PART II

WILD CAMELS

(*Camelus ferus*)

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The Conservation Status and Management of Wild Camels in Mongolia

Critically endangered wild camels (*Camelus ferus*) survive in just four more or less isolated populations in Mongolia and China (Reading et al. 1999). In 1975, Mongolia established the Great Gobi Strictly Protected Area "A" (GGSPAA) to help conserve the unique Gobi ecosystem and its rare flora and fauna, such as the wild camel (*Camelus ferus*) and Gobi bear (*Ursus arctos*). Subsequently, China created the Lob Nur Wild Camel Conservation National Natural Reserve in Xinjiang (Uigur Autonomous Region) and the Wild Camel Conservation Natural Reserve in Annanba (Gansu Province).

At present, an unknown number of wild camels inhabit these reserve areas. We have also a poor understanding of the factors limiting wild camel populations, primarily due to the difficulty of studying such wide-ranging animals that inhabit such harsh environments. That said, researchers have hypothesized that several factors may negatively influence wild camels, including poor reproduction, global climate change with increasingly dry and harsh climactic conditions and loss of water sources, predation, inter-breeding with domestic Bactrian camels (*Camelus bactrianus*) and a variety of human impacts. In this article we discuss the current status of wild camels in Mongolia, the various threats to this critically endangered species and aspects of its conservation.[1]

THE CURRENT STATUS OF WILD CAMELS IN MONGOLIA

We believe that three main factors influence the demography and distribution of wild camels: water sources, foraging opportunities and lack of human disturbance. However, factors affecting wild camel distribution have not been rigorously studied and most of our observations are biased by the difficulty of accessing much of the range of wild camels.

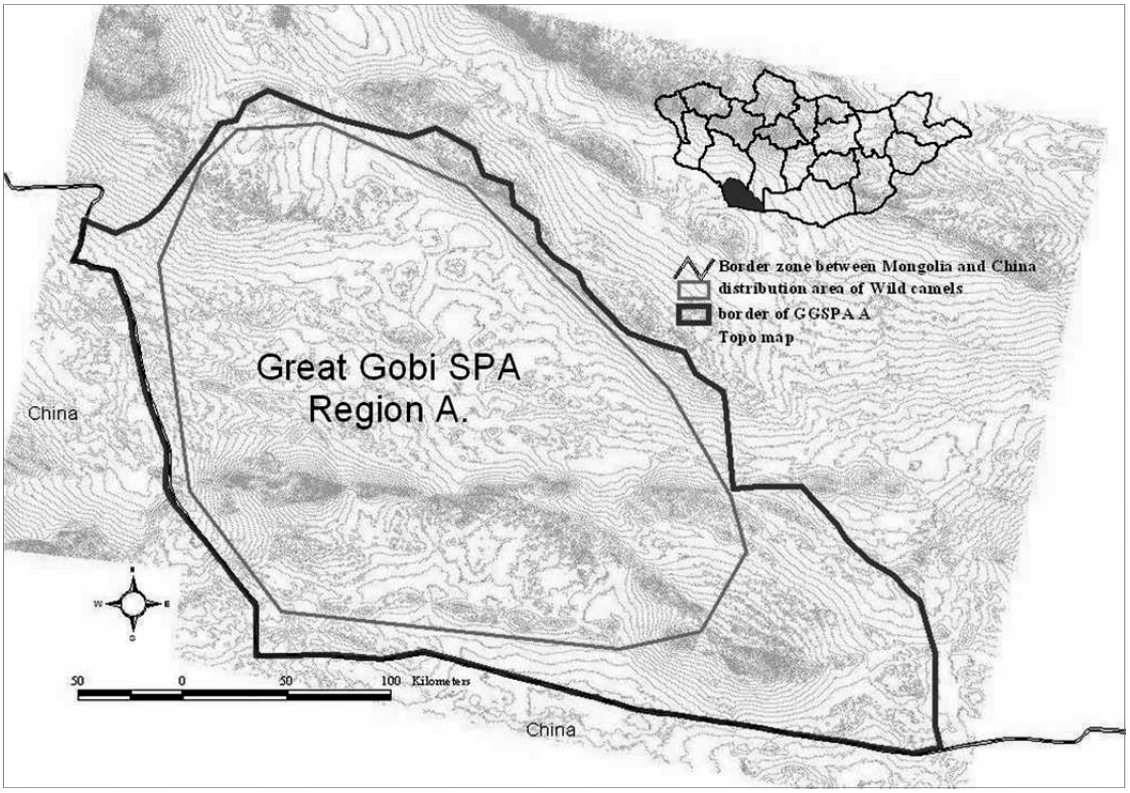
DISTRIBUTION

Given these caveats, we observed that herds congregate in and around massifs, as most springs occur there and snow cover on slopes provides a valuable water source during winter. Camels appear to shift to areas that have received recent rainfall in search of flushes of vegetation. We and others have observed herds of up to 100 individuals near mountainous areas of the Gobi, especially in October and November just prior to the rut (Tulgat/Schaller 1992, Schaller 1998).

Wild camel distribution in Mongolia today covers around 28,000–30,000 sq. km in the GGSPAA, suggesting a reduction in the wild camel habitat of about 70% since the last century. This loss in range suggests a decrease in population numbers of wild camels, although we do

[1] We would like to thank everyone who made our work possible, especially the Zoological Society of London's EDGE program, WCPF UK, Denver Zoo, the Institute of Biology at the Mongolian Academy of Science, the Great Gobi A Strictly Protected Area Park Administration staff, Chicago Zoological Society, Lincoln Children's Zoo, and also all the drivers and assistants who have helped us in the past. Special thanks are due to Mr. Choijin, who helped from our first trips to the Great Gobi "A" SPA to study wild camels and taught Adiya Ya. how to play cards during the long nights. Finally, thanks go to Henry Brown for helping with the translation into English.

not know if the decrease is proportional to habitat loss or if the population has remained stable and wild camels have simply retreated to a smaller range (Tulgat/Schaller 1992, Schaller 1998, Tulgat 2002, Guoying et al. 2002). We mostly observe camels in the southern part of the park (as we refer to the GGSPAA in this article), along the Atas and Ingis mountain ranges and also in the low-lying mountains on the northern edge of the park (see graph 6). Between these two areas, the region is more sparsely vegetated (except when it rains) with fewer water sources. Camels may gather around Atas Mountain to obtain moisture following early snowfalls in October and November. Following harem formation in December and January, males and their harems tend to move toward the center of the park while pregnant females and sub-adults remain near the mountains (Tulgat/Schaller 1992). This distribution has not changed over the past 30 years (Adiya et al. 2006).



Graph 6: Map showing the distribution (inner circle) of the last remaining wild camel population in Mongolia, in the Great Gobi Strictly Protected Area A (GGSPAA).

One way to learn about the distribution of wild camels is to monitor their movements via satellite.[2] Between 2002 and 2003, Reading et al. (2005) collared a female camel that covered a minimum distance of 4,527 km, moving further during the winter months (November to March) and leaving the park on one occasion for a few days. She used a home range[3] of 17,232 sq. km, although her core-use area was much smaller at 8,696 sq. km. She used two main areas: just south of Atas Mountain in the southern part of the park and an elevated area in the northeast of the park. Reading et al. (2005) also collared a bull camel, but – owing to on technical problems – received only 20 locations between 2003 and 2004. That camel travelled at least 683 km. His home range covered 8,191 sq. km and his core-use area covered 7,255 km^2. Based on these lim-

[2] GPS satellite collars make it possible to track movement patterns and habitat use and collared camels may be followed over a period of one year. For a more detailed description of the process see the article by Chris Walzer in this volume.

[3] The home range is the total area that an individual camel covers during the observed period, while the core area refers to the region where it stays for more than 50% of the time. A range of 17,000 sq. km is remarkable but expected in dry and harsh desert regions. It is also comparable with the home range of the Khulan (Mongolian wild ass; *Equus hemionus hemionus*).

ited data, the authors suggested that an important wild camel habitat might include the areas north and south of the Atas Mountain and the area to the northeast of Khavtsgait ("wild camel") Mountain next to the Nariin Khokhiin Range (see graph 6). The exact knowledge about the wild camels' distribution and preferred habitats is essential as a basis for further ecological studies and conservation efforts.

Wild camels have been recorded crossing the border in winter (Guoying et al. 2002) to reach Dacoatan Spring in China's Gansu Province, which lies 80 km south of the Atas Mountain Range in the GGSPAA in Mongolia and 15 km from the border.[4] However, Chinese authorities lifted a ban on mining in this area in 1990. Mining poses a considerable threat to the wild camels that use this spring, because miners use potassium cyanide to extract gold, thereby contaminating large grazing areas (Adiya/Dovchindorj 2006).

As mentioned, wild camels survive in only one population in the Mongolian Trans-Altai Gobi desert (GGSPAA) and in three groups in China, namely a small area of the Taklamakan Desert, the Gashun Gobi in the north of Lop Nur and Arjin Mountain (Wilson/Reader 1993, Reading et al. 1999). Although the populations around Lop Nur and Arjin Mountain seem to be connected, from a conservation perspective ideally all separate wild camel populations should be linked to improve genetic exchange and thus the chance to build a stable population. However, the Silk Road and later the Gansu-Xinjiang highway and the Lanzhou-Xinjiang railway have separated the Lop Nur Lake region from the Altai-Gobi Desert. In addition, a green corridor from Weili to Ruoqiang, the Tarim River and Lop Nur Lake has separated camel populations in the Taklamakan Desert from populations in the Gashun Gobi Desert and the northern piedmont of Arjin Mountain (Guoying et al. 2002). Accordingly, this highly endangered animal nowadays faces the disadvantage of being dispersed in at least three isolated populations with a still unidentified number of individuals.

Historical and Current Population Numbers

Historically, wild camels were extensively distributed throughout central Asia. Estimates of wild camel numbers in Mongolia have ranged widely from at least 300 in 1943 to about 500 in 1959-60 (Bannikov 1976, Dash et al. 1977) and up to 2000 in 1999 (Reading et al. 1999). [5] Unfortunately, all but the last of these surveys were conducted with methods that prevent accurate population estimates. General flaws in most surveys included small survey areas and different routes/methods applied during the trips, as well as gross extrapolations from transects and point counts, which neither accounted for the distance at which animals were sighted nor for the different terrains encountered. (Reading et al. 1999). Yuan Guoying, professor at the Institute of Environmental Protection in Xinjiang, China, suggests that as few as 730 wild camels remain in Mongolia and China; 75% less than 15 years ago (Anonymous 1998). Another estimate puts the world population of wild camels at 880, making it more endangered than the giant panda (*Ailuropoda melanoleuca*) (McWilliam 1997). Hare (2000) believed 350 wild camels remained in the GGSPAA in Mongolia and approximately 650 camels inhabited Xinjiang province, China. Guoyang et al. (2002) estimated about 730–880 wild camels surviving in three main areas in northwestern China and southwestern Mongolia.[6]

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[4] Some researchers believe that when camels occasionally cross the border into China they are killed there for meat (Tulgat/Schaller 1992), although no data exist to support these allegations.

[5] Results of other surveys in Mongolia were about 900 in 1974, 400–700 individuals in 1976, 500–800 individuals in 1980–82, 500–600 between 1982 and 1988, and 480 in 1989 (Bannikov 1976; Dash et al. 1977; Zhirnov/Ilyinsky 1986).

[6] Including about 40–60 camels in the eastern Taklamakan Desert, 280–340 in the northern piedmont of the Arjin Mountains and Aqik Valley, 60–80 in the Gashun Desert, and 350–400 in the frontier region of Mongolia (Altai-Gobi desert) and China (Xinjiang, Gansu and Inner Mongolia province) (Guoying et al. 2002). During one survey, Adiya and Dovchindorj (2006) observed only 10 wild camels in the Arjinshan Mountain and Gumuago Desert in China.

Focusing on Mongolia, sporadic surveys and research, especially by the joint Russian-Mongolian Gobi Scientific Expedition in the 1980s, provided most of the historic information on wild camels. Results from these expeditions suggested that camel numbers were declining and camel recruitment was low (a small proportion of young observed) (Reading et al. 1999). Young camels (between six months and one year old) averaged 4.6% during the 1980s surveys, suggesting that recruitment of young individual (i.e., birth rates and/or survival rates) has been poor since 1982 (Tulgat/Schaller 1992).

Population estimates of wild camels continued to vary widely in the 1990s. Surveys conducted from 1990 to 1994 estimated 450 individuals in 1990 and 320–345 individuals in 1993–1994 (Tulgat 2002). In the only systematic survey of wild camels of which we aware – an aerial survey conducted in March 1997 – a density of 4.98 animals per 100 sq. km or 1,985 camels in total were estimated (Reading et al. 1999).[7] However, of these more recent surveys only the work by Reading et al. (1999) covered the entire range of the camel, used standardized routes, and accounted for sight-ability, making interpretation of the results of other surveys difficult at best.

In a nutshell, population estimates for wild camels vary widely and were determined using several different methods that unfortunately preclude direct comparisons to assess demographic trends. Few surveys used rigorous methods that permitted determination of confidence limits. Instead, most estimates represent "guestimates" (educated guesses) based on non-systematic travels through a variable portion of the wild-camel range. As such, it remains very difficult to determine how many wild camels persist, even to the correct order or magnitude (i.e., hundreds or thousands), and whether the population is declining, remaining relatively stable, or increasing. Acquiring exact data, however, is essential for further conservation strategies and should have highest priority of all considered future measures.

DEMOGRAPHY

In addition to the unknown numbers of remaining individuals, demography also remains poorly understood and insufficiently studied. The wild camel's 14-month gestation period and strong reproductive seasonality limited to the rut season between November and March means that females can give birth to a calf only every other year at most. Yet surveys consistently find much lower productivity. Researchers generally report that calves comprise less than 10% of the wild camel herds, often substantially less, with female-to-calf ratios varying from 1:0.06 to 1:0.18). The ratios for one-, two-, and three-year olds were even lower (Dash et al. 1977, Zhirnov/Ilyinsky 1986, Indra et al. 2002, Adiya 2005, Dovchindorj et al. 2007). Researchers also reported a higher proportion of males in camel populations than females (Adiya 2005, Dovchindorj et al. 2007). The factors preventing higher pregnancy and juvenile survival rates remain poorly studied. In addition to slow reproduction rates there are severe threats to the existing population of wild camels.

THREATS TO WILD CAMELS

Several factors threaten the persistence of wild camels in Mongolia. The most important of these include illegal mining, poaching, loss of water sources, hybridization between wild and domestic Bactrian camels and human disturbance from nomadic pastoralists. We briefly examine each of these threats.

[7] Magash and Indra (2002) estimated around 400 ±12 wild camels in GGSPAA between 1998 and 2000. Indra et al. (2002) observed 307 wild camels in 36 groups during surveys in 1999. A 2004 transect survey along roads estimated a wild camel density of 0.17 individual/ 1000 ha, or a population of 470 wild camels (Dovchindorj et al. 2007). The Institute of Biology, Mongolian Academy of Science, estimated 328 ± 66 camels in 2003 and a density of 0.1–0.3 animals/ 1000 ha. Studies conducted in 2004 and 2005 estimated a population of 463 ± 92 camels (Adiya et al. 2006).

Illegal Mining

The rapid increase in illegal mining in Mongolia (Reading et al. 2010) has also begun to impact the GGSPAA. The park administration has reported several instances of illegal gold mining in the GGSPAA since 2008. Miners generally use potassium cyanide[8] to extract gold, which pollutes areas where wildlife and especially wild camel forage (Hare 1997). Mining also disturbs wild camels, moving them away from vital pastures and water points. In the winter of 2008, we encountered ten illegal mining sites with small-scale mining operations extracting gold within the buffer zone and core area of GGSPAA[9] (Adiya 2008b). Park rangers indicate that usually two to three cars filled with people enter the protected area to mine for several days. In some cases rangers catch and fine them or chase them out of the protected area. We also discussed illegal extraction of gold with herders and most of them reject this activity because of the damage it inflicts on pasture land. However, some herders stated that if they did not extract the gold themselves, foreign mining companies would come and take it.

Poaching

Hunting for meat formerly represented an important threat to the wild camel population (Zhirnov/Ilyinsky 1986). However, since the creation of the GGSPAA administration, hunting has mostly disappeared (Adiya et al. 2004). Officials reported only three instances of people entering the park to hunt without permits from 1995 to 1999 (Mijidorj 2002b).

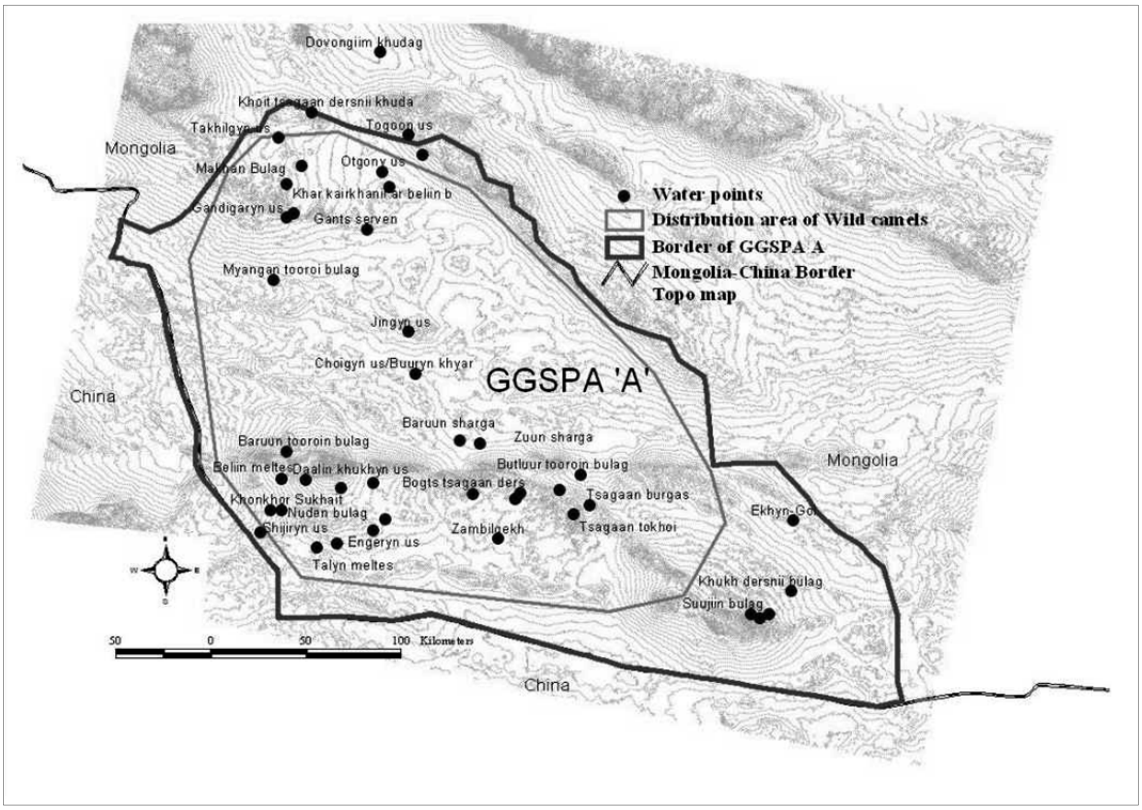
Loss of Water Sources

Climate warming and decreased precipitation has decreased the number of springs and oases as water sources available to wild camels, which is increasing pressure on the population in the region. Sixteen springs have dried up in recent years. The decrease in water sources adds extra pressure on the remaining water points (Oyunsuren/Munkhgerel 2007, Sarantuya 2000). Wild camels must now cover greater distances to find water.

During a survey in August 2008, Adiya (2008a) surveyed a total of 35 surface water points (see graph 7). 15 of these water points had dried up and four points did not contain enough water to sampled. Not all of the remaining sources contained water suitable for drinking.

[8] Potassium cyanide (KCN) is a highly toxic inorganic compound used to extract gold from soil. KCN damages energy production in the cell. It might be of interest that Wikipedia (consulted 8 Sept., 2011) mentions a number of prominent persons were actually killed or committed suicide using KCN, including members the Nazi Party, such as Hermann Göring and Heinrich Himmler, World War II era British agents (using suicide pills), and KCN was a popular method of murder in fiction, especially in the novels of Agatha Christie (remark ed. E.-M. Knoll).

[9] Like many other national parks, the GGSPAA is organized in a core and a buffer zone. The core area is a strictly protected region were natural development should be uninfluenced by human activities, while in the buffer zones carefully managed activities such as agriculture, pasturing or tourism are allowed and benefit local communities.



Graph 7: Map indicating the water points in the GGSPAA. A total of 15 water points had dried up and four points did not contain enough water for sampling: Mazaalain Shand, Tsagaan Tolgoin Us, Jingiin Us, and Zuun Sharga. Samples from the remaining 16 water points found that only four sources contained water suitable for human and animal consumption: Togoon Us, Shar Hulsnii Bulag, Boodog Sairiin Us, Maikhan Bulag. Nine sources held water suitable for animals but not humans: Otgonii Us, Shijiriin Us, Taliin Melyes, Bogts Tsagaan Ders, Tsagaan Tohoi, Tsagaan Burgas, Gandigariin Us, Tahilga, Khushuut Dund Us. Three sources provided water not suitable for human or animal consumption: Baruun Tooroi, Belin Beltes, Nuden Bulag. A previous survey by the Geo-ecology Institute at Baruun Shargiin Us, Chigiin Us and Myangan Tooroin springs found water unsuitable for human or animal consumption. During our survey in 2008, these points had already dried out. Most of the wells lie within the habitat of wild camels.

HYBRIDIZATION

Hybridization between domestic and wild camels poses a major threat to wild camels (Hare 2004, Silbermayr et al. 2010). Although genetically distinct (Ji et al. 2009. Silbermayr et al. 2010), domestic and wild camels can produce viable offspring. Tulgat (1992) suggested that herdsmen generally kill hybrid offspring due to the inferior quality of their wool, yet our discussions with local herders found that they intentionally hybridize camels to produce faster racing camels. In the second half of 2006, we recorded 44 hybrids amongst 17 pastoralist families living the buffer zone of GGSPAA: 13 males (castrated bulls), 15 adult females, six young males and ten young females. We believe that many more hybrids exist, as some families hide their hybrids. All bull hybrids we observed were castrated, as herders are convinced that second generation hybrids become weak and ill-tempered. However, hybrid females may give birth to second-generation hybrids, although we found no evidence of this during the survey, i.e. we observed no hybrid females with calves.[10.]

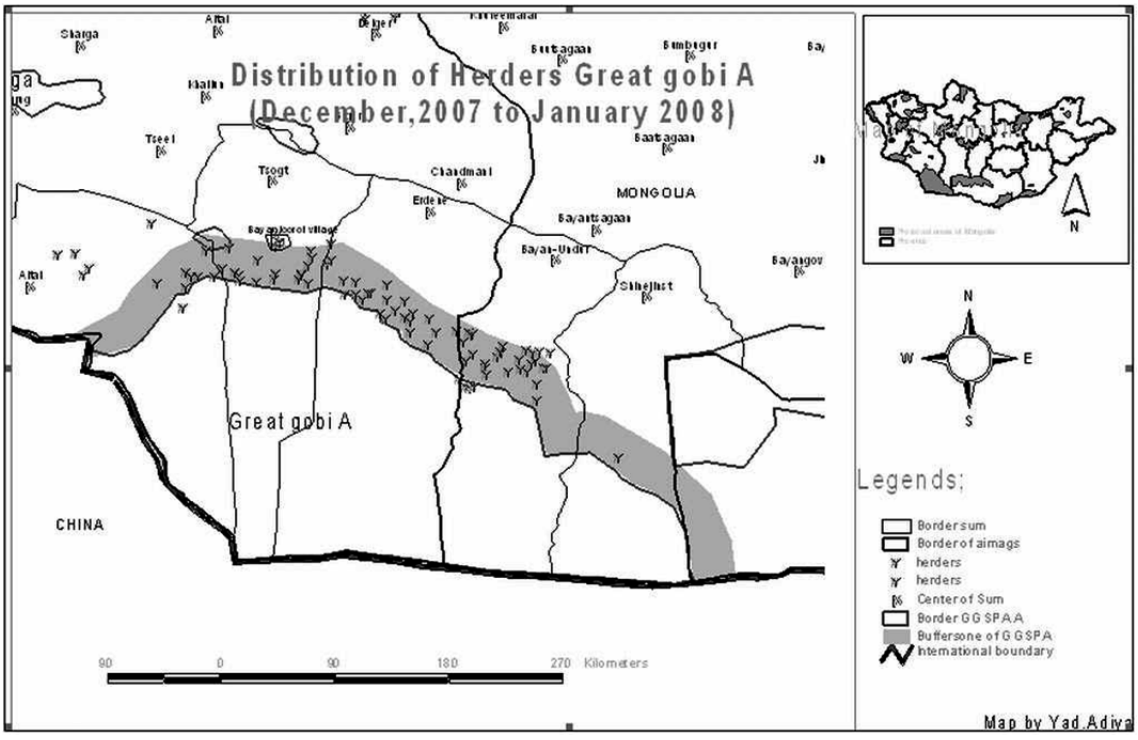
Domestic camels also sometimes join wild camel herds after becoming separated from their own herd. From 1995 to 1999, park rangers removed five domestic camels from wild camel herds to avoid hybridization. At certain times, wild and domestic camels may be attracted to the

[10] For more information how to detect hybrids using genetic tools see the article of Silbermayr and Burger in this volume.

same locations. In August 1998, for example, Mijidorj (2002b) observed 43 wild camels grazing with 23 domestic camels in Tahilga Bulag, probably because the high productivity of the oases at the time attracted both species to the site. Hybrid numbers increased following the bad winter of 2000/2001, when pastoralists led domestic herds further into the park in the search of food. Finally, during the rut, wild camels become extremely aggressive and may collect domestic females without the intervention of the pastoralists who legally reside in the buffer zone of GGSPAA (see graph 8).

Human Impacts and Livestock

Apart from hybridization, there is human impact on wild camels and their habitat in several other ways: grazing depletes wild-camel forage, the construction of shelters for herders and their livestock disturbs habitat, poaching directly kills and disturbs wild camels, the use of freshwater springs depletes water and disturbs camels trying to access those water points, collecting saxaul and shrubs for fuel depletes forage and disturbs animals, and livestock introduces diseases into wild camel populations. Many of these factors also increase desertification in the region (Sarantuya 2000). Further impacts include intensive agriculture in wild camel habitats, permanent human settlements near oases, feather-grass harvesting and an increase in motor-vehicle routes passing through the wild camel habitat. Basically, the simple presence of pastoralists keeps wild animals away from valuable pastures and water sources (Adiya et al. 2006). And livestock can transmit diseases as pastoralists release domestic animals such horses, cattle and domestic camels during the warm season for up to five months without active management (Enkhbileg et al. 2007b). All of these factors have led to the reduction in the wild camel's distribution during the 20th century (Tulgat 2002).



Graph 8: Map of herder winter camps in the buffer zone of the GGSPAA

Some areas of GGSPAA have to struggle with these anthropogenic impacts. For example, at the northwest boundary local pastoralists cross the buffer zone and herd their animals inside the park, causing degradation of habitat and dispersal of wildlife from the area (see graph 8). At some water points, as a further example, security posts are positioned to guard the national border with China but at the same time impacts on the habitat and the wildlife that come to drink there (Adiya et al. 2006).

WILD-CAMEL CONSERVATION AND MANAGEMENT

We propose addressing the situation of the critically endangered species *Camelus ferus* with several strategies, but focus on two strategies here: activities to conserve and strengthen the remaining population and captive breeding; while recognizing that other strategies would likely also benefit wild camel conservation. Mongolia has been employing both strategies. Two factors have saved the wild camel from extinction up to now: their extreme shyness and the fact that they inhabit one of the most remote habitats on earth (Tulgat/Schaller 1992). The large habitat requirements of the wild camel make it an ideal umbrella species[11] for conserving the habitat of the entire Trans-Altai Gobi (Dulamtseren 2002). The GGSPAA administration provides wild camels with active protection and a management program, but is seriously under-funded and under-staffed. The northern part of the park permits limited human use during drought periods, which enables the herders' livestock to graze around oases. Rangers conduct regular anti-poaching patrols across the northern and central parts of the GGSPAA. The remote southern half of the park contains military posts near the Chinese border, but otherwise few humans venture into this inhospitable place.

In the late 1990s, the Mongolian Academy of Sciences in cooperation with the GGSPAA administration and the Denver Zoological Foundation initiated a conservation project for the wild camels to assess the causes of population decline and develop ways to tackle it (Reading et al. 2005). In May 2007, the Zoological Society of London created two fellowships for a Mongolian and a Chinese scientist to study wild camels in their respective countries under their Evolutionarily Distinct and Globally Endangered (EDGE) program. This program highlights and invests in evolutionarily unique, critically endangered species, and it rated the wild Bactrian camel as the eighth most endangered mammal species in the world. A National Conservation Strategy Workshop for the wild camel in Mongolia took place in August 2010, which brought together representatives from most relevant groups, including officials from local and national governments, science and conservation experts and members of local communities.[12] During this workshop, participants followed the International Union for Conservation of Nature (IUCN) Species Conservation Planning Task Force's recommendations to develop a draft Mongolian National Conservation Strategy for the wild camel and its desert habitat. Participants examined current knowledge of *Camelus ferus*, proximate and ultimate threats to wild camels and specific actions required to reduce and reverse these threats, which the group then prioritized. Hopefully, the conservation strategy will be presented to the Mongolian Ministry of Nature, Environment and Tourism for official endorsement in 2012, so that the participants can begin to implement the planned actions. The plan calls for 1) preserving the genetic integrity of wild camels, 2) improving wild camel habitat (including both pasture and water), 3) increasing the population size and distribution of wild camels, 4) developing national and international awareness of the plight of wild camels, and 5) initiating sustainable conservation management of the species. Since we know so little about the status, biology and ecology of wild camels, more research is desperately needed, in particular, more rigorous and systematic population monitoring.

CAPTIVE BREEDING

Captive breeding began in Mongolia in 1987. Between 1987 and 1991, the GGSPAA administration captured ten male and 12 female wild camel calves and raised them using domestic Bactrian females. Unfortunately, only six males and seven females survived this experiment. The authorities failed, however, to separate the wild from the domestic camels after they had

[11] Umbrella species have very large habitat requirements relative to other species in the same habitat. Therefore, by ensuring protection of sufficient habitat for these organisms, other plant and animal species in the same area are usually protected as well.

[12] The Mongolian Academy of Sciences' Institute of Biology, the Wild Camel Protection Foundation Mongolia and the Zoological Society of London organized the workshop with the support of the Mongolian Ministry of Nature, Environment and Tourism.

matured, which led to some hybridization. In addition, aggressive wild males in captivity led to a number of problems, injuring both humans and other camels. The United Nations Development Program (UNDP) Mongolia Biodiversity Project tried to address this problem by establishing a more formal captive breeding program. However, the park authorities demonstrated only minimal interest in the program and possessed few resources, which aggravated the situation (Schaller 1998, Mijidorj 2002a).

In 2000, researchers from the State University of Agriculture in Mongolia tried to establish another captive breeding center. However, difficulties associated with herd management, the distance of the center from the distribution of wild camels, and hybridization problems between domestic bull camels and captive wild female camels led to the end of the program (Enkhbileg et al. 2007a). In 2003, the Mongolian government and the Wild Camel Protection Foundation (WCPF) signed an agreement to start a further captive breeding program near the GGSPAA. In October 2003, 12 wild camels from the former captive breeding program of the park were captured to initiate a new, more actively managed program (Hare 2004). The program hopes to produce enough animals for eventual reintroduction into the wild as a means of expanding the distribution of wild camels, although debate continues over whether wild or captive-born animals should be used if officials deem that reintroduction is desirable.

CONCLUSIONS

Wild Bactrian camels are critically endangered, surviving only in small areas of Mongolia and China. Despite decades of work, we still know very little about these unique animals or the reasons for their decline. Nevertheless, several factors possibly threaten the persistence of wild camels, including illegal mining, poaching, a reduction in the number water sources, hybridization with domestic Bactrian camels, and human disturbance. Recent research and conservation initiatives promise to improve our understanding of the species and the threats facing them, thereby increasing population size and distribution. We recommend undertaking several conservation-management actions, including (i) raising awareness at both the local and national levels about the plight of wild camels; (ii) conducting research and consistent, long-term monitoring of wild camel populations, (iii) establishing a trans-boundary park between China and Mongolia and creating corridors for wild camels to move between isolated habitats within Mongolia; and (iv) improving regulations and law enforcement and addressing socio-economic concerns to mitigate human impact.

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