SNOW LEOPARD
STATUS, DISTRIBUTION AND PROTECTED AREAS COVERAGE

A REPORT

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Background: This document reports on the status, distribution and protected areas coverage for snow leopard across its range in Central Asia. It is intended to aid in updating the existing knowledge base of snow leopard status and distribution during the Snow Leopard Survival Strategy (SLSS) Workshop organized by the International Snow Leopard Trust (ISLT), and to be held in Seattle on May 21-25, 2002. The SLSS workshop provides an unique opportunity to solicit feedback from scientists, conservation organizations, government agencies and knowledgeable experts in order to:

(1) Verify the accuracy of information presented in this document (much of which was published 5-10 years ago) and to identify data gaps, especially with respect to population size and protected areas coverage for this species;

(2) Aid organizations in developing tightly targeting conservation actions by identifying critical snow leopard areas, parks and reserves, and by implication, the intervening linking corridors linking key protected areas;

(3) Serve as a catalyst for encouraging range-countries to conduct field surveys into snow leopard status and distribution, especially in those areas deemed the most important to the maintenance of a viable metapopulation across the 12 countries in which the species' occurs.

The information provided in this document represents an update of the material author compiled and submitted in support of the Snow Leopard Chapter for the IUCN-Survival Service Commission's *Cat Action Plan* (Jackson and Nowell 1996). The author has drawn upon unpublished information and personal communications along with material contained in the Snow Leopard Information Management System (SLIMS) sponsored by ISLT, to whom the author extends his appreciation.

This report makes only cursory mention of the threats implicated in the decline of snow leopards across their range. Readers are referred to review papers by Fox (1989; 1994), Jackson and Fox (1997a), Nowell and Jackson (1996), and Schaller (1998), among others. Nowell (1997) briefly reviewed the trade market for snow leopard.

Much of the range-wide information on protected areas (*PAs*) coverage is taken from Green (1988, 1992), selected country reports (e.g., Singh et al. 1990), or from unpublished sources (e.g., Nepal and Bhutan). Green and Zhimbiev (1997) identified 109 protected areas covering an area of 276,123 km^2 , comprising of those places known to have snow leopards or as lying within potential snow leopard habitat. According to the information set contained in SLIMS (Jackson 1992, cited in Nowell and Jackson 1996), the number of protected areas is more like 120, but a vast majority are far too small to harbor a significant number of snow leopards. For example, of 102 protected areas, only 25% exceeded 1,000 km^2 in size, while 55% covered an area of 500 km^2 or less (Nowell and Jackson 1996). Another point of note is that many *PAs* contain relatively high percentages of non-habitat in the form of rock and permanent ice (WWF-US manuscript in preparation), so that size alone can be rather misleading.

There is little information on the current management status of protected areas or their role in sustaining snow leopard populations (Fox 1994, Green 1993, 1994, Green and Zhimbiev 1997). Jackson and Ahlborn (1990) felt that a large proportion of Nepal's snow leopard population probably occurred outside of the country's protected areas, where they were at greater risk from human activity. Transboundary or transfrontier protected areas may play an especially important role in sustaining the overall snow leopard population, since much of the species' range encompasses mountain ranges that constitute international borders (Fuller and Ahmed 1997, Green 1994, Singh and Jackson 1999). Green and Zhimbiev (1997) claim that 66% of the snow leopard *PAs* serve as *de facto* or potential transboundary protected areas.

To date, only Mongolia, Pakistan and Russia have implemented or drafted National Snow Leopard Conservation Plans (SLSS 2002), and although India initiated such a process at the 5th International Snow Leopard Symposium in 1986, it has yet to be followed through.

Total Range Area and Population

As shown in Table 1, Snow leopards are found in 12 countries across Central Asia (China, Bhutan, Nepal, India, Pakistan, Afghanistan, Tajikistan, Uzbekistan, Kyrgyzstan, Kazakhstan, Russia, and Mongolia). China contains as much as 60% of the snow leopard's potential habitat.

Inaccessible and difficult terrain, along with the secretive nature of this rare cat helps account for the fact that large parts of its range have yet to be surveyed, or have been surveyed only on rare occasions. Much of the snow leopard's distribution is located along contentious international borders, adding to the difficulty of reliably establishing the species' current status and distribution. In addition, many surveys were conducted over a decade ago, so that the existing database may be seriously outdated. There is now general agreement that population estimates of around 2,000 made in the early 1970's, when the endangered species regulations were enacted, are too low. Fox (1989) placed the total snow leopard range at 1.23 million km^2, with a world population of 3,350 - 4,050

animals. These figures were updated between 4,510 and 7,350 snow leopards within a total potential habitat area of 1,835,000 km^2 (Fox 1994). Table 1 compares population estimates three sources.

Table 1: Snow Leopard Population Estimates by Country

Country	*Green (1988)*	*Fox (1989)*	*Fox (1994)*
Afghanistan	n/a	n/a	100-200 (area-based estimate, low density)
Bhutan	n/a	n/a	100-200 (area-based estimate, moderate density)
China	350 (Gansu)	1,400	2,000-2,500 (Schaller 1990; Jackson 1992)
India	200 (Ladakh)	200-600	200-600 (Chundawat et al. 1988; Fox et al. 1991)
Mongolia	500-900	500-900	500-1,000 (Green 1988; Schaller 1994)
Nepal	150-300	150-300	350-500 (Jackson pers. comm.)
Pakistan	104-130	100-250	100-300 (Schaller 1976; 1977)
Former USSR	300--1000	1000-2000	
Russia	-	-	50-150 (Smirnov et al 1990; Koshkarev pers comm.)
Tajikistan	-	-	120-300 (Sokov 1990; Buzurukov pers comm.)
Kyrgystan	-	-	800-1,400 (Zhirjakov 1990; Koshkarev pers. comm.)
Kazakhstan	-	-	180-200 (Annenkov 1990; Zhirjakov 1990)
Uzbekistan	-	-	10-50 (Braden 1982, Koshkarev pers. comm.)
Totals:	1,604-2,880	3,350-4,050	4,510-7,350

Drawing on the 1:1,000,000 World Digital Charts, and using GIS, Hunter and Jackson (1997) estimated potential habitat for snow leopard at about three million km^2, with some six percent falling within the existing or proposed network of *PAs* (Table 2). For a map of potential habitat, see Figure 1 in Jackson and Ahmed (1997). At an uniform density of one cat per 300 km^2 this would translate into a total population of about 10,000 individuals. Obviously, not all of this area is occupied by the species because of excessive hunting pressure, lack of sufficient prey, disturbance by livestock and attendant humans, presence of marginal habitat or other factors. However, on the basis of available habitat, there could easily be as many as 6,000 to 8,000 snow leopards, especially given densities in known "hotspots" of the order of 5-10 individuals per 100 km^2. Conversely, areas classified as offering good habitat may no longer support good numbers of snow leopard. This exemplifies the difficulty of making population estimates without ground-truthing maps for their accuracy along with also verifying population extrapolations with data accruing from credible field status surveys.

It is often difficult to validate the reliability of published information, especially in the rapidly changing world we have seen over the past decade or so. For example, with the emergence of four entirely new independent "snow leopard " states in the Post-Soviet Central Asia, it is not hard to see why so much confusion exists over what were formerly well established permanent or temporary nature reserves given the radical political, social and economic change the region has undergone. Even in a relatively stable country, protected areas recognized by the State government may not receive equivalent recognition from the central government, such as the case of Jammu and

Kashmir in India. There is often considerable variation in the reported size of a protected area among different sources.

Table 2: Potential Habitat Area (in square kilometers) for Snow Leopard across its Range in Central Asia (Hunter and Jackson, 1997).

Country	***Total Habitat***	***Good***	***Fair***	***Percent Protected***
Afghanistan	117,653 (50,000)	32,748	84,905	0.3
Bhutan	7,349 (15,000)	1,269	6,080	57.4
China	1,824,316 (1,100,000)	290,766	1,533,550	6.3
India	89,271 (75,000)	33,996	55,275	14.4
Kazakhstan	71,079 (50,000)	14,775	56,304	1.7
Kyrgyzstan	126,162 (105,000)	32,783	93,379	1.1
Mongolia	277,836 (90,000)	21,180	256,656	2.5
Myanmar (Burma)	4,730 (0)	3,094	1,636	0.0
Nepal	27,432 (30,000)	12,388	15,044	26.7
Pakistan	81,016 (80,000)	32,348	48,668	6.6
Russia	302,546 (130,000)	41,166	261,380	4.5
Tajikistan	78,440 (100,000)	27,337	51,103	13.3
Uzbekistan	13,834 (10,000)	5,083	8,751	5.8
Disputed Areas	3,064	773	2,291	0.0
All Countries	3,024,728	549,706	2,475,022	6.0

Note: Figures in brackets indicate range estimate from Fox, 1994

COUNTRY BY COUNTRY STATUS ACCOUNT

Afghanistan

The area of potential habitat in this country been estimated at 80,000 km^2, 50,000 km^2, and 117,653 km^2 respectively by Fox (1989), Fox (1994), and by Hunter and Jackson (1997). Sayer (1980) and Adil (1997) reported on distribution and conservation of snow leopards in Afghanistan, but neither authors offered a population estimate. There are reliable sightings from the Big Pamirs, the Wakhan corridor, and the small Pamirs (specifically the Qule Chaqmaktin, Tegar Qarom and Berget valleys). It is also reported from Zebak in the southern part of Badakhshan. Reports from the Ajar valley by local people have not been substantiated. In the past, snow leopards been widely hunted because of the fur trade and stock theft (Petocz 1978). No doubt snow leopards and their ungulate prey have been very significantly impacted by the past 20 years of war, but information is lacking (Adil 1997; Zahler and Graham 2001).

The current status of snow leopard in Afghanistan is not known. Given the long history of civil war and armed conflict, it is hardly surprising that Afghanistan's wildlife laws are not being enforced nor are its *PAs* receiving any protection or management.

Bhutan

Potential snow leopard range in Bhutan totals as much as 15,000 km^2 according to Fox (1994). The 7,349 km^2 GIS-generated estimate provided by Hunter and Jackson (1997) is probably somewhat low. However, due to extensive forest cover the lower elevational limit for the species in Bhutan is probably closer to 3,800 than the 3,000 - 3,500 m typically of other parts of the Himalaya. As much as 57% of potential snow leopard range falls within existing *PA* system (Hunter and Jackson 1997). Assuming a density of one cat per 100 km^2, there would be about 100 snow leopards in Bhutan (Jackson and Fox 1997b).

Sign surveys have been conducted in two portions of Jigme Dorje National Park (Jackson and Fox 1997b; Jackson et al. 2000). Both surveys confirmed presence, but suggested lower average densities than in the Shey-Phoksundo National Park in Nepal, despite the greater abundance of blue sheep in Bhutan compared to Nepal (Fox and Jackson, this workshop).

When the Jigme Dorje Wildlife Sanctuary was declared in 1974, it encompassed the entire northern border of the country totaling 7,892 km^2 in area (Blower 1986). In 1995 the reserve was upgraded to national park status, but reduced in area to a contiguous 4,350 km^2 area along the country's western border with China (WWF-Bhutan unpub. data). Surveys are needed to confirm snow leopard presence in Torsa Strict Nature Reserve (650 km^2), the 1,184 Kulong Chhu Wildlife Sanctuary and possibly also the 755 km^2, Sakteng Wildlife Sanctuary. Occurrence within the 890 km^2 Thrumshingla National Park is deemed very unlikely, while the 1,730 km^2 Black Mountain National Park is isolated by extensive forest cover from the main distributional range of snow leopard in Bhutan (Jackson et al. 2000).

China

Fox (1994) estimated the total amount of snow leopard habitat in China at 1,100,000 km^2 with a population of 2,000-2,500 individuals (assuming a mean density of 1 animal per 250-300 km^2). Potential habitat was computed at as much as 1,824,316 km^2 (Hunter and Jackson 1997), making China, potentially at least, the single most important country with as much as 60% of all snow leopard range. Approximately 6% of this is thought to be is under *PA* coverage (Hunter and Jackson 1997).

Snow leopards occur in six provinces or autonomous regions (Qinghai, Gansu, Sichuan, Yunnan, Xinjiang and Xizang or Tibet), but are on the verge of extinction in a seventh (in Inner Mongolia). Wildlife was severely affected during cultural revolution throughout China, but especially in Qinghai Province. The trading in snow leopard bones and body parts for use in the traditional Chinese medicine (TCM) constitutes an increasingly serious threat throughout this region.

The largest reserve complex (in excess of 478,000 km^2) is that located on the Tibetan Plateau within Tibet and along the boundary of Xinjiang and Qinghai. However, these reserves harbor few snow leopards, because of unfavorable terrain, sporadic and generally low blue sheep numbers, or the presence of habitat rendered marginal by the high base altitude of the northwestern portions of the Tibetan Plateau (Schaller 1998). This protected area complex consists of Kokixile (83,500 km^2) in Qinghai, the 300,000 km^2 Chang Tang Reserve (including the Memar addition) in Tibet, and the 45,000 km^2 Arjin Shan Reserve in Xinjiang, with a proposed 50,000 km^2 addition along the central Kun Lun Range, also in Xinjiang. With the recent addition of the Xianza Reserve in Tibet's Siling County, this is the second largest protected area in the world (the largest, in Greenland, is mostly under permanent snow and ice cover).

Gansu Province: Liao and Tan (1988) listed 9 counties that reported snow leopards, but the species occurs along the periphery of this province, with most or all populations having been seriously depleted. It is now only marginally present in the Qilian Shan range along the border with Qinghai and in the Die Shan (several individuals only) along the border with Sichuan. Snow leopards have been extirpated from the Mazong Shan and the other outlying ranges along the Gansu-Inner Mongolia boundary (Wang and Schaller 1996).

The 5,000 km^2 Yanchiwan Reserve contains a small population (Schaller et al 1988b). The Qilian Shan National Nature Reserve, with a total area in excess of 20,000 km^2 was formerly offered good habitat, but there are now very few snow leopards or blue sheep left there (Jackson and Hunter 1994, unpub. data). More abundant blue sheep and argali populations, along with snow leopard sign, was found in a relatively small area in Subei County south of Zhangye (Jackson and Hunter1996, unpub. data), but there is apparently a decrease in number toward the Xinjiang boundary. Status surveys are urgently needed in the western edge of the province, as well as the central and eastern section of the Qilian Shan Reserve. Depletion of prey (blue sheep, argali, white-lipped and red deer) by unregulated hunting and poaching is probably the most important factor in the decline of snow leopard in this area. The status of poaching for the bone trade is unknown, here and in most other parts of snow leopard range in China.

Qinghai Province: Liao and Tan (1988) listed a dozen counties which contain snow leopard, Liao (1994) prepared a range map for the species, and Yang (1994) reported on recent field sightings. However, the most comprehensive and also wide-ranging field surveys were undertaken by Schaller and his co-workers during the mid-1980's.

Schaller et al. (1988b) estimated the total population at about 650 snow leopards within an occupied range of some 65,000 km^2 (based on an average of one cat per 100 km^2). This amounts to about nine percent of the total area of Qinghai and fringing parts of Gansu Province. Their range map shows a highly fragmented range including the Arjin Shan (bordering Xinjiang), the Danghe Nanshan, Shule Nanshan, and Qilian Shan bordering Gansu Province, and the Kunlun Shan which bisects Qinghai and terminates in the Anyemaqen Shan, along with a series of small massifs in the south near Tibet and Sichuan. Within the latter range section, Schaller et al. identified three "hotspots" (North Zadoi, South Zadoi, and Yushe), where the snow leopard density was placed at about one cat per 25-35 km^2. Abundant sign was also noted in parts of Eastern Anyemaqen and the Shule Nanshan in the extreme north of Qinghai Province. While the map prepared by Liao (1994) has important differences in the snow leopard's geographical distribution pattern from that of Schaller, it also illustrates the cat's range is highly fragmented in Qinghai.

Snow leopards have only been confirmed from two protected areas: the Dulong Hunting Reserve which covers about 75 km^2 and is obviously too small an area to harbor more than one or two cats, and Wild Yak Valley which is considered marginal snow leopard habitat (D. Miller, pers. comm.). At least 6 other areas (Kokixili 83,500 km^2, Arksai County Liqiaru Snow Leopard Area, Arba Snow Leopard Reservation, Ganza Snow Leopard Reservation, and Baoxin Snow Leopard Reservation) were proposed for reserve status at the 7th International Snow Leopard Symposium (Fox and Du, 1994). However, the legal status of these remains uncertain.

Sichuan Province: There is virtually no information on snow leopard distribution and status in Sichuan Province. Even its presence in selected giant panda reserves has yet to be confirmed, it is probably present in low numbers in various areas above timberline (Schaller 1998). Liao and Tan (1988) listed 10 counties where snow leopard have been reported, including Yaan, Baoxing, Jinchaun, Xiaojin, along with Aba, Garze, Dege and Batang. Clearly, surveys are urgently needed to confirm and establish the current distribution of snow leopard in Sichuan.

Yunnan Province: Information on snow leopard status and distribution in Yunnan is lacking, and field surveys are also urgently needed in this province. The amount of potential habitat, however, is limited to a small area in the Hengduan Shan where the TAR, Sichuan and Myanmar meet.

***Inner Mongolia Autonomous Region*:** According to Schaller (1998), snow leopards once occupied most of the large desert ranges on the Inner Mongolia-Ningxia border, including the Dongda Shan, Yabrai Shan, Ulan Shan, Daqing Shan and the Helan Shan, along with the Longshou Shan on the Inner Mongolia - Gansu border.

The species is now on the verge of extinction in Inner Mongolia and its continued survival is considered unlikely (Wang and Schaller 1996). A few cats may persist in the Arqitu area of the Lang Shan, and transients are occasionally killed along the border with Mongolia. Wang and

Schaller cite three areas which receive some protection, but none of these any longer support snow leopard. These areas are the Helan Shan (2,225 km^2) on the Inner Mongolian-Ningxia border, Ludansuoulin (not suitable snow leopard habitat) on the Mongolian border (106° 3" - 107°E) and the Lerenzhouer Reserve (which probably harbors the area's largest argali population).

Tibet Autonomous Region (TAR): As noted by Schaller (1998), the status and distribution pf snow leopards within the species' core range still remains largely unknown. However, it occurs sporadically across the entire Tibet Autonomous Region, with a more or less continuous distribution along the northern slopes of the Himalaya, and along the larger mountain ranges which bisect the Tibetan Plateau.

Surveys by Schaller (1998) indicate snow leopards are scarce in the Gandise and Nyainqentangla ranges, and both rare and localized in the vast Chang Tang Reserve, which he attributes to a paucity of blue sheep and cliff or other suitable escape habitat. Despite wide-ranging surveys across much of northwestern Tibet, Schaller rarely encountered snow leopard sign. This pattern may hold for other parts of Tibet, For example, a survey of over 40,000 km^2 area south of Lhasa along the Bhutan border indicated snow leopards had been virtually exterminated in the last decade. Several areas with reasonable blue sheep populations lacked snow leopard sign. Furthermore, initial surveys across parts of eastern Tibet indicate that blue sheep, the snow leopard's primary prey across the Tibetan Plateau, are very sparse and highly localized. The more extensive forest cover of SE Tibet further limits potential habitat for snow leopard, a fact not accounted by in the potential range map developed by Hunter and Jackson (1997). Elsewhere in eastern or northeastern Tibet, the more intensified human settlement and animal husbandry practices would be expected to adversely affect both snow leopard and their prey species, but this needs to be validated through surveys.

The best habitat for the species seems to occur in the sparsely populated and more broken western parts of Tibet, especially along the international border with Nepal and India. Jackson(1994a) reported up to 100 cats in the Qomolangma Nature Preserve, a 33,910 km^2 area along the main Himalaya and Nepalese border and centered on Mt. Everest.

Other reserves that may harbor snow leopard include the Xianza Reserve in central Tibet and the Medog (626 km^2) or Namche Barwa Reserve on the Yarlung Tsangpo in southern Tibet which is a comprised of a series of adjacent areas including the Dongjiu red goral reserve, the Bomi Gangxiang nature reserve, the Niela Tsangpo, and the Deyanggou takin reserve -- a number of which are located in the area under Indian administration (Jiang and Bleisch 1996). In addition, there are three small reserves near the town of Zayu and the India's Arunachal Pradesh border which may harbor a few snow leopards, but this needs to be confirmed with ground surveys (Schaller, pers. comm).

Thus, snow leopard status and habitat in Tibet urgently needs to be delineated. Areas with the highest priority for status surveys are the Nayainqentanglha, Taniantaweng and Ningjing Shan mountains in eastern and south-eastern Tibet, and along with western Nepal, the mountains bordering Uttar Pradesh in India, and the Nganlang Kangri mountains bordering Ladakh.

Xinjiang Autonomous Region: Schaller et al. (1988a) judged there were about 750 snow leopards in 170,000 km^2 of suitable habitat in Xinjiang, or about 10.6% of its total land area. Snow leopards are found in the Tien Shan mountains almost to the Mongolian border (Nan Shan and Karlik Shan); along the Mongolian-China border in the Altay, Baytik and Khavtag Shan complexes, in the Dhungarian Alatau (along the Kazakhstan border), the Arjin Shan and Kun Lun range along the northern edge of the Tibetan Plateau, the Pamirs along the Tajikistan/Afghanistan border, and the Karakorum mountains along the Pakistani border (see distribution map published by Schaller et al. 1987). There are three known reserves, but more if hunting areas are included too. The information in Schaller's distribution map is probably out-of-date now.

Known reserves are the (1) Taxkorgan Reserve (14,000 km^2 estimated population of 50-75 leopards, mainly in Mariang area) (Schaller et al. 1987); (2) A Er Jin Shan or Arjin Mountains (45,120 km^2), home to only a few snow leopard because of marginal habitat, with most snow leopards ranging across the south-eastern edge of the reserve (Butler et al. 1986; Schaller 1998); and (3) the Tomur Feng Reserve (100 km^2), which harbors fewer than 15 cats and with reports of 12 snow leopards having been killed during the winter of 1986-6 in a nearby area (Schaller et al. 1987). There are several proposed or *de facto* hunting reserves in Xinjiang that may harbor snow leopard. These are located in Hamu, Altay and Aksu (Pamir) prefectures, but no further information is available at the time of writing.

Judging by the number of pelts displayed in the Kashgar (Kashi) bazaar, poaching of snow leopard and other felid species is a serious problem. In 1992, one observer reported more than 30 snow leopard pelts being openly displayed for sale.

India

Chundawat et al (1988) estimated potential habitat for snow leopard in India at 95,000 km^2, of which 72,000 km^2 is located within Ladakh (a figure which includes about 20,000 km^2 within the disputed area between Pakistan and China). Mallon's (1984) report of only 100 - 300 snow leopards in Ladakh is certainly too low. Fox et al. (1991) reported that there were about 400 cats in NW India within the 72,000 km^2 area. These authors placed India's total snow leopard number at about 500, derived by extrapolating from an average density of one animal per 110 km^2 for good habitat along the north slopes of the Himalaya (an area of 30,000 km^2) and one per 190 km^2 for lower quality habitat along the southern slopes of Himalaya (area of 22,000 km^2). Hunter and Jackson estimated the amount of potential habitat in India at 89,271 km^2 of which about 14.4% under *PA* status.

There are at least 18 and possibly as many as 34 existing and proposed protected areas which could harbor snow leopard (Rodgers and Panwar 1988; Government of India 1988; Fox et al. 1991; Green 1992; Green 1993; Singh et al. 1990; ISLT, unpub. data). Bhatnagar et al (2001) listed 25 protected areas, totaling 7.6% of the biogeographic zone supporting the species. Snow leopards are reported or may be present in the following protected areas (Asterisk indicates confirmed presence):

Jammu and Kashmir State: A total of 12 areas, but the status of many is uncertain. These are Hemis National Park* (4,100 km^2) (good population); Dachigam National Park (141 km^2) (reported

seasonally); Overa-Arun Wildlife Sanctuary (425 km^2); Kishtwar National Park* (425 km^2) ; Rangdum (Nunkun) Wildlife Sanctuary* (200 - 550 km^2); Kanji Wildlife Sanctuary (100 - 340 km^2); Lungnag Wildlife Sanctuary* (400 - 1,000 km^2); Tongri Wildlife Sanctuary (25 - 70 km^2); Karakorum (Saichen-Shyok) Wildlife Sanctuary* (5,000 km^2); Daultberg Depsang Wildlife Sanctuary (500 - 1,000 km^2); Changtang Wildlife Sanctuary (1,000 - 3,000km^2); and Rupshu Wildlife Sanctuary* (1,000 - 3,000 km^2).

Himachal Pradesh State: the Pin Valley National Park* (675 km^2); Great Himalayan National Park*? (1,716 km^2); Kanwar Wildlife Sanctuary (61 km^2); Khokhan Wildlife Sanctuary (592 km^2); Kugti Wildlife Sanctuary (118 - 379 km^2); Lippa Asrang Wildlife Sanctuary (31 - 109 km^2); Nargu Winch Wildlife Sanctuary (278 km^2); Raksham Chitkul Wildlife Sanctuary (34 - 138 km^2); Rupi Bhaba Wildlife Sanctuary (125 - 269 km^2); Sechu Tuan Nala Wildlife Sanctuary (103 km^2); Tirthan Wildlife Sanctuary (61 km^2); and the Tundah Wildlife Sanctuary (64 km^2).

Uttaranchal State *(formerly Uttar Pradesh)*: Nanda Devi National Park* (630 km^2); Kedarnath National Park* (967 km^2); Valley of Flowers National Park (88 km^2); Govind Pashu Vihar Wildlife Sanctuary* (953 km^2); and Yamunotri Wildlife Sanctuary (200 km^2).

Sikkim State: Kangchendzonga National Park* (850 km^2); Dzongri Wildlife Sanctuary (468 km^2); and Tolung Wildlife Sanctuary (230 km^2).

Arunachal Pradesh State: Dibang Valley (2,000 km^2). Reports of snow leopard from the 1,807 km^2 Namdalpha National Park are highly likely to be erroneous, since the small amount of alpine habitat present is separated from the main Himalaya by extensive forest cover.

A density estimate is available only for one protected area, namely Hemis National Park. Mallon and Bacha (1989) estimated 75-120 cats in a 1,200 km^2 area of Hemis National Park of Ladakh. On the basis of tracks, Fox et al. 1991 concluded there were 5 to 10 snow leopards in the reserve or as many as 14 on the basis of available prey, a number later increased to 50-75 (Fox and Nurbu 1990).

Following in the apparent success of its tiger conservation initiative, in 1986 the Government of India launched Project Snow Leopard at the 5th International Snow Leopard Symposium which was held in Srinagar, Jammu and Kashmir. However, there has been very little follow-through, unlike the Project Tiger model. Basically, the snow leopard 'conservation plan' (Government of India 1988) identified reserves with known or potential snow leopard habitat and offered management and staffing recommendations for the key 13 snow leopard protected areas. Other than the surveys by Fox et al (1989) and centered in Jammu and Kashmir, there has been no systematic survey of the species in other parts of its range within India. Bhatnagar et al. (2001) offer a regional perspective for snow leopard conservation in the tans-Himalaya of India.

Myanmar (Burma)

A small area of potential habitat occurs in Myanmar along the Yunnan border (Hunter and Jackson 1977). While a few blue sheep remain, the presence of snow leopards is deemed unlikely (Alan Rabinowitz and George B. Schaller, pers comm.). A focused survey along the 4,700 km^2 area of high mountains is required to verify presence/absence of snow leopard. If presence were to be confirmed, Myanmar would become the 13th country with a wild snow leopard population.

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The only potential protected area is Mt. Hkakabo Raza, National Park which harbors the remaining blue sheep (Wikramanyake et al. 1998, 2001).

Mongolia

McCarthy (2000) estimated total range at 103,000 km^2, a figure similar to the Mallon's (1984) estimate of 130,000 km^2, and the Schaller et al. (1994) estimate of 90,000 km^2 -- but substantially different from Hunter and Jackson's figure 277,836 km^2. However, the latter is based on GIS modeling rather than field observation or interviews of local residents. The main populations are said to occur in the Altay and Transaltai Gobi mountain ranges, with smaller populations in the Khangai, Hanhohiy Uul and Harkhyra Uul ranges. Koskharev (1998) reported sightings made along sections of the Mongolia - Russian border (see account under Russia). Schaller et al. (1994) placed the eastern-most range extent at about 103 degrees longitude (see note under Inner Mongolia, China).

Thornback and Holloway (1976) placed Monglia's total population at less than 300, which is certainly too low a number. Bold and Dorzhzunduy (1976) estimated a total snow leopard population of 500-900. They judged there were 190-250 snow leopards in a 6,600 km^2 area in the South Gobi Province, and a calculated density of 4.4/100 km^2 in a 1,000 km^2 area encompassing the Tost Uul Range. Based on field surveys in the Altai and South Gobi area, Schaller et al. (1994) placed the total at about 1,000 snow leopards, and published a detailed range map that highlighted the very fragmented distributional pattern. Schaller et al. (1994) found sign of at least 10 cats within a 200 km^2 area of the Burhan Budai of the Altay, a density substantially above that existing elsewhere .

McCarthy (2000) provided a detailed range map and assessment and of snow leopard status and distribution in Mongolia, based on 328 sign transects across the snow leopard's entire range in this important range county. Presence is reported or suspected from up to 10 aimags, with population estimates varying from 800 to 1,700 individuals (McCarthy 2000, "A Snow Leopard Conservation Plan for Mongolia"). The highest densities are said to occur in the South Gobi, Central transAltai, and Northern Altai, with remnant populations in Khangai and possibly Khovsgol where the last snow leopards were sighted in the 1960s. McCarthy's surveys indicated that snow leopards cross 20-65 km of open steppe in traveling between isolated massifs. McCarthy concluded the snow leopard distribution in the Khangai is much reduced over that previously reported by Mallon (1985) and Schaller et al. (1994).

At least 10 protected areas harbor snow leopards (McCarthy 2000), totaling about 18% of the snow leopard's range within Mongolia. The protected areas include: (1) the Transaltay Gobi Strictly Protected Area or SPA (consisting of Great Gobi 'A' 44,190 km^2 and 'B' 8,810 km^2), (2) Khokh Serkh SPA; (3) Otgontenger SPA; (4) Tsagaan Shuvuut SPA; (5) Turgen Uul SPA; (6) Gobi Gurvansaikhan National Conservation Park or NCP, a 12,716 km^2 area in the south Gobi (Reading 1995); (7) Altai Tavaan Bogd NCP; and (8) The Burhan Buudai Nature Reserve, Alag Khairkhan Nature Reserve and Eej Uul National Monuments, in all totaling 1,110 km^2 within the snow leopard's range in the central TransAltai Gobi. No snow leopard sign has not been observed in the 723 km^2 Khokh Serkh SPA by either Schaller or McCarthy. Gurvan Saikhan and Altai Tavaan Bogd are the two largest *PAs* totaling some 28,080 km^2. McCarthy (2000) provides a list of areas meriting consideration for protected area status.

Nepal

The total amount of potential range is about 30,000 km^2 with a country-wide population of 150-300 animals (Jackson 1979, unpub. data). By applying a computerized habitat suitability model, Jackson and Ahlborn (1990) placed the hypothetical population for Nepal at between 350 and 500 individuals. Hunter and Jackson estimated the potential habitat at 27,432 km^2 with 26.7% under *PA* status.

Snow leopards are distributed along the northern border of Nepal with Tibet, with the largest populations occurring in the western parts (Mustang, Mugu, Dolpo and Humla districts) of Nepal (Jackson 1979). Snow leopards have been sighted north of the Annapurna Range, in the Langtang Himal, Rolwaling Himal, Makalu, Walunchung and Kanchenjunga massifs. Jackson and Ahlborn (1989) reported a density of at least 5-10 snow leopards per 100 km^2 in the remote, uninhabited Langu Valley of west Nepal. These are slightly higher than estimates from Manang (north of the Annapurna Range) in the Annapurna Conservation Area (Oli 1995), where blue sheep and livestock biomass exceeds 1,200 kg per km^2 (Jackson et al. 1994b).

Snow leopard presence has been confirmed in all but one of the following protected areas (Ahlborn and Jackson 1990, Dhungel 1994, Kattel and Bajimaya 1997): Langtang National Park (1,710 km^2); the Shey-Phoksundo National Park (3,555 km^2); Dhorpatan Hunting Reserve (1,325 km^2); Annapurna Conservation Area (7,629 km^2 in area, including the Manang, Nar Phu and Mustang sectors each offering good to excellent snow leopard habitat); Sagarmatha National Park (1,148 km^2); Kangchenjunga Conservation Area (2,035 km^2); Manaslu Conservation Area (1,663 km^2); and possibly elevation portions of the 2,233 km^2 Makalu-Barun National Park and Conservation Area. The 35,000 km^2 Qomolangma Nature Preserve in Tibet and centered on Mt. Everest, provides a corridor linking the protected areas of Makalu-Barun, Sagarmatha, Langtang, Manaslu and Annapurna, thus offering a potentially vast transfrontier protected area (Singh and Jackson 1999).

Based upon a computerized habitat model, Jackson and Ahlborn (1990) concluded that 65% of Nepal's snow leopard population were located outside of its protected areas. Populations of 50 or more individuals might be expected in three reserves (Shey-Phoksundo, Langtang and Annapurna),

but no protected area is expected to contain more than 180 animals even assuming mean densities as high as 5 snow leopards per 100 km^2 as suggested from sign surveys (Jackson and Ahlborn 1989; Fox and Jackson, this workshop).

Pakistan

Fox (1994) estimated snow leopard range in Pakistan at 80,000 km^2, while Schaller (1976) placed the total number at 100-250. Schaller searched a 300 km^2 area in Chitral known for snow leopard, but found evidence of only four or possibly five. Density estimates are lacking, but assuming a mean density of 1/250 km^2, the total population for Pakistan would be no more than about 320 snow leopards. Snow leopards occur in the Hindu Kush range in the Northwest Frontier Province's Chitral District, and in the Karakorum Range of the Northern Areas in the Gilgit, Hunza and Baltistan districts. A good population of snow leopard is reported from the Shimshal area in Hunza, but no density estimate is available (Wegge 1988). Its presence in Azad Kashmir Province remains unconfirmed (Roberts 1977). Malik (1997) described key threats to the species.

Hunter and Jackson (1997) estimated potential habitat at 81,016 km^2, of which some 6.6% is under *PA* status. Green (1988) reports the total amount of protected area supporting snow leopard is 3,190 km^2, but this figure has been greatly increased with the establishment of Conservancies under a United Nations Development Programme sponsored project. In addition, The Mountain Areas Conservancy Project (MACP) of UNDP/IUCN has delineated four areas or Conservancies totaling 16,300 square km, where community-based biodiversity conservation initiatives are currently being undertaken (MACP 2001). All of these areas likely support snow leopards. Two, the Nanga Parbat and Gojal Conservancies, are located in the Northern Areas, with the other two (Tirichmir and Qashqar Conservancies) in the North-West Frontier Province With the exception of the Khunjerab National Park and the recently established Conservancy areas, these *PAs* are too small to protect more than a very few cats, whose likely wander well beyond the *PA* boundary. The list in Fuller and Ahmed (1997) indicates there almost existing protected areas within potential snow leopard range in Pakistan (an asterisk below indicates protected areas where the species' presence has been confirmed):

North-West Frontier Province (NWFP): Chitral Gol National Park* (77.8 km^2); Agram Besti Game Reserve* (25 km^2); Goleen Gol Game Reserve *(442 km^2); Gahriat Gol Game Reserve* (48 km^2); Parit Gol Game Reserve (55 km^2), and Tirichmir and Qashqar Conservancies (size unknown).

Northern Areas: Khunjerab National Park* (2,669 km^2); Baltistan Wildlife Sanctuary* (414 km^2); Kilik/Mintaka Game Reserve (650 km^2); Naz/Ghoro Game Reserve (72 km^2); Sherquillah Game Reserve (168 km^2); Askor Nullah Game Reserve (129 km^2); Astore Wildlife Sanctuary (415 km^2); Chassi/Bowshdar Game Reserve (370 km^2); Danyor Nallah Game Reserve (443 km^2); Kargah Wildlife Sanctuary* (443 km^2); Nazbar Nallah Game Reserve* (334 km^2); and Pakora Game Reserve (75 km^2).

Snow leopard also occur in the proposed Central Karakorum National Park, but this *PA* was never formally declared. However, portions appear to fall within the Gojal Conservancy of MACP. The species is also very likely to occur in the Nanga Parbat Conservancy.
Azad Kashmir: Machiara National Park (including adjacent Bichla Manur protected area in NWFP) (260 km2); Ghamot Game Reserve (273 km^2).

Former USSR

With an estimated range of about 400,000 km^2, the USSR was said to support 1,000 to 2,000 snow leopards before its breakup (Braden 1982; Bannikov 1984). In Kyrgyzstan and Tajikistan alone, Koshkarev and Vyrypaev (2000) reported at least 1,200 - 1,400 snow leopards, a figure that represents 75% of the total estimated USSR snow leopard population. According to these authors and Bannikov (1984), there were 150 -200 cats in the Russian Union Republic, 100 in Uzbekistan and 180-200 in Kazakhstan for a total of about 2,000. Koshkarev (1989) estimated about the population of the Tien Shan and Dzhungarsky Alatau at 400-500 individuals

Snow leopard and large ungulate populations have plummeted in Kyrgyzstan, Kazakstan and Tajikistan since the dissolution of the Soviet Union in 1990, in large part due to rampant poaching exacerbated by the shift to a market economy and failure of government to pay its workers regular wages. Based upon a 3-4 fold increase in poaching, Koshkarev and Vyrypaev (2000) concluded that snow leopard numbers in Kazakhstan and Kyrgystan has decreased by at least 50%, along with a loss of habitat and greatly weakened protected areas management. Prior to 1990, as many as 25 protected areas may have harbored snow leopard (Braden 1984; ISLT, unpub. data). The current legal and management status of many reserves is unknown, but most are adversely affected by severe reductions in funding, poor staffing, and lack of political will for conservation shown by most independent Central Asian States.

The following paragraphs detail population estimates according to new sovereign states:

Russia

Potential habitat totals 131,000 km^2 (Koshkarev, pers comm.), with snow leopards being reported from the Altay and Sayan ranges bordering the People's Republic of Mongolia. Sopin (1977, cited in Fox 1989b) estimates the mean density at 0.75 - 1.5 individuals per 100 km^2 in parts of the Altai Mountains, for a total population of about 40. Until recently, there were no confirmed sightings from the Eastern Sayan Mountains, although tracks had been reported by local herdsmen in the early 1980's (Medvedev 1990). Koshkarev (1996) found sign in all three areas he surveyed in the central and eastern Sayan region, concluding that the Kropotkinskiy, Okinskiy and Tunkinskiy Mountains probably contained a core population of 20-30 snow leopards. This investigator (Koshkarev 1998) reported an average density of 1.5 snow leopard per 100 km^2 in the Tunkinskiy Range.

Smirnov et al (1990) estimated about 80 snow leopards resided in southern Siberia, including animals that wandered into Mongolian territory. There are unsubstantiated reports from the Southern Muisky and Kodar Mountains east of Lake Baikal (Koshkarev 1998). Koshkarev (1998) found old snow leopard sign in the mountains of western Hovsgol on the Mongolian side of the border.

Hunter and Jackson listed potential habitat at 302,546 km^2, with 4.5% under *PA* status. This is a significant increase in the area of potential range within Russian territory.

The presence of snow leopard is confirmed in two protected areas: the 389 km^2 Sayano Shushensky State Nature Reserve (where densities may be as high as one per 100 km^2 according to Zavatsky 1988), and the 864 km^2 Altaiskiy State Nature Reserve. Also reported from the following *Zakazniki* or short-term reserves: 1,030 km^2 Ininskiy, 2,413 km^2 Kosh-Agachskiy, 1,780 km^2 Shavlinskiy and the 3,200 km^2 Khindiktig-Khol'skiy.

Kyrgystan (Kirgizia)

Snow leopards occur in the Talasskiy Alatau and Ferganskiy mountains, as well as the Tien Shan bordering China and Kazakhstan (Braden 1982, Kosharev 1989). Koshkarev (1989) mapped snow leopard occurrence over much of its range in Kyrgystan, recording 20 inhabited areas (totalling 6,554 km^2), with an estimated population of 113-157. Densities ranged between 0.8-4.7 per 100 km^2, averaging 2.35 animals per 100 km^2. Over the entire snow leopard range in Kyrgyzstan (65,800 km^2), Kosharev judged the mean density to be one snow leopard per 100 km^2. In 1992, Kosharev (unpub. report prepared for IDRB, London) estimated 800 snow leopards inhabited the Tien Shan mountains of Kyrgyzstan and adjacent regions of Kazakhstan. Hunter and Jackson estimated potential habitat at 126,162 km^2, with about 1.1% under *PA* status.

Snow leopards occur in the 182 - 1,167 km^2 Besh-Aral'skiy State Reserve, the 173 - 190 km^2 Issyk-kul'skiy Reserve, the 182 - 242 km^2 Narynskiy *zakaznik* Reserve, the 237 km^2 Sary-Chelekskiy Nature Reserve (also Biosphere Reserve), and the 194 km^2 Ala Archa National Park. The government recently established the Sarychat-Ertush nature reserve in the central Tien Shan, which offers good habitat for snow leopard, argali and ibex.

Kazakhstan

Hunter and Jackson estimated potential snow leopard habitat at 71,079 km^2, with about 1.7% currently under *PA* status. In the south, snow leopards occur along the Khigizskiy Range and Tasskiy Alatau bordering Kyrgystan, in the Sarytau Mountains near Alma Ata, and bordering China in the Dzungarsky Alatau (where they are reportedly most common). Annenkov (1990) reported some 65-70 snow leopards in a 8,200 km^2 area, a mean density of 0.83 individuals per 100 km^2. Zailiskiy Alatau or northern Tien Shan has about 20 leopards according to Zhirjakov (1990), with the average number of tracks seen along a 10 km route being 0.2-1.2. The ratio of cats to ungulates (primarily ibex) is 1:160. The Alma Ata Sanctuary, located in the northern Tien Shan in the Zailisky Alatau has an estimated density of one snow leopard per 100 km^2, for a total population of about 20 (Zhirjakov 1990).

Snow leopards are reported from the 744 km^2 Aksu Dzhabagliy State Reserve and the 915 km^2 Alma Atinskiy Nature Reserve. Its presence in the 714 km^2 Markakol'skiy State Reserve is suspected, but unconfirmed (E. Koshkarev, pers comm.).

Tajikistan

Little is known about the current status and distribution of snow leopard in this Republic. Sokov (1990) estimated numbers at 200 - 300, significantly higher than a later estimate by Bururukov and Muratov (1994) who placed the total at 80-100 snow leopards. These authors attributed the decrease to a decline in the number ibex, the snow leopards primary large ungulate prey species across the Pamir and into the Tien Shan. There have been no recent censuses to my knowledge.

Snow leopards are said to occur in the central and western parts in the Zeravshanskiy, Gissarskiy, Karateginskiy, and Petr Pervyi mountains, and in the Hazratishog and Darvaskiy Mountains, and in the Gorno-Badahshansk area, including the Pamirs.

Hunter and Jackson estimated potential habitat at 78,440 km^2, with about 13.3% under *PA* status (a figure which assumes the Great Pamir NP is a functional entity since it was declared in 1992). Snow leopard are present in two of the three protected areas: Six animals were reported from the 161 km^2 Ramit State Reserve and the 197 km^2 Dashti-Dzhumskiy Reserve (Sokov 1990). Also reported from the 300 km^2 Iskanderskul'skiy lake reserve (but there is little habitat), the 680 km^2 Muzkul'skiy, 5,006 km^2 Pamisskiy, and the 510 km^2 Sangvorskiy *Zakazniki* reserves.

Uzbekistan

This range country stands at the far western edge of the snow leopard's range. They are reported from the Turkestanskiy, Chatkalskiy and Gissarskiy ranges bordering Tajikistan and Kyrgystan (Braden 1982), with the total population estimated at about 50 animals (Sludskiy 1973, cited in Braden 1982). More current estimates are not available. Hunter and Jackson estimated potential habitat in Uzbekistan at 13,834 km^2, of which about 5.8% is under *PA* status.

Snow leopards are reported from the 106 km^2 Zaaminskiy State Reserve and the 324 km^2 Uzbek National Park, as well as the 875 km^2 Gissarskiy State Reserve, which was formed by the Kyzylsuiskiy and Mirakinskiy reserves. The Chatkal'skiy State Reserve, consisting of two areas 111 and 242 km^2 in size, and separated by 20 km, also harbors snow leopards (ISLT, unpub. data).

CONCLUSIONS

Population estimates of snow leopards have been upgraded over the figure reported in the first *Red Data Book*, with the world's total remaining population now placed at between about 4,000 and 7,000 individuals. However, this estimate is rally a'guestimate' based upon surveys which were mostly undertaken over a decade ago, and or in the case of the Central Asia Independent States

when protected areas were in better shape than they are today. There is thus an urgent need to conduct updated field surveys using a standardized protocol such as SLIMS (Snow Leopard Information Management System), and to ensure in-country protected areas staff are trained on such techniques. It will be a very daunting task even to determine presence/absence of snow leopards across their vast and rugged range. Therefore, a more productive approach may involve mounting focused surveys to assess current predator and prey population status within key "hotspots" and representative protected areas of the existing network. Range boundaries and limits could probably be established or further refined through systematic interviews of knowledgeable persons within each of the 12 range countries. However even these steps will likely require considerable coordination, effort and cost, given the inaccessibility of snow leopard habitat and difficult logistics of undertaking field surveys. Despite such constraints, it is imperative that any status survey be well planned and executed in order to generate the necessary (and reliable) information vital to (1) assessing the importance or potential significance of different protected areas, (2) for identifying how and where reserves might best be linked by landscape level corridors, and (3) designing and developing effective site-specific conservation initiatives. Toward these goals, the full involvement and participation of local communities, wildlife agencies and research institutions is vital.

The SLSS offers a good opportunity to begin the process by mapping known sightings, and at least identifying and prioritizing known or suspected "hotspots" for further ground-truthing. Consensus is needed to determine where limited resources may best be directed in order to identify threats and designate key populations for a concerted, collaborative conservation effort.

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