth (Harris 1993; Harris and Miller 1995). Chiru were also observed in an area on the plains just south of the Yeniugou in November 1986 (Schaller and Ren 1988). This was suspected to be a resident population that shifted between Yeniugou and the plains (Schaller 1998). Monitoring data on this population since the early 1990s revealed a dramatic decline (attributed to winter poaching) in 1997 (Harris et al. 1999).

The remaining chiru in southwestern Qinghai appear to be migratory and part of one main population. In addition, there seems to be part of another population that enters seasonally from Tibet. Feng (1991) observed chiru, including females and young, in late July in his survey areas from the Lhasa-Golmud road west to Ulan Ul Hu, then north to the foothills of the Burhan Budai Shan and back to the road. In November 1986, Schaller observed chiru along each side of the Lhasa-Golmud road between Wudaoliang and Tuotuohe.

b. Xinjiang

In Xinjiang, chiru are mainly found south of the Kun Lun, and on the Aksai Chin plains (Schaller *et al*. 1991).

The Tula Valley extends for about 300 km along the southern base of the Arjin Shan and one of its subranges, the Yüsüpalik Tag. Schaller (1998) surveyed the western half in 1987 and the eastern half in 1988 and found chiru throughout.

Chiru have also been documented in the Arjin Shan Nature Reserve (Achuff and Petocz 1988). Near the western edge of the chiru's range, the species was reported at the Keriya Pass (35°40' N, 82°05' E) on the Xinjiang-Tibet border.

c. Tibet

Chiru remnants persist in the central Chang Tang (Tibetan for "northern plains"), most of them in small, scattered herds. Most of the northern Chang Tang lies within the Chang Tang Nature Reserve. Chiru are rare on the southern margin of the reserve (32°30' N). They are similarly scarce along the western border of the reserve. The rest of the reserve is occupied by chiru that are either migratory or shift ranges seasonally.

d. India

The only chiru outside China are located in the Ladakh region of India. Chiru occur in only two small areas of eastern Ladakh, where about 200 males cross the border seasonally from Tibet and the Aksai Chin area of Xinjiang (Fox et al. 1991).

2. Populations known or assumed extirpated

The current range is divided into two areas: a northern one of about 490,000 km^2 and a central one of about 115,000 km^2. Distribution between the two areas was continuous until recent decades, and there may still be rare contact near the western end. The range of chiru west to east appears to be much as it was a century ago (Bower 1894). However, current chiru populations in the central Chang Tang of Tibet are highly fragmented and occur in small, scattered herds. The range has also contracted in eastern Qinghai (Schaller 1998).

In December 1906, Sven Hedin had observed ''great flocks'' of chiru West of Dogze Co, at about 32 10' N, 84 45' E (Hedin 1922). Today the nearest chiru population winters over 75 km to the north.

In February 1908, Hedin encountered chiru ''by the hundreds, and in larger flocks than ever'' just north of Gerze, an area now devoid of chiru. In March 1908, he reported ''numerous antelopes'' near Dong Co (32 10' N, 84 45' E); today chiru do not frequent that valley.

In September 1907, Hedin noted several grazing antelopes near holy Mount Kailas. Chiru are rare in that region today.

The southern margin of the Chang Tang reserve, south of about 32 30' N, is almost devoid of chiru, although occasional animals are encountered southeast of Shuanghu. The animals are similarly scarce along the western border of the reserve in an area where Hedin had found numerous tracks.

Humans have directly and indirectly caused the decline in chiru populations over the past several decades. Chiru have been slaughtered illegally for their fine wool, which after being smuggled to India is woven into high-priced scarves and shawls (See Section 9B. 2, below). Within the past 50 years, and especially the past 25 years, good rangelands in the wildlife habitat of the Chang Tang region that had few or no nomads previously have been permanently settled, and there is pressure to develop marginal pasturelands as well.

C. Biogeographical and phylogenetic history of the taxon

The chiru has existed on the Tibetan Plateau since at least the early Pleistocene and is the only genus of large mammal endemic to the Tibetan Plateau (Schaller 1998). Two late Miocene fossils, genus *Qurliqnoria*, found in the Qaidam Basin were considered by Gentry (1968) to be related to chiru, and a Pleistocene fossil, *Pantholops hundesiensis*, a chiru slightly smaller than the living one, was described from western Tibet (Pilgrim 1939).

6. Environment and habitat description

A. General environment and habitat

Chiru prefer flat to rolling terrain, although they readily ascend high rounded hills, penetrate mountain ranges and cross passes by following valleys. Alpine steppe or similar semiarid habitats are favored, often at elevations between 3,700 m-5,500 m.

In Qinghai, they concentrate on rolling uplands above 4,600 m during winter (Schaller et al. 1991). In Xinjiang's Tula Valley, chiru frequent elevations as low as 3250 m, but most of their range lies above 4,000 m and on the Depsand Plain in northern Ladakh they can be found as high as 5,500 m. Desert steppes and other arid areas (< 400 mm of precipitation per year) have been seasonally occupied.

Other endangered, threatened, rare or vulnerable species in chiru habitat include wild yak, Tibetan argali sheep, Tibetan wild ass and Tibetan brown bear.

B. Physical characteristics of habitat

1. Climate

Harsh, cold and windy. Average annual temperature below freezing; absolute minimum -38ºC (- 40ºF) and below, with few frost-free days.

2. Physiographic provinces

Alpine meadow, alpine steppe and desert steppe vegetated with graminoids, a few forbs and low shrubs.

The brief growing season extends June through September.

3. Edaphic factors

Soil in alpine meadows is saturated with meltwater from glaciers and snowfall. The soil is also characterized by a sod layer that is 10 to 40 cm thick. Soil in the alpine steppe is of poor

quality for plant growth, comprised of gravel, sand, silt and clay. This soil is alluvial or eolian in origin and lacks a sod layer (Schaller 1998).

C. Biological characteristics of habitat

1. Vegetation types

Vegetation on the alpine steppe is sparse and 85% of the ground is usually bare. Graminoids often compose over 66% of the vegetation, particularly *Stipa* (*S. purpurea, glaresa, subsessilifolia), Kobresia (K. prainii, robusta, persica), Poa (P. poiphagorum, pagophila, calliopsis, litwinowiana), Elymus sibiricus, and Carex moorcroftii*, to mention the most important species.

Grasses and sedges, especially *Carex moorcroftii*, are also dominant in desert steppe, together with the dwarf shrub *Ceratoides compacta*. Forbs are a small component of alpine steppe, usually less than 15% in *Stipa* grassland, but at times more than 30% in mountain meadows. A few forbs, such as *Potentilla bifurca*, *Saussurea stoliczkai*, and the mat-forming *Leontopodium pusillum*, are widespread, and legumes of the genera *Astragalus* and *Oxytropis* are among the important species.

2. Chiru diet

Chiru are mixed feeders, favoring graminoid and forb plant species (Miller 1997; Schaller 1994). Preferred graminoids include *Carex moorcroftii*, *Kobresia* sp., *Poa* sp., and *Stipa* sp., while favored forbs include *Oxytropis* sp., *Potentilla bifurca* and *Leontopodium pusillum*, with the percentage of plant species in the chiru's diet changing seasonally (Schaller 1994).

Harris and Miller (1995) indicated that chiru males in their study site in Qinghai had relatively diverse diets, feeding primarily on *Kobresia* sp. and forbs (both legumes and non-legumes). By contrast, females and young living segregated from males relied exclusively on forbs, in particular *Potentilla bifurca*. They completely avoided both grasses and sedges during the summer.

7. Population Biology of Chiru

A. General

Schaller (1998) found that there are no precise accounts of chiru numbers in the past. Obtaining accurate density estimates of chiru populations is complicated by the fact that the abundance of chiru in an area depends on the movement patterns (i.e. migration) of a particular population. Chiru can be considered as both: 1) resident, making only local movements; and, 2) migratory, where animals may travel up to 250-300 km between summer and winter ranges. Areas therefore may be devoid of chiru in one season and full of them the next. Status has therefore been described by region.

B. Demographics

1. Qinghai

In 1991, 2,076 antelopes (927-3,247, 95% CI) were found in Yeniugou (Wild Yak Valley) within the Kun Lun Mountains (Harris 1993; Harris and Miller 1995). Schaller and Ren (1988) recorded a density of 1.47 chiru/km2 in an area just south of the Yeniugou in November 1986.

In a survey that went from the Lhasa-Golmud road west to Ulan Ul Hu, then north to the foothills of the Burhan Budai Shan and back to the road, Feng (1991) observed 4,843 chiru, including 2,000 females and young in late July. He estimated a total population of 6,000-7,000 in 75,000 km^2 of southwestern Qinghai, giving a crude density estimate of 0.08-0.09/km^2.

In November 1986, 281 chiru (0.015/km^2) were counted within 50 km along each side of the Lhasa-Golmud road between Wudaoliang and Tuotuohe (17,900 km^2), excluding the census area of Feng (1991) (Schaller et al. 1991).

2. Xinjiang

305 chiru were counted in a survey of the western half in 1987 and the eastern half in 1988 (Schaller 1998).

During July 1988, 37 animals were counted in the Yüsüpalik Tag.

A survey of 4,000 km^2 of the Kunlun Shan and the uplands to the south of the Tula Valley just west of Arjin Shan Reserve, revealed 438 chiru, or 0.11/km^2 (Schaller et al. 1991).

The western section of the Arjin Shan Nature Reserve had 2,946 chiru at a density of 0.16/km^2 (Achuff and Petrocz 1988). No reliable estimates exist for the whole reserve.

3. Tibet

Schaller's most extensive censuses were conducted on alpine steppe roughly between Shuanghu and Yibug Caka in December 1991 and October 1993 by driving through valleys and basins and by scanning hills and plains in an effort to count most animals. This area was selected because chiru concentrated there in winter. In 1991, a total of about 3,900 chiru were counted in 17,500 km^2, and in 1993, a total of 3,066 chiru were counted in 10,500 km^2. These densities are probably not exceeded elsewhere over such a large area.

C. Total Number of Chiru

Because chiru are sexually segregated by season, migratory, and widespread at varying densities, their numbers can only be estimated with any accuracy through aerial censuses, a technique that has not been possible to date. Schaller (1998) addresses some of the problems with estimating chiru on the ground and highlights the fact that hunting has also had an impact on estimates. The numbers therefore represent best guesses (Tables 1 & 2).

In the early 1990s, it is estimated that 35,000-40,000 chiru were present in the Chang Tang Reserve (Feng 1991; Schaller 1998). Scattered herds outside the reserve probably amounted to a few thousand.

Reports suggest that there were approximately 45,000 chiru in Tibet (Liu and Yin 1993; Schaller 1998).

In Qinghai, 6,000-7,000 chiru were estimated in the southwest (Feng 1991) and there were several thousand in and around the Yeniugou and a few east of the Lhasa-Golmud highway resulting in perhaps 10,000-12,500 in the whole province.

Except for a few hundred chiru in the Aksai Chin area, most animals in Xinjiang are in or near the Arjin Shan Reserve. No more that 10,000-15,000 chiru remain in Xinjiang.

Schaller (1998) guessed that the total for the whole Plateau in the mid-1990's could be as low as 65,000-72,500.

D. Migration

Male and female chiru segregate during the summer beginning in late April or May when most 10- to 11-month-old males separate from their mothers. Adult females and their female offspring migrate north in May and June to calving grounds. Males tend to stay close to their wintering grounds. Seasonal sexual segregation also occurs in resident populations of chiru (Achuff and Petocz 1988).

The northern Chang Tang region of Tibet and Qinghai is divided into distinct wintering and calving areas. Schaller (1998) found four migratory populations (West Chang Tang, Central Chang Tang, East Chang Tang, Qinghai) based on the movements of females. The proportion of the total chiru population that is sedentary or migratory and the extent to which animals can shift from one to the other remains unknown. Wintering areas are fairly well known, but most calving grounds remain obscure.

1. Migration of Females

a. West Chang Tang Population

Schaller (1998) felt that the chiru in this area may have shifted their migration routes. Historically the area was called Antelope Plain due to the abundance of chiru observed in the early 1900s, but Schaller's visits in 1992 found only a few animals, mostly males. In 1996,

however, a Chinese expedition reported many females giving birth near Gozha Co. Schaller (1998) noted that the migration route followed a narrow path starting near a small lake (Yue Ya Hu) along a valley below the base of Toze Kangri. Chiru crossed another plain into hills bordering the basin of Heishi Beihu (Blackrock Northlake) and eventually into the low hills bordering Xinjiang. The calving ground is thought to exist near the end of this route, though Schaller could not follow the herd to this region to confirm it.

In July and early August 1990, the Aru Basin contained many males and just a few females, all without young, but on 11 August a herd of 2,000 females and young arrived from the north and remained on the northern edge of the basin. In 1992, Schaller returned to Aru Basin to await the return migration, but again when chiru arrived in the area they did not move south, but were observed moving southeast from Toze Kangri, passed through the hills just south of Luoutuo Hu and crossed the Aru range by a low pass. Bypassing the basin, they continued south and also spread east and west over the alpine steppes, most reaching their autumn and winter range by the end of August or early September.

b. Central Chang Tang Population

Schaller (1998) was unable to delineate the eastern limit of the large West Chang Tang population. In 1990, Schaller drove north of Dong Co and then east along 33 N latitude. Groups of chiru females and young were observed throughout the basin around Yibug Caka, east and northeast of Mayer Kangri, along the western end of the Jangngai Range, and up to Gomo Co. Schaller believed that this was one population, but their calving ground was unknown. In July 1991 and June 1994, Schaller explored Tian Shui Valley, traveling as far north as Gyangnyi Caka (35° N, 87° E) looking for the calving ground. He found at least 800 females and young in the hills south of the Tian Shui Valley, but the female/young ratio was very low (100:5).

c. East Chang Tang Population

The main wintering ground of the East Chang Tang population extends in a line between the northern end of the Amu Range and southern slopes of the Jangngai Range, a distance of 100 km. Most chiru winter in a strip of alpine steppe no more than 50 km wide. Schaller could not find the calving ground for this population. Schaller's observations in May and June 1994 led him to hypothesize that this population calves near the Tibet-Qinghai border.

d. Qinghai Population

The main wintering grounds of this population appear to be in the southwestern corner of Qinghai, where large concentrations were found in the upper Tuotuohe and Golo Valleys. A calving ground was speculated to occur 200 km from the northwest near the Tibetan border. During July to October 1991, Harris and Miller (1995) documented that male chiru were found in high-elevation (4,300-4,700 m) plant communities, whereas females were concentrated in low-level, broad basins. By late September, 1991, males were no longer in these communities and moved westward toward the females.

2. Migration of Males

Adult and yearling males associate little with females during summer. In July 1991 and June 1994, Schaller (1998) traveled widely within an area of about 40,000 km^2 extending from the Jangngai Range and Purog Kangri north 200 km to Gyangnyi Caka and beyond Dogaicoring Qangco. The males were widely dispersed singly and in small herds even in areas through which females do not migrate. However, certain localities contained concentrations, as in the Aru Basin. These concentrations were noted in the western and east parts of the reserve, but not the central part. Males exhibited three types of movement patterns: 1) remaining on their wintering grounds all summer; 2) traveling a short distance to a summer range; and, 3) traveling a greater distance to summer areas, usually north.

E. Population and Herd Dynamics

Population composition is difficult to ascertain except when animals have congregated for the winter rut. Not only are the sexes segregated and widely dispersed for much of the year but each sex also may form certain associations. Females with young and without young may each congregate, and adult males occasionally form large herds, something that is not seen among yearling males.

Chiru give birth in the second half of June and early July to a single young. Females probably conceive at the age of 1.5 or 2.5 years and give birth at age 2 or 3 years. Subadults grow rapidly making yearling females often difficult to distinguish from adults after the age of 15 months. Each population has to be reviewed separately due to differences in habitat and weather that can influence population composition.

The ratio of males to females varied considerably even when a population was on its winter range. Schaller (1998) felt that this was in part because males continued to arrive at these areas throughout the winter. Between 1990 and 1993, the combined Central and East Chang Tang populations averaged 29% males, 53% females, and 18% young.

The ratio of young to females varied considerably from year to year, probably due to inclement weather and snowstorms at calving time. In 1993, Schaller found similar ratios for East, Central, and West Chang Tang at 45:100 when young were less than 6 months old. The winter was quite benign that year. In 1990, however, the ratios between Central and East Chang were markedly different at 12:100 and 31:100, respectively. The reasons for the reproductive failure of one population remain unknown. In August 1990, there were 49:100 (n = 681) young to females in the West Chang Tang around the Aru Basin, whereas two year later, after heavy snows during the birth season, it was somewhat lower at 40:100 (n = 2,812). Therefore, under normal circumstances, the ratio of young to females ranged from 30:100 to 50:100, indicating that normally half of the young die within a month or two of birth. This situation is very similar to other migratory ungulates including wildebeest (Sinclair 1979), caribou (Kelsall 1968), white-eared kob (Fryxell 1987) and Mongolian gazelle (Schaller 1998).

Survival of young in their first year of life is low. In October 1993, the ratio of young to females in the East Chang Tang was 45:100. In late May, 1994 the female young to females

was 15:100. Assuming that young males, which would have left their mothers by this time, were equally abundant, the ratio expected would be 30:100, indicating that at least one third of the young had died during the winter and early spring.

Yearling males averaged 6% in the populations, and assuming that the percentage of females was similar, yearling recruitment was 12%. Given that 47% of adult females were counted in the populations, the yearling recruitment indicates that at least two-thirds of chiru do not survive to age two.

8. Management practices

Traditionally, nomads were governed by aristocratic families and the incarnate lamas of local monasteries. These overlords imposed taxes on the nomads and allocated pastures to each nomad family for a period of three years. However, families did enjoy private ownership of their herds. At the end of each three-year period, each family was granted a new pasture area suitable for the size of its herd. This system functioned well on the steppe of the Chang Tang (Schaller 1997).

In 1959, when China took control of Tibet, the triennial pasture rotation system was abolished. During China's Cultural Revolution, in the late 1960s, nomads were stripped of their right to own livestock and communes were established. High taxes and forced sales of livestock created wide-scale poverty among the nomad population. Poverty encourages people to kill wildlife.

In the 1950s and 1960s, roads were built into the Chang Tang and administrative posts were established. In 1976 the government encouraged nomads to move north from the heavily settled areas around Xianza. Several communes did so, establishing and abandoning various settlements, largely because of a shortage of fresh water. Despite failures in resettlement, the government continues to plan for settling uninhabited land to the north, even though it is marginal for livestock.

The human population has grown considerably since its arrival a quarter century earlier, in part due to a high reproductive rate and in part to continuing immigration.

In 1981, the communes and taxes were abolished. Administrative units, known as *xiangs* were established to implement regulations. The leaders of the *xiangs* limit the number of livestock each family can own. Depending on conditions, this number tends to vary from 40 to 70 animals per person (Schaller 1998).

Herder populations in chiru habitat are increasing with government encouragement of livestock production, leading to less tolerance of grazing competition from wildlife species, (Schaller 1994; Miller and Schaller 1996).

9. Evidence of threats to survival

A. The present or threatened destruction, modification or curtailment of habitat or range

1. Human activity in chiru habitat

Increasing movement, resource extraction activities, rangeland use and settlement by pastoralists in chiru habitat present a variety of potential threats that will likely lead to the curtailment, adverse modification or destruction of the antelope's habitat resulting from rising grazing competition between Tibetan antelope and livestock.

a. Competition with livestock

Livestock tended by nomadic or semi-nomadic pastoralists and livestock-related activities, such as agriculture and fencing, create direct and indirect competition with Tibetan antelope for available resources, both within and outside established protected areas. Livestock production is already curtailing and modifying chiru habitat and could eventually lead to the destruction of some portion of the species' range through usurpation, overgrazing and/or desertification.[1]

b. Rangeland Fencing

Changes in government policy have resulted in a proliferation of rangeland fencing on the Tibetan plateau.

Livestock frequently graze year-round in antelope habitat and increasingly nomads are fencing for winter-spring grazing and fodder production, usurping additional grassland resources in chiru habitat. Tibetan antelope need open range in order to survive (Miller and Schaller 1997). Enclosure and conversion of grasslands disrupts antelope habitat, posing a particular threat in the spring, when weakened chiru are attempting to rebuild their energy reserves, and in the fall, as antelope are preparing for the harsh winter.[2]

c. Gold Mining

Gold mining endangers chiru habitat with environmental contamination and can lead to illegal hunting by prospectors who augment their income by poaching. Mining contaminates chiru habitat and pollutes water sources because it is "carried out without adequate environmental precautions ... There is [arsenic], mercury and cyanide scattered over the mountains ... chemical-laden debris is pushed over hills into creeks..." (USEC 1996). Governments may periodically enforce bans on such activities, and have done so in Tibet, but in general it is difficult to control illegal miners from occupying large areas of land and trying to exploit mineral resources. Illegal mining activity also opens another avenue for profiting from poaching (USEC 1996).[3]

d. Oil Drilling

In 1997, an exploratory team from Wuhan Geology University and the South China Petroleum Bureau working in the Chang Tang basin discovered sedimentary rock layers ''likely to bear oil'' (USEC 1998). Oil exploration and production have commenced within the chriu's range and pose a threat of destroying antelope habitat; polluting the immediate environment with

toxic production chemicals, effluents and emissions; and increasing the incidence of poaching by drawing additional, impoverished settlers into the region.

2. Degradation of habitat in protected areas

Three protected areas have been set aside specifically to safeguard Tibetan antelope populations and habitat in China: Chang Tang Nature Reserve (Tibetan Autonomous Region), Kekexili (aka Kokoxili or Hoh Xil) National Reserve (Qinghai Province), and Arjin Shan Nature Reserve (Xinjiang Province), Xianza Reserve, Tibet. Unfortunately, these reserves, due to a combination of remoteness, an influx of settlers and a lack of existing management capacity, are unable to effectively protect the chiru or its habitat.

a. Protected areas do not encompass a diversified range of chiru habitats.

Miller (1997a) notes that while many of the protected areas in the Tibetan Plateau region encompass high-altitude rangelands, protected areas at lower grassland elevations are scarce. In areas of unprotected habitat, isolated chiru populations are vulnerable to poaching and habitat encroachment.[4]

The single most significant gap in chiru habitat protection remains unresolved because the location of the species' calving areas along the northerly migration routes remain unknown (Schaller 1996). "Preserving the chiru requires that its entire range, including the birthing grounds, be protected'' (Miller and Schaller 1997). Schaller (1998) observes that chiru populations already suffer from fragmentation and that further dispersal will ultimately lead to lower survival rates and population numbers.

b. Increasing levels of human settlement in reserves degrade natural habitat

In addition to natural increases due to high birthrates among pastoralists, immigrants from other parts of the Plateau are moving into protected areas. The density and proximity of temporary or permanent human settlement, whether aggregate or dispersed in nomadic units, in relation to chiru habitat in the grasslands can create detrimental impacts.[5]

c. Livestock grazing in protected areas

Pastoral use of protected-area grasslands creates resource competition with chiru and other ungulate species, can degrade the quality of range through overgrazing, and introduces modern vehicles and weapons that can easily be turned to poaching.[6]

d. Reserves cannot effectively protect chiru from poachers.

The Chang Tang reserve staff lacks the funding, experience, personnel and equipment to adequately prevent chiru poaching and other threats to the species. (Miller 1997a).[7]

B. Overutilization for commercial, recreational, scientific or educational purposes

1. Hunting

Schaller and Gu (1994) have written that in recent decades, ‘‘as many pastoralists have moved into areas that were once unoccupied, or virtually unoccupied, the traditional and well-adapted system of pasture allocation has been modified by the government and wildlife is hunted commercially."

Historically, nomads employed muzzle-loaders, dogs and leg-hold traps to kill ungulates and fur-bearers. These activities have certainly contributed to the chiru's decline in the past, but were probably at a sustainable level. Wildlife is still hunted by these methods today, but nomads also have access to modern rifles through purchase, on loan from the government to protect livestock from wolves, or on illegal rental from officials who expect wildlife products in payment. (WPSI 1997; Schaller 1996). A growing network of roads places local hunters in contact with traders interested in purchasing chiru wool, wild yak meat and other products.

Chiru are primarily killed for their wool, known in trade as shahtoosh (‘‘king of wool’’), which is one of the finest animal fibers known (10-12 microns in diameter). Chiru hides are sold to traders who shear the wool for smuggling, primarily to India, where it is woven into shahtoosh scarves and shawls. The demand for chiru wool and shahtoosh products is the most serious threat to the continued existence of the Tibetan antelope.

Schaller speculates that during the 1980s and 1990s tens of thousands of chiru were killed to supply the illegal demand. A chiru provides about 150 gm of wool. In the winter of 1992 an estimated 2,000 kg of wool reached India and consignments of 600 kg were seized (and released) in India during 1993 and 1994 (Bagla 1995). This amount alone represents 17,000 chiru.

In 1993, a herdsman received the equivalent of $60/kg of chiru wool (Schaller 1998). By the time the wool reached India it was traded for $1,250-$1,500/kg. In Western markets, scarves and shawls are typically priced at $2,000-$8,500, with prices occasionally as high as $30,000 each, depending on size and quality (WPSI 1997).

Traders from Tibet also use shahtoosh to barter for tiger bones, which are illegally sold as medicinal products, resulting in an illegal two-way trade in two endangered species (WPSI 1997). The tiger is a CITES Appendix I species and listed by the IUCN as ‘‘endangered.’’ All trade in tiger products is banned in India and China, but the soaring value of shahtoosh is apparently promoting this new link in the tiger trade. A 1997 report by the Wildlife Protection Society of India states that ‘‘The authors have no doubt that it will be impossible to control the tiger bone trade if the shahtoosh trade is not brought to a halt’’ (WPSI 1997).

In addition, chiru are killed for medicinal products, hides and meat. When mixed with other ingredients, chiru horn reportedly kills bacteria and stops diarrhea. Horns are sold and/or bartered for treatments at, for example, the Tibetan Medical College in Lhasa. This "tradition" has only developed recently in substitution for saiga antelope (*Saiga tatarica*) horns. Saiga went extinct in China in the 1950s due to intense demand for their horns. Chiru meat is

typically consumed locally by the herdsmen, although organized poaching operations discard the meat and horns (China State Department 1998).

2. Trade

The international trade in shahtoosh is by far the greatest threat to the survival of the Tibetan antelope and appears to be growing in scope over the last decade (WPSI 1997). The escalating price of raw shahtoosh in India and of finished shahtoosh products in Asia, Europe and North America is clearly driving antelope poaching, making it essential to halt the trade to protect the chiru.

''Fashioned for Extinction'' (WPSI 1997) details the specifics of chiru poaching and the shahtoosh trade, and describes their impact on Tibetan antelope populations. It was researched and written by the Wildlife Protection Society of India -- one of the country's leading wildlife conservation organizations. The report documents the biology of the Tibetan antelope, the history and characteristics of shahtoosh trade and manufacture, contemporary methods of shahtoosh smuggling, international regulatory mechanisms, international wildlife seizures reported in the 1992-97 period, and makes recommendations for halting the shahtoosh trade and protecting the chiru.[8]

The State Forestry Administration (SFA 1998) of China released a status review of the Tibetan antelope, ''Conservation Status of the Tibet Antelope'' [*sic*] in December, 1998. The SFA has overall responsibility for wildlife management and protection in China. The agency estimated the Tibetan antelope population at approximately 50,000-75,000, citing poaching figures of 20,000 annually based on carcasses, and seized pelts and wool. (While this figure may be at some variance with other estimates, determining the full scope of antelope poaching is difficult.) The SFA report concludes that foreign demand is driving chiru poaching and the shahtoosh trade, which must be eliminated to successfully protect the Tibetan antelope.[9]

C. Disease or predation

1. Predation

Schaller (1998) documented chiru mortality due to predators and hunters, disease, starvation and inclement weather. Wolves, snow leopards, lynx and brown bear prey on chiru. However, predators have been largely decimated in recent years (Schaller 1998). He also noted that dogs owned by pastoralists and local workers killed chiru. In October 1985, he counted 19 dog kills along the Lhasa-Golmud road in Qinghai. Chiru were impeded by heavy snow and malnutrition, reducing their flight distance and making them susceptible to attacks by dogs.

2. Disease

Schaller (1998) found evidence of pneumonia, and fecal samples from chiru indicated that they have several kinds of potentially harmful endoparasites. Chiru were also infested by warble

flies (family *Oestridae*) and nasal bot flies. These insects modify chiru behavior, causing them to move to cooler areas (ice patches, water) or dig sandy hollows at the expense of feeding and could have a deleterious impact on the energetics of individuals, as has been noted in caribou (Helle 1980).

D. The inadequacy of existing regulatory mechanisms

1. Inadequacies of international, national and state regulatory mechanisms

Regulation of the shahtoosh trade worldwide is insufficient to prevent continued smuggling and sale of shahtoosh products. CITES has weak enforcement provisions and regulation of national laws in China and India is inadequate due to insufficient funds, capacity or effort (Miller and Schaller 1997; WPSI 1997). In the US, the lack of an Endangered Species Act listing means that the USFWS is unable to take full advantage of enforcement options contained in the Act but absent from CITES.

Since the national laws of China and India prohibit the taking of Tibetan antelope or trade in its products -- except in exceptional circumstances -- (and because China has expressed its conviction that the shahtoosh trade is detrimental to the survival of the species) little lawful opportunity for exporting shahtoosh -- and no provision for commercial trade -- exists under CITES, in spite of the continuing trade.

a. China

The 1989 Law of the People's Republic of China on the Protection of Wildlife does not provide for specific conservation measures for the recovery of wildlife species, or designate and set aside critical habitat. Wildlife protection under Chinese law appears to focus primarily on preventing and punishing poaching.

The Chinese government, however, readily acknowledges that it has insufficient funds, personnel and expertise to prevent chiru poaching and the shahtoosh trade, or provide any reasonable level of protection for the antelope. In spite of legal and regulatory mechanisms designed to prohibit the taking of endangered species and the trade in wildlife products, in actuality the State's ability to interdict Tibetan antelope poaching is severely limited.[10]

China’s State Forestry Administration is faced with such a daunting task protecting the antelope that the combination of inadequate resources (funds and equipment), insufficient staffing and training, and the presence of a well-organized, -armed and -supplied poaching and smuggling network essentially nullifies the implementation of China's regulatory laws protecting the Tibetan antelope and banning the shahtoosh trade, which are ultimately inadequate to effectively protect the species.

b. India

The effectiveness of India's regulation of the shahtoosh trade is seriously compromised because the state of Jammu and Kashmir has a separate wildlife act, superseding and independent of national law, that legalizes trade in Tibetan antelope products (WPSI 1997). [11]

c. USA

Implementation of CITES alone is inadequate for preventing the sale of shahtoosh products in the US, because the Convention only prohibits the *trade* (import and re-export) of shahtoosh (CITES 1975).

Establishing the case that suspected shahtoosh smugglers are responsible for importing or conspiring to export shahtoosh products that may be in their possession is more difficult than meeting the ESA standard of proving that a suspect may have offered shahtoosh for sale in interstate or foreign commerce. As a result, shahtoosh smuggling and sales continue relatively unimpeded. Various USFWS and independent investigations have reliably reported the availability of shahtoosh products for sale in the US since at least 1993 (WPSI 1997; USFWS/DLE 1998-1999). However, a shahtoosh case has never been successfully prosecuted in the USA (USFWS/DLE 1998-1999).[12]

Despite subpoenas being issued, and some cases moving forward in the USA, the existence of open investigations and continuing reports of shahtoosh sales in the US clearly indicate that CITES alone is inadequate to effectively prohibit shahtoosh imports and that the US government has not yet been able to take ‘‘effective means to stop commercial activities related to shahtoosh," as China's State Forestry Administration has requested.

d. State law (USA)

Some states derive their wildlife enforcement authority directly from the ESA. New York, for instance, adopts the federal ESA list of Endangered and Threatened Wildlife and Plants. However, since CITES enforcement is a federal responsibility, these states cannot investigate alleged Convention violations or prosecute violators. Under the ESA, the interstate commercial sale or transport of shahtoosh in states adopting ESA listings would be illegal under both state and federal law, giving these states the jurisdiction to pursue violations of state wildlife law (Fitzpatrick, pers. comm. 1999).

2. Inadequate law enforcement in protected areas

Even though China's State Forestry Administration (SFA), protected-area managers and law enforcement personnel regularly monitor chiru populations, conduct anti-poaching patrols, undertake educational and public outreach programs, and attempt to improve anti-smuggling efforts, they are outnumbered and outgunned by poachers -- violent encounters are not uncommon and poaching in nature reserves is routine (SFA 1998).[13]

E. Other natural or manmade factors affecting the species' continued existence

1. Snowfall

Schaller (1998) was in Qinghai during the heaviest snowfall documented for that area. Thirty cm of snow and cold temperatures forced chiru to paw through the crusted snow. Many chiru left their traditional winter range and traveled east. Chiru are not adapted to deep snow and travel during this period further depleted their energy reserves.

Schaller examined 12 probable malnutrition deaths in 1985. Bone marrow checks of seven of these animals were devoid of any fat. In 1986, he discovered the skeletons and mummified bodies of 193 chiru within 15 km of the upper Tuotuohe Valley. All age classes were represented. This blizzard killed a disproportionate number of young and yearlings. The ratio of young to females was 50-58:100 in 1985 whereas in 1986 no young were seen around Tuotuohe and only 17:100 were observed near Wudaoliang. The blizzard not only killed many of the young of the year, but also resulted in reproductive failure in the following year.

II. RECOMMENDATIONS

A. Listing Recommendations

1. The Tibetan antelope should be listed as Endangered by the USFWS

An Endangered ESA listing would prohibit the sale of shahtoosh in interstate and foreign commerce; provide the additional mechanism of banning interstate and foreign transport of shahtoosh in the course of commercial activity (a distinct problem for consignments entering US port cities that are moved to other states for sale); and reinforce the CITES ban on importation of Tibetan antelope products. An Endangered listing would create opportunities for the USFWS to provide financial and technical support to China for chiru conservation, as well as to conduct overseas law enforcement investigations. No other US law can confer a degree of protection for the Tibetan antelope similar to the ESA, making an Endangered listing essential to halting the shahtoosh trade in the US and protecting the antelope in the Tibetan Plateau region.

B. International cooperation recommendations

China's State Forestry Administration has repeatedly appealed for international collaboration to halt the shahtoosh trade. An ESA listing would allow the USFWS to address China’s request by allocating funding, assigning personnel and/or providing technical/training assistance in the development and implementation of conservation management, research and law enforcement programs regarding the Tibetan antelope in order to help the SFA better monitor and protect chiru populations and interdict the shahtoosh trade (ESA 1973). The USFWS could provide similar assistance to India under the ESA, if requested.

In addition, the USFWS could provide assistance to Chinese wildlife management personnel through the existing bilateral Nature Conservation Protocol With China (1986/1996), particularly with regard to US-China exchanges for training in CITES inspection, law enforcement, survey techniques and species identification/assessment (USFWS/AIA 1999).

C. Conservation and recovery recommendations

The following recommendations are elaborated on pages 325-327 in Schaller (1998) and only briefly stated below:

1. Reserves should be managed on an ecosystem-landscape basis to accommodate migrations.

2. Restrict human access to reserves, creating special zones for key chiru mating-ground areas.

3. Establish a policy to eliminate long fences that restrict chiru populations.

4. Hunting must be stopped, as must international trade.

5. Chiru populations should be monitored.

6. Prevent immigration to, and settlement within, nature reserves.

7. Provide settlers and nomads with opportunities to increase their returns from livestock products.

8. Monitor extractive activities around reserves and prevent disruption within critical chiru reserves.

Appendix I

Table 1

Composition of two migratory chiru populations in late August and September 1990 (Schaller 1998).

	Central Chang Tang	**East Chang Tang**
Sample Size	1,250	621
Adult male	278 (22.2%)	115 (18.5%)
Yearling male	78 (6.2%)	29 (4.7%)
Adult female	580 (46.4%)	293 (47.2%)
Yearling female	76 (6.1%)	30 (4.8%)
Young	238 (19%)	154 (24.8%)
Males: 100 females	54.3	44.6
Yearlings: 100 females	23.5	18.3
Young: 100 females	36.3	47.7

Table 2
Composition of three migratory Chang Tang chiru populations during winter (Schaller 1998).

	Central		East		Qinghai
	10/1993	12/1991	10/1993	12/1991	11/1993
Sample Size	770	1,381	2,126	2,146	471
Adult male	105 (13.6%)	352 (25.5%)	444 (20.9%)	637 (20.9%)	95 (20.2%)
Yearling male	46 (6%)	88 (6.4%)	124 (5.8%)	147 (6.8%)	48 (10.2%)
Female	428 (55.6%)	839 (60.7%)	1073 (50.5%)	1041 (48.5%)	225 (47.8%)
Young	191 (24.8%)	102 (7.4%)	485 (22.8%)	321 (15%)	103 (21.7%)
Males: 100 females	35.3	52.4	52.9	75.3	63.6
Young: 100 females	44.6	12.2	45.2	30.8	45.8

Notes

[1] A nomad household usually grazes a mixture of livestock consisting of goats, sheep, yak and horses (Miller 1999b). While these livestock species are selective feeders, together they consume a broad variety of plant species amounting to the range of plants necessary to chiru survival. Sheep and goats prefer graminoids and forbs, especially *Potentilla* and *Leontopodium*, a mix similar to the

chiru's diet, while yaks favor graminoids. Both livestock and wildlife species prefer plants of high nutritive value and easy accessibility (Schaller 1994). Where livestock and chiru range overlap, livestock compete directly with Tibetan antelope for the wildlife's most important forage species, which are critical for winter survival, especially *Stipa* species during autumn and spring months.

Herder populations in chiru habitat are increasing with government encouragement of livestock production, leading to less tolerance for grazing competition from wildlife species, even though proportionally few wild ungulates survive in their native habitat (Schaller 1994; Miller and Schaller 1996).

In particular, the crucial alpine *Stipa* steppe zone ''represents the last real refuge for wildlife and especially for... chiru birthing grounds. Further encroachment by pastoralists in these last wildlife refuges will have a profound detrimental effect on wildlife populations.'' Indeed, nomad sedentarization ''poses problems of overgrazing and increased competition for forage between wildlife and livestock. Many herders now have less tolerance for wildlife.'' (Miller and Schaller 1997). Some research indicates that areas of overgrazing currently exist around nomad settlements (Miller 1999a; Miller and Schaller 1996). The authors conclude that ''...there will have to be limits placed on the number of livestock allowed, at least in some areas at certain seasons, such as chiru breeding grounds'' (Miller and Schaller 1996).

Perhaps most ominously for wildlife populations, Schaller and Binyuan (1994) observed that development and modernization may pose one of the greatest threats to chiru in the future. "It is not realistic to expect the [Chinese] government to adopt a laissez faire, noninterventionist policy in Tibet. 'Development' of animal husbandry is a major government goal... Tibetan officials have begun to invite Western development experts to assist in the 'modernization' of the pastoral economy... The impetus to increase livestock productivity under the 'Four Modernizations' policy by the application of 'science' is very strong in Tibet and is likely to intensify in the years ahead" (Schaller and Binyuan 1994). Accordingly, competition and conflicts between herders and wildlife may likely increase, along with further adverse modification of chiru habitat.

[2] Historically, the grassland wildlife habitat of the Tibetan Plateau was characterized by open range. In the mid-1980s, the Chinese government instituted a policy of privatizing winter and spring grazing lands to individual households, and nomads began fencing and sowing portions of this range in Qinghai Province, and areas of Gansu and Sichuan provinces. Currently, the government is also implementing the privatization and fencing of summer pasture in these provinces. These policies have yet to reach nomadic pastoralist areas of the Tibetan Autonomous Region (Miller 1999b), although groups of pastoralists are fencing winter rangeland on a voluntary basis (Miller 1999a), including within the Chang Tang Reserve (Miller and Schaller 1997).

Some studies indicate that fencing and privatization of rangeland resources may lead to lower levels of grassland productivity, and increased wind and soil erosion, potentially reducing the quality and availability of chiru grazing range. Miller notes that "The long-term ecological implications of privatizing the rangeland... [have] received little analysis yet," (Miller 1999b).

Fencing poses a threat to Tibetan antelope habitat by creating the potential for interference with migration patterns (Miller 1999a; Miller and Schaller 1996), by excluding chiru from prime grazing areas, by limiting accessible range during crucial grazing periods, and by promoting range degradation due to overgrazing by livestock and rangeland manipulation (application of agricultural inputs, such as chemicals and fertilizer).

[3] Illegal wildcat gold mining is a widespread problem in Western China, where gold deposits are mined "with no regard to the environment" (USEC 1996).

Miller and Schaller observed that in 1994, 2,000-3,000 gold miners from Qinghai Province moved into the Nyima area along the southern boundary of the Chang Tang Reserve and that gold mining is prevalent throughout much of the eastern portion of chiru habitat (Miller and Schaller 1997).

Bleisch (1999) noted that managers in the Arjin Shan Nature Reserve have reluctantly turned a blind eye to gold mining within the protected area, because local authorities derive tax revenues from the mines. The impact on chiru populations has been severe: "There is no question now that gold mining camps have served as bases for the poachers and have provided them with essential logistical support. Without it, it would be very difficult for the poachers to operate in these remote regions." As a result, "...poaching has already had a profound impact on the chiru population of the reserve. Several areas where calving females formerly congregated are now empty of chiru during the calving season'' (Bleisch 1999).

Following on recent anti-poaching efforts in Arjin Shan Nature Reserve , managers are attempting to phase out gold mining by next year, but in the meantime, Bleisch (1999) predicts that "With the price of chiru wool still driven up to extraordinary levels by international demand for shahtoosh shawls, there is no question that the poachers will return in the future," particularly during the winter poaching season, when the antelope are in full coat.

[4] Miller and Schaller (1997) note that ''... preserving chiru requires that its entire range, including the birthing grounds, be protected. The westernmost chiru population in the [Chang Tang] Reserve is known to migrate into the neighboring Xinjiang Uygur Autonomous Region to give birth, an area currently not included in the protected area system. The easternmost population is also believed to migrate out of the reserve into Qinghai Province, a region not officially protected at the present time. These vital birthing grounds need to be preserved if the remaining chiru populations are to survive....'' In addition, it is not certain whether the boundaries of Xinjiang's Arjin Shan Nature Reserve adequately protect similar vital areas, or even whether additional calving locations exist outside the Chang Tang or Arjin Shan reserves.

[5] Most good rangelands in the Chang Tang region have been permanently settled. An estimated 3,500 families totaling 19,000 people live and graze 1.5 million head of livestock in areas overlapping chiru habitat (Miller and Schaller 1996). The reserve extends over five counties, including Shuanghu, a Special Administrative Area slated for development. In 1993, Schaller (1998) reported that 4,100 households comprising 22,000 people used the Chang Tang Reserve.

[6] Schaller has observed that domestic livestock were gradually introduced into the area of the Chang Tang Nature Reserve, which is prime chiru habitat, during the last thousand years and that over the centuries, wild ungulates and livestock species were able to adapt and accommodate one another sustainably because "pastoralists managed their animals well and hunted mainly for subsistence'' (Schaller 1994).

However, recent changes in pastoral production practices in the Chang Tang Reserve pose ''a danger to wildlife and the Chang Tang ecosystem" (Miller and Schaller 1997), particularly in chiru breeding grounds, and in the alpine steppe zone, which is "now essentially usurped by pastoralists'' (Miller and Schaller 1996).

There are six species of wild ungulates and four species of domestic ungulates within the Chang Tang Reserve for which the ecological requirements have been assessed. There are three major habitat zones, of which the *Stipa* zone represents the best rangeland where wild and domestic ungulates are most abundant. Nomads have exterminated all wild yak in the zone, but consider kiangs (*Equus kiang*), and to a lesser extent chiru and blue sheep, competitors of livestock.

Schaller (1998) collected data on local livestock numbers and calculated the livestock and wild ungulate biomass for the Chang Tang Reserve. His research and calculations indicated that livestock greatly exceeded the wild ungulates in both number (25:1) and biomass (9:1).

In the early 1990s, the total number of domestic animals in the reserve reached 1.4 million, the majority of which were sheep, creating an ecological density of 4.6-4.7 animals/km^2. Schaller, (1998) calculated biomass of livestock, of which sheep were the highest (88.57 kg/km^2). Schaller (1998) also estimated that 103,000 or 0.35/km^2 wild ungulates use the reserve of which the most abundant are chiru (37%). Chiru had the third-highest biomass (10%) of wild ungulates using the reserve. However, such comparisons are fairly limited in usefulness, since half the reserve has little or no livestock. Much of the wildlife is concentrated in the *Stipa* zone of Nyima and Shuanghu counties, where there are 91,520 km^2 of suitable habitat and ungulate densities range from 0.3-0.4 wild ungulates/km^2 and 8.7 domestic ungulates/km^2. Biomass for wild ungulates and livestock was 40kg/km^2 and 345 kg/km^2, respectively. Wildlife in general and chiru in particular, represent a small fraction of the total ungulate biomass occupying the antelope's range. Wildlife density was highest where nomad and livestock densities remained low, but this is most probably due to hunting of chiru, rather than competitive exclusion of chiru by domestics. However, increased densities of domestics could result in more direct competition between chiru and livestock.

[7] In the Chang Tang Reserve, law enforcement efforts have been difficult due to a lack of equipment, personnel and funds, as well as a highly organized poaching network (SFA 1998). In 1991, the Tibet Wildlife Act was passed. At that time, the Tibet Forest Bureau made every official and household aware of the laws and began to enforce them. Schaller (1998) documents both successes and failures in the enforcement of these laws.

Schaller and Gu (1994) note that with the increasing availability of vehicles beginning three decades ago, "truck drivers, officials, military personnel and other outsiders also began to shoot wildlife. In recent years, commercial hunting for yak meat and chiru wool has become a major threat to the survival of these two species, even though they are fully protected by law." In fact, increasing human populations in the Chang Tang are potentially of greater concern for their poaching activities than for grazing competition with livestock.

[8] Chiru are poached on the Tibetan Plateau, primarily in Arjin Shan, Chang Tang and Kekexili nature reserves, by a variety of hunters, including local herders, residents and officials; military personnel; gold miners; and truck drivers (Schaller 1993; Schaller 1994). Chiru are always killed to collect their wool; no cases of capture-and-release wool collection are known. Hunters shear the hides, and collect and clean the under-fur of the antelope, or sell the hides to dealers who prepare the shahtoosh -- each carcass yields 125-150 gm of shahtoosh (WPSI 1997).

Shahtoosh is smuggled by truck and yak or mule caravan from China through Nepal or India to the state of Jammu and Kashmir (J&K). Shahtoosh manufacturing in J&K is controlled by a wealthy, influential group of 12-20 trader and artisan families who prepare, weave and finish the raw shahtoosh into scarves and shawls that are sold throughout India (in contravention of national law and CITIES) and smuggled abroad. Shahtoosh products have been made in J&K for centuries.

Raw shahtoosh is de-haired, spun into fiber and woven on hand looms, then finished using a softening process. Ladies' shawls are traditionally one meter wide and two meters long, usually brown, beige, grey or off-white in color. Larger mens' shawls measuring three meters by one-and-a-half meters are also produced. An estimated 300-400 gm of shahtoosh are required to manufacture a lady's shawl, representing two-three chiru, while a man's shawl typically consumes the wool of five antelope (WPSI 1997).

''Fashioned for Extinction'' is particularly informative in documenting shahtoosh smuggling routes and techniques. Shahtoosh leaves Tibet via mountain border crossings with India or Nepal, or is smuggled overland from Lhasa. Increasingly, trucks are replacing livestock caravans as the preferred smuggling method, with shahtoosh often concealed in shipments of sheep wool, or hidden within the vehicle's cargo. Smuggling via airline from Kathmandu has also been reported by investigators.

Once shahtoosh reaches India, it is smuggled by road, rail and air directly to Srinagar in J&K or via Delhi. Although some raw shahtoosh has reportedly been exported to Italy, primarily finished shahtoosh products are smuggled overseas, frequently by mail, courier, hidden in shipments of ''woolen goods,'' or packed in traders' luggage (WPSI 1997).

Law enforcement authorities have confiscated shahtoosh shawls and scarves in the US, Canada, Italy, the UK and France, as well as in major Indian cities, Nepal, Japan, China and Hong Kong. Despite these seizures, few violators have been successfully prosecuted under national or international laws (WPSI 1997).

[9] The State Forestry Administration (SFA) of China emphasizes that the principal impetus for the global shahtoosh trade is ‘‘the existing market of the Tibet antelope wool... outside China [*sic*],’’ because ‘‘in some of the involved countries and regions, the Tibetan antelope wool... has not been eliminated from the market effectively [*sic*].’’

The SFA acknowledges that China’s efforts to eliminate poaching and stem the shahtoosh trade have done little to halt these activities: ‘‘Even though the Chinese government has implemented strict law enforcement, it has not be able to stop the slaughtering and smuggling [*sic*].’’ The SFA claims that in China ‘‘there has never been local market or tradition of using the animal’s meat, skin, bones or horns...’’ and ‘‘the Chinese people never had the tradition of using shahtoosh,’’ asserting that ‘‘All the poached antelope wool is smuggled outside of China.’’ The SFA report concludes ‘‘It is clear that elimination of trade and process of the Tibetan antelope wool in these countries is crucial and urgent for protecting and restoring the wild population [*sic*].’’

[10] In its 1998 species status review, the State Forestry Administration, which is responsible for wildlife protection, noted that in spite of "enormous efforts [that] have been made by the relevant Chinese agencies and a series of actions taken" to prevent chiru poaching and shahtoosh smuggling, "the activities are still going on." In view of the international scope of the shahtoosh trade, the SFA therefore made an "appeal for a joint effort with involved country government, international organizations and individuals to cease the crime of the poaching and illegal trade of the antelope wool, and protect and restore the species [*sic*]" (SFA 1998).

In its review, the SFA evaluated the scope of chiru poaching and shahtoosh smuggling and the agency's ability to address these threats. Based on confiscated antelope pelts and wool, and discarded carcasses, the SFA estimates that 20,000 antelope are poached a year in China, and that "frequent disturbance from poaching activity has seriously interrupted [the] antelope's original migratory and reproduction [*sic*]" (SFA 1998).

The SFA clearly suggests that existing regulatory mechanisms are inadequate to protect the chiru, because the agency has been unable to ‘‘stop the slaughtering and smuggling." The reasons are various: "With limited police power, poor equipment and funding, the antelope habitat is too big [600,000 sq. kms.] and difficult to be guarded closely..." and smugglers are "well organized in poaching, transportation, wool collecting and smuggling" (SFA 1998). The SFA emphasizes that the principal impetus for chiru poaching and shahtoosh smuggling lies outside China, in shahtoosh-consumer nations. ‘‘It is clear that elimination of trade... of the Tibetan antelope wool in these countries is crucial and urgent for protecting and restoring the wild population...’’ The SFA requested that ‘‘governments, organizations and individuals from those countries and regions where shahtoosh trade and process still occur... take effective means to stop commercial activities related to shahtoosh’’ (SFA 1998).

In China, convicted shahtoosh smugglers have been punished with sentences ranging from three to thirteen years imprisonment and fines of 700-15,000 yuan -- approximately $85-$1,800 -- for hunting chiru or trading in Tibetan antelope hides (Xinhua 1998).

In the early 1990s, the Tibet Forest Bureau began a major effort to suppress the chiru wool trade. By 1993, a total of 1,127 hides had been confiscated from Lhasa and the fine for killing chiru rose to $118, while 10 chiru poachers were arrested in a two-month period. Anti-poaching patrols, guards, and checkpoints were established and Shuanghu, Nyima and several other sites. In Qinghai, motorized Chinese hunters were encountered with high-powered rifles resulting in 1,600 chiru hides being confiscated during one anti-poaching patrol alone.

In October 1998, 14 poachers in the Tibetan Autonomous Region were convicted of collectively killing 500 antelope and purchasing 212 chiru hides, and sentenced to three-thirteen years imprisonment (Xinhua 1998). In December 1998, two were sentenced to six and seven years respectively for poaching more than 100 antelope and trafficking in more than 200 hides (AFP 1998). In early 1999, two poachers were sentenced to four and eight years respectively for using two jeeps and a truck to kill 170 antelope in Arjin Shan Nature Reserve and sell 120 of the hides. Two other hunters were sentenced to six and seven years receptively for killing 110 chiru in Kekexili Nature Reserve and trafficking in 200 hides (Liu, P 1999). A further 42 arrests of poachers were made in Kekexili reserve in April 1999, along with the seizure of 1,000 antelope pelts (Xinhua 1999).

The largest enforcement effort to date, involving several jurisdictions and dubbed the ‘‘Hoh Xil Number One Action,’’ resulted in the arrest of 66 poachers, the dispersal of 17 poaching rings, and the confiscation of 1,658 chiru hides between April and May, 1999 (Liu, J 1999).

Based on Schaller's estimate of a total population of 50,000-75,000 remaining Tibetan antelope, the SFA report concludes that the species is "on the verge of extinction... because the existing market of the Tibet antelope wool and its products outside of China is continuously providing huge profit [*sic*]" (SFA 1998).

Crackdowns have also increased in Hong Kong, with the most significant conviction for shahtoosh smuggling under national law implementing CITES handed down in April 1999, when a dealer was convicted of attempting to sell 140 shahtoosh shawls and given a three-month suspended jail sentence and an HK$ 300,000 fine (approximately US$ 39,000) -- the highest ever for a charge of violating Hong Kong’s Animal and Plants Protection Ordinance. An Indian national was arrested in December 1998 for trying to sell 23 shahtoosh shawls and pled guilty, receiving an HK$ 20,000 (US$ 2,580) fine (ENS 1999b; Pegg 1999; TRAFFIC 1999). Wildlife officers also seized 140 shawls from dealers in 1997, as well as an unspecified quantity in 1995 (TRAFFIC 1999).

[11] The Srinagar region in India’s state of Jammu and Kashmir (J&K) is the world’s only known location of shahtoosh weaving and commercial production, as well as the principal source of shahtoosh trade and sales (WPSI 1997).

The Jammu and Kashmir Wild Life (Protection) Act, 1978 [*sic*] (the J&K Act) designates the Tibetan antelope as a Schedule II species. Trade in Schedule II species, including shahtoosh, is permitted under certain conditions. The J&K Act specifies that state permission is required to possess Schedule II wildlife products, that unlicensed dealers are prohibited from selling these

products and that licensed dealers are required to report to the government any import of Schedule II animal products**.**

Jammu and Kashmir officials have repeatedly denied the state's illegal role in shahtoosh smuggling and manufacture, and emphasized the state's autonomy to regulate wildlife products. In April 1999, the J&K government announced plans to license shahtoosh weavers for a fee of 5,000 rupees a year (US$ 650) (ENS 1999a).

Regardless of the fact that the J&K Act supersedes India's national wildlife act in the state of Jammu and Kashmir, under CITES it is still a violation of the Convention for India to tolerate its states allowing the movement of shahtoosh into and out of the country. By failing to halt this trade, India is demonstrating that existing national regulatory mechanisms are inadequate to preventing and prosecuting the shahtoosh trade.

India faces a profound regulatory conflict in its attempts to control the shahtoosh trade. Until national wildlife law can be reconciled with the law of the state of Jammu and Kashmir, it will be difficult, if not impossible, for India to interdict the shahtoosh trade. In addition, India's failure to adhere to CITES provisions prohibiting the import and export of shahtoosh creates a major incentive for smugglers, shahtoosh manufacturers and retailers, and the state of Jammu and Kashmir to continue the illegal trade.

In 1997, the shahtoosh trade was estimated to be worth $160 million a year in India, an amount that clearly does not reflect the inflated retail value of shahtoosh products in First-World countries. Shahtoosh investigations or seizures have been reported in Australia, Belgium, Canada, China and Hong Kong, France, Germany, Italy, Japan, Mexico, Nepal, Pakistan, Singapore, South Africa, Spain, United Arab Emirates, United Kingdom, and the United States. With the exception of CITES non-signatory nations, the Indian state of Jammu and Kashmir is the only locality where the shahtoosh trade is legal (WPSI 1997).

Because of pressure from two NGOs (TRAFFIC-India and Wildlife Protection Society of India), India began to enforce its laws, resulting in confiscations of shahtoosh shawls in December 1995. These crackdowns revealed that the "shahtoosh trade is widespread and flourishing," according to the Wildlife Protection Society of India (WPSI 1997). WPSI has "collected evidence of the availability of shahtoosh shawls in dozens of establishments in Delhi" alone, and reported that as of mid-April, 1999, five seizures of shahtoosh netting almost 300 shawls had been made this year (Wright 1999). In spite of numerous shahtoosh seizures over the last five years, no perpetrators have yet been prosecuted in India (Indian Express 1998).

CITES management authorities in Italy and France have also taken action against the trade. In February 1997, police in London seized 200 shahtoosh shawls valued at $0.5 million, to give just one of several recent examples.

[12] In a particularly clear-cut case, Michael Sautman, a cashmere expert capable of the unaided identification of shahtoosh, reported a Madison Avenue, New York retail outlet of the Italian

company Malo to the USFWS in May, 1998 because it was openly selling shahtoosh shawls (Sautman 1998). More than a year later, Service law enforcement personnel reported to the Tibetan Plateau Project that the case is still under investigation and no charges have yet been filed (USFWS/DLE 1999). In addition to the Malo case, Service personnel report ‘‘a number’’ of other ongoing shahtoosh investigations.

In July, 1998 CNN reported that in the US, ‘‘Shahtoosh shawls are being sold nationwide in department stores and in high-end boutiques" (CNN 1998*). The Village Voice* reported as recently as May, 1999 that local retailers are ‘‘selling shahtoosh under the counter’’ in New York stores (Trebay 1999). In addition, shahtoosh has been offered for sale on the Internet in the US (Sautman 1998).

[13] In 1992, Chinese law enforcement officials patrolling "Altun Mountain" (Arjin Shan) Nature Reserve in Xinjiang Province were captured by 27 armed chiru poachers and subsequently released when the hunters escaped with the antelope hides. In 1996, officials were fired on by poachers in Arjin Shan; they subsequently arrested 20 poachers and confiscated 20 rifles and 10,000 rounds of ammunition (WPSI 1997).

In its 1998 report, ‘‘Conservation Status of the Tibet Antelope [*sic*],’’ the SFA noted that "incomplete statistics" indicate that since 1990, 100 cases have been identified (poaching cases are not distinguished from smuggling cases in the report); 17,000 antelope pelts and 1,100 kgs. of shahtoosh seized, along with 300 guns and 153 vehicles; and nearly 3,000 people arrested, while three poachers have been killed in the course of law enforcement actions. In addition, Sonam Daijie, the leader of the highly effective "Wild Yak Patrol"' anti-poaching squad in southwestern Qinghai Province, was killed in a shootout with chiru poachers in 1994 (Liu, J 1999).

Bleisch (1999) reported that in a confrontation with poachers in Arjin Shan Nature Reserve during a June-July, 1999 antelope research expedition, his team encountered 917 antelope carcasses and a group of poachers in the act of skinning dead chiru. Shots were exchanged between poachers and one of the research team members, and two poachers were apprehended, along with 40 antelope skins, a jeep and fuel cache, guns and ammunition.

A June 21 Agence France Press (AFP 1999) report on the incident (citing a Beijing Youth Daily article) reported that more than 30 poachers were involved in the incident and that one was killed -- a report that Bleisch, who was not at the scene of the shoot-out, could not corroborate (Bleisch 1999). An August 7 official report by Arjin Shan Nature Reserve managers later confirmed many of the details of Bleisch’s report, with slightly different figures provided, and concluded that ‘‘During the exploration, it has been found that chiru poaching is still rampant’’ in Arjin Shan (Arjin Mountain Nature Reserve Management 1999).

Literature Cited

Anon., ‘‘Conservation Status of the Tibet Antelope’’ [*sic*]. State Forestry Administration of China, December, 1998. Translated by World Wide Fund for Nature (WWF), China.

Anon., Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1975.

Anon., Endangered Species Act, 1973.

Anon., Jammu and Kashmir Wild Life (Protection) Act, 1978 [*sic*], Government of Jammu and Kashmir Civil Secretariat -- Law Department.

Anon., Law of the People's Republic of China on the Protection of Wildlife, 1989.

Anon., Wildlife (Protection Act) of 1972, The.

Anon., USFWS/DLE, pers. comm. to the Tibetan Plateau Project, June 1998-August, 1999.

Anon., USFWS/AIA, ''Nature Conservation Protocol with China,'' 1999: http://www.fws.gov/r9dia/global/china.html .

Anon., re the Jammu and Kashmir trade in shahtoosh.

Achuff, P., and Petocz, R. 1988. Preliminary resource inventory of the Arjin Mountains Nature Reserve, Xinjiang, People's Republic of China. Gland, Switzerland: World Wide Fund for Nature.

Agence France Press (AFP). 1998. ''China jails two for hunting the endangered Tibetan antelope.'' Dec. 30, 1998.

Agence France Press (AFP). 1999. ''Suspected poacher dies in shoot-out with police over Tibetan antelope.'' June 21, 1999.

Arjin Mountain Nature Reserve Management. 1999. ''Conclusions of Research on the Xinjiang Muztagh Chiru Calving Grounds.'' August 7, 1999.

Bagla, P. 1995. '''Sustainable Tigers?'" BBC Wildlife 15 (5):55.

Bleisch, W., Ph.D., China Exploration and Research Society 1999. Pers. comm. to the Tibetan Plateau Project via email.

Chanda, A.K. '''Shahtoosh,' king of wool, spells extinction for antelope,'' Agence France Press. March 19, 1999.

CITES. 1998. CITES Secretariat: http://www.wcmc.org.uk/cgi-bin/anap97.pl .

CNN. 1998. ''Endangered Antelope Killed for High-End Fashion," CNN Interactive. July 5, 1998: cnn.com/TECH/science/980705/tibetan.antleope/ .

Environment News Service. 1999a. ''India's Confused Policy on Shahtoosh Shawls,'' April 21, 1999.

Environment News Service. 1999b. ''Hong Kong Cracks Down on Shahtoosh Traders,'' April 5, 1999.

Feng, Z. 1991. Wild animal resources in the Hoh Xil region. Chinese Journal of Arid Land Resources 4: 247-253.

Fitzpatrick, John 1999. New York Department of Environmental Conservation, Division of Law Enforcement. Pers. comm. to Tibetan Plateau Project.

Fox, J. L. 1997. "Rangeland Management and Wildlife Conservation in the HKH," Rangelands and Pastoral Development in the Hindu Kush-Himalayas. Kathmandu: International Centre for Integrated Mountain Development.

Fox, J., Nurbu, C., and Chundawat, R. 1991. ''The mountain ungulates of Ladakh, India.'' Biol. Cons. 58: 167-190.

Fryxell, J. 1987. ''Food limitation and demography of a migratory antelope, the while-eared kob." Oceologica (Berlin) 72: 83-91.

Gatesy, J., Yelon, D., DeSalle, R., and Vrba, E. 1992. ''Phylogeny of the Bovidae (Artiodactyla, Mammalia), based on mitochondrial ribosomal DNA sequence.'' Mol. Biol. Evol. 9: 433-446.

Gentry, A. 1992. The subfamilies and tribes of the family Bovidae. Mammal Review 22: 1-32.

Goldstein, M., and C. Beall. 1990. Nomads of Western Tibet. Berkeley and Los Angeles: University of California Press.

Harris, R. B. 1993. ''Wildlife conservation in Yeniugou, Qinghai Province, China.'' Ph.D. Thesis, University of Montana. Missoula, MT.

Harris, R. B. and D. J. Miller. 1995. ''Overlap in summer habitats and diets of Tibetan plateau ungulates.'' Mammalia 59: 197-212.

Harris, R. B., D. H. Pletscher, et al. 1999. ''Status and trends of Tibetan plateau mammalian fauna, Yeniugou China.'' Biological Conservation 87: 13-19.

Kaji, K. 1983. An expeditions to the source of the Yellow River in China. Honyurui Kagaku 51: 1-9. (In Japanese).

Kelsall, J. 1968. Migratory barren-ground caribou of Canada. Canadian Wildlife Service Monograph no. 3. Ottawa: Canadian Wildlife Service.

Liu, J. 1999. ''China resolves to end chiru poaching.'' China Daily. June 30, 1999.

Liu, P. 1999. (no title), Guangming Daily. February 6, 1999.

Liu, W., and B. Yin, eds. 1993 Precious and rare wildlife and its protection in Tibet Beijing: China Forestry Publishing House. (In Chinese.)

Ma, L. 1991. Glimpses of northern Tibet. Beijing: Chinese Literature Press.

Macdonald, D. 1985. The Encyclopedia of Mammals. Ed D. Macdonald. New York: Facts on File Publications.

Miller, D. J. 1997a. "Conserving Biological Diversity in the HKH-Tibetan Plateau Rangelands." Rangelands and Pastoral Development in the Hindu Kush-Himalayas. Kathmandu: International Centre for Integrated Mountain Development.

Miller, D. J. 1995. "Herds on the Move: Winds of Change Among Pastoralists in the Himalayas and on the Tibetan Plateau," Discussion Paper Series. No. MNR 95/2. Kathmandu: International Centre for Integrated Mountain Development.

Miller, D. J. 1997b. "A Photo Essay of Himalayan and Tibetan Pastoralism." Rangelands and Pastoral Development in the Hindu Kush-Himalayas. Kathmandu: International Centre for Integrated Mountain Development.

Miller, D. J. 1999a "Snowstorms, Restocking, and Settling Nomads on the Tibetan Plateau in Western China." In press.

Miller, D. J. 1999b. "Tough Times for Tibetan Nomads in Western China: Snowstorms, Settling Down, Fences, and the Demise of Traditional Nomadic Pastoralism." In press.

Miller, D. J., and G. B. Schaller 1997. "Conservation Threats to the Chang Tang Wildlife Reserve, Tibet." Ambio Vol. 26 (3): May, 1997.

Miller, Daniel J., and G. B. Schaller 1996. "Rangelands of the Chang Tang Wildlife Reserve in Tibet.'' Rangelands 18(3): June, 1996.

Pegg, J. 1999. ''$300,000 fine for rare shawls dealer.'' South China Morning Post. April 14, 1999.

Sautman, Michael. 1999. Personal comms. to Tibetan Plateau Project via phone and email. June 1998-September, 1999.

Schaller, G.B. 1977. Mountain Monarchs: Wild Sheep and Goats of the Himalaya. Chicago: University of Chicago Press.

Schaller, G. B. 1993. ''In a high and sacred realm.'' National Geographic. 184: August, 1993.

Schaller, G. B. 1998. Wildlife of the Tibetan Steppe. Chicago: University of Chicago Press.

Schaller, G.B. and G. Binyuan. 1994. "Ungulates in Northwest Tibet." National Geographic Research & Exploration 10 (3), 1994.

Schaller, G.B., J. Ren, and M. Qiu. 1988. ''Status of snow leopard in Qinghai and Gansu Provinces, China.'' Biol. Cons. 45: 179-194.

Schaller, G.B., J. Ren et al. 1991. ''Observations on the Tibetan antelope (*Pantholops hodgsoni*).'' Applied Animal Behaviour Science 29: 361-378.

Shukla, Saurabh. ''A shawl that is a shroud,'' Indian Express, August 16, 1998.

Sinclair, A. 1979. ''The eruption of the ruminants.'' Serengeti, dynamics of an ecosystem, ed. A. Sinclair and M. Norton-Griffiths. Chicago: University of Chicago Press.

TRAFFIC. 1997. ''High-Fashion Shawls Threaten Species With Extinction," December 19, 1997.

TRAFFIC. 1998. ''Illegal Christmas Sale Stopped in Hong Kong,'' December 18, 1998.

TRAFFIC. 1999. ''Shahtoosh Dealer Sentenced in Hong Kong,'' April 13, 1999.

Trebay, G. "Dead Chic, The Killer Trade in Shahtoosh." The Village Voice. May 26-June 1, 1999.

U.S. Embassy China, "Gold Mining in China: Taming the Wild West," 1996. U.S. Embassy China website: www.usembassy-china.gov/english/sandt/goldw.htm .

U.S. Embassy China, "Tibetan Researcher on Changing Herder Lifestyles," 1998. U.S. Embassy China website: www.usembassychina.gov/english/sandt/tibethrd.htm .

Wright, B. and A. Kumar. 1997. Fashioned for Extinction – An Expose of the Shahtoosh Trade. New Delhi: Wildlife Protection Society of India.

Wright, B. 1999. Pers. comm. to the Tibetan Plateau Project via email. April 16, 1999.

Xinhua, ‘‘Tibet Punishes Poachers.’’ Oct. 28, 1998.

Xinhua, (no title). April 30, 1999.