

Current Population and Conservation Status of the Tibetan Wild Ass (*Equus kiang*) in the Arjin Mountain Nature Reserve, China

Mardan Turghan,¹ Ming Ma,^{1*} Xiang Zhang,² Tong Zhang¹ and Ying Chen³

¹Key Laboratory of Biogeography and Bioresource in Arid Land, Xinjiang Institute of Ecology and Geography, CAS, Urumqi, China, 830011

²Environmental Protection Agency of Bayinghulin Autonomous Prefecture, Xinjiang, China, 841000

³Fudan University, Shanghai, China, 200433

Abstract.- The Kiang (*Equus kiang* Moorcroft, 1841) is listed as a Least Concern species by the IUCN. From 2011-2012, field surveys were conducted in the Arjin Mountain Nature Reserve in Xinjiang, China to collect up to date information about the current population and conservation status of the Kiang (*Equus kiang* Moorcroft, 1841). During the survey, direct (observation) and indirect (questionnaire survey) methods were used to collect information about the Kiang. The study area was divided into seven main sites (At Atkan, Kara Dong, Kara Qokka, Ixak Patti, Ayak Kum, Aqqik Kul and Whale Lake) within the nature reserve. The study was conducted in the early morning and late afternoon, when the Kiang is most active. A total population of 8,500-9,500 Kiangs were estimated for the reserve of 45,000km², with the highest population in Ayak Kum (34.9%), followed by Ixak Patti (22.06%), Aqqik Kul (21.01%), Whale Lake (12.98%), Kara Qokka (5.18%), Kara Dong (3.53%) and At Atkan (0.30%). The overall population density of the sites was recorded as 0.63±0.23 animals /km², with the highest density of 1.47/km² recorded in Ayak Kum, while the lowest observed density of 0.01/km² was recorded in At Atkan. Although the results are encouraging, the species is still threatened, and intensity of the potential threats varied between sites. Fencing, intensified competition with domestic livestock, road infrastructure construction and mining activities were the major threats to the conservation of the Kiang in the Arjin Mountain Nature Reserve. We recommend that such threats need to be addressed and monitored specifically in future for the conservation of the Kiang population.

Key Words: Tibetan wild ass, Tibetan Plateau, Arjin Mountain, Population Estimates, Conservation of Kiang.

INTRODUCTION

The *Equus kiang*, commonly called the Kiang or Tibetan wild ass, is the only equid living on the Qinghai-Tibetan Plateau (Antoine and Steeve, 2009). It is widely distributed at elevations of 2,700–5,300 m (Schaller, 1998), where it inhabits open terrain, alpine meadows, desert steppes, broad valleys and rolling hills sparsely vegetated with grasses and sedges (Harris and Miller, 1995; Schaller, 1998; Bhatnagar *et al.*, 2006; Antoine and Steeve, 2009). The species extends into northern parts of Pakistan, India, Nepal and possibly Bhutan; the western limit of its distribution lies on the border of Khunjerab National Park in Pakistan (75°19'E), and its eastern limit occurs in Qinghai, China (102°54'E) (Antoine and Steeve, 2009).

The Kiang is one of the world's least studied species (Sharma, 2004). It is listed as "Least Concern" in view of its distribution, large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (IUCN, 2011). Unlike the Asian wild ass *Equus hemionus*, of which the population has declined drastically, the Kiang continues to have a wide distribution with fairly large populations. Although it has a broad range, the Kiang distribution has become increasingly fragmented and are facing several threats including conflicts with anthropogenic pressure and competition with other wild domestic livestock, over-hunting, and possible disease transmission from domestic livestock (Schaller, 1998).

The current population estimate of the Kiang worldwide is 60,000-70,000 animals, 90% of which are reported to be in China (Shah, 2002). In Xinjiang, the best known Kiang population is in the Arjin Mountain Nature Reserve (Schaller, 1998).

* Corresponding author: maming@ms.xjb.ac.cn
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West of the Reserve, 108 Kiang were sighted in a 4,000 km² area, which provides an estimation of about 4,500-5,500 (Schaller, 1998). The Kiang were more abundant in the eastern half of the reserve, where over 1,000 Kiang were sighted by Butler *et al.* (1986), whilst Feng (1991) had recorded 770 Kiang within 1030 km². These numbers were extrapolated for an estimate of 41,262 Kiangs for the whole reserve (Gao and Gu, 1989), which was considered grossly overestimated by Schaller (1998). The western Arjin Mountain Nature Reserve had a very low Kiang density of 0.137/km², especially in the vicinity of gold-mining camps. Kiang numbers were estimated to be 1,500 in this area of the reserve (Shah, 2008).

Estimating abundance is one of the most important prerequisites for the conservation and management of wildlife because it defines the need and scope of human action (Ramson *et al.*, 2012). Because the current status and trends of Kiang populations are contended or otherwise inadequately recorded or researched, it is difficult to come up with one set of data that may apply to the entire Kiang population and its range. Population declines or increases show regional variation (Schaller, 1998), and, it must be stressed, these figures come from several surveys conducted using different methods over a period of less than 20 years. Also, the Kiang is a transborder species, and their propensity to make large-scale movements makes any attempt to quantify their numbers for any given area very difficult (Shah, 1996). For this reason study on their estimates are urgently required throughout the Kiang's distribution range. The purpose of this article is to evaluate the current population and conservation status of the Kiang in the Arjin Mountain Nature Reserve, as well as to document the major threats for the conservation of Kiangs in the reserve.

MATERIALS AND METHODS

Study area

The study was conducted around the seven protection stations in the Arjin Mountain Nature Reserve (Fig.1). The reserve, one of the last great expanses of wilderness left on Earth, is located in Qarkilik County, Xinjiang Uyghur Autonomous

Region, in western China (E87°10' □ 91°18' □ N36°00'□37°49'). It was established in 1983 in order to protect its mountain ecosystem and was later upgraded to a National Nature Reserve in 1986. Bordering the Qinghai-Tibetan Plateau to the north and covering an area of 45,000km², it is the 2nd largest Nature Reserve in China after the Chang Tang Nature Reserve in Tibet (Ma *et al.*, 2005). The altitude ranges from 3,876 m at Ayak Kum to over 6,973 m at Muztagh Mount (Chen, 1985). The entire area is under snow cover from November to March. Broad, rolling alpine steppes broken by hills, glacier-capped mountains and large basins studded with wetlands and salt lakes are the visible forms of landscape in the region. The climate is characterized by dry, cold winters, strong winds, high levels of solar radiation, a wide range of temperature between day and night, a short frost-free period, low precipitation and high evaporation. Annual precipitation varies from 200 ± 300 while the annual evapotranspiration is about seven times greater. Precipitation is mainly concentrated in July and August. Annual temperatures range from -31°C in January to 28°C in July; the recorded lowest temperature is -41°C.

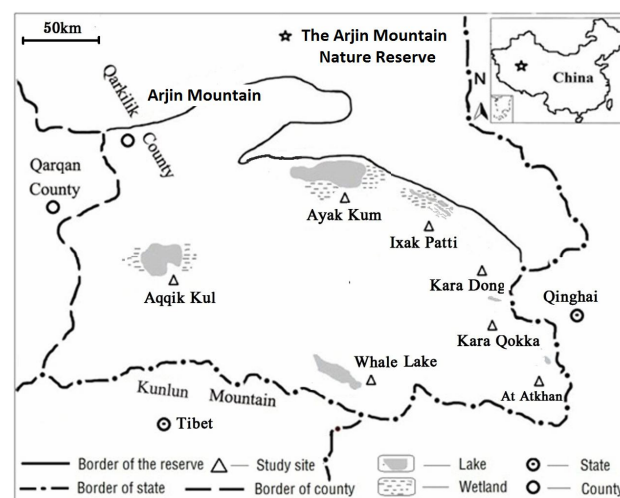


Fig. 1. The study sites of the Kiangs in the Arjin Mountain Nature Reserve, China.

The remote and mysterious reserve, characterized by high elevations, low annual precipitation, low nutrient levels and extremely cold weather in the winter, provides protection for a

unique assemblage of wildlife; the terrestrial vertebrates include 49 mammal species and more than 120 bird species. Among them are the wild yak (*Bos mutus*), Tibetan antelope (*Pantholops hodgsonii*), snow leopard (*Uncia uncia*), ibex (*Capra ibex*), black-necked crane (*Grus nigricollis*), bearded vulture (*Gypaetus barbatus*), Pallas's fish eagle (*Haliaeetus leucoryphus*) and golden eagle (*Aquila chrysaetos*), which are all listed as Category I Key National Protected Species under the Chinese Wild Animal Protection Law (CWAPL).

The mammalian fauna inhabiting the Reserve is unique and lacks research. Pastoralists living on the plateau have always had some impact on the wild life populations, although their subsistence economy and relative isolation until the 1950s allowed most species to persist in relative security. In recent years, these species have become increasingly vulnerable to poaching and habitat alteration as human populations in nearby areas have increased and as improved access and increased wealth generally have allowed incursions.

Study method

During the study conducted from May 2011 to July 2012 (53 days in total), the area was divided into seven sites (Fig. 1) based on the topography and geographic conditions, which permitted complete coverage of the reserve. Each site represents an preexisting administrative unit used as a protection station. Visual counts were conducted in the early morning and late afternoon, when the Kiang is most active, and on sunny days only, since that is when Kiangs and foals can be counted up to a distance of 10 km. We completed censuses at each site within the first two days of arrival and compared it with the neighboring census to ensure that no significant movement of the counted animals had occurred between the sites in order to avoid the possibility of double-counting of the same animals.

The total count method was conducted at all study sites; the entire Kiang habitat was traveled by car and on foot, ascending to the vantage points where available, and stopping at the same locations in each study period (May 2011, October 2011, May 2012). A positive identification of all Kiangs was made by scanning the surrounding terrain using binoculars and a spotting scope. To avoid repeat

counts of the same individuals, disturbing the Kiangs was avoided as far as possible, and the direction of their movement of the animals was carefully observed. Habitat quality and extent of disturbance in and around these areas were also considered while estimating the population (Zulfiqar *et al.*, 2011). Data recorded included date, time, GPS location, groups and population size, vegetation type, water sources, grassland fences, mining sites, roads and domestic sheep.

Secondly, interviews with local wardens and pastoralists, officials of the administrative bureau of the reserve, were conducted to get information on domestic livestock, mining sites, road construction, poaching and conservation action planned for the Kiang. The severity of the potential threats to the Kiangs in different sites were estimated based on literature reviews, preliminary interviews and field assessment.

RESULTS AND DISCUSSION

Kiang was distributed in all the survey sites in the Arjin Mountain Nature Reserve. The result of the study was shown below and was discussed in the light of present knowledge on Kiang.

Population status

During the surveys from May 2011 to Oct 2012, a total length of 945 km was traveled and 11,913 Kiangs in 463 groups were recorded. The mean group size was 27.73 ± 39.79 (SD), ranging from one to 380 Kiangs. The overall population density was recorded as 0.63 ± 0.23 individuals/km², with the highest density of 1.47/km² recorded in Ayak Kum while the lowest observed density of 0.01/km² was in At Atkhan (Table I). Large numbers of Kiangs were found in the eastern half of the reserve (Tables I-III, Figs. 1-2).

Ayak Kum had a highest observed density of 143.57 animals/100km², followed by Ixak Patti (90.72 animals/100km²). The lowest observed density occurred in At Atkhan (1.25 animals/100km²) due to a high level of disturbance from residential areas, road infrastructure construction and mining activities.

In our study we found 3,933, 4,107 and 3,873 Kiangs in May 2011, October 2011 and May 2012

Table I.- Number of Kiang, groups, mean group sizes(\pm SD), and animals/ km² observed in different sites the Arjin Mountain Nature Reserve, China (May 2011, Oct 2011, May 2012).

Sites	Date	Area surveyed (km ²)	Distance traveled (km)	No. of group	No. of Kiang seen	Mean group size \pm SD	Kiang density/ km ²
At Atkhan	May 2011	1000	50	7	16	2.29 \pm 1.38	0.02
	Oct 2011	1000	50	3	5	1.67 \pm 1.15	0.01
	May 2012	1000	50	5	9	1.80 \pm 0.84	0.01
Kara Qokka	May 2001	800	40	20	153	7.65 \pm 5.21	0.19
	Oct 2011	800	40	11	183	16.64 \pm 11.73	0.23
	May 2012	800	40	17	175	10.29 \pm 7.26	0.22
Kara Dong	May 2001	500	25	13	87	6.69 \pm 4.68	0.17
	Oct 2011	500	25	6	58	9.67 \pm 5.96	0.12
	May 2012	500	25	9	73	8.11 \pm 6.11	0.15
Ixak Patti	May 2001	600	30	26	483	18.58 \pm 12.23	0.81
	Oct 2011	600	30	17	628	36.94 \pm 24.29	1.05
	May 2012	600	30	23	522	22.70 \pm 14.29	0.87
Ayak Kum	May 2001	1000	50	39	1470	37.69 \pm 56.91	1.47
	Oct 2011	1000	50	21	1331	63.38 \pm 77.08	1.33
	May 2012	1000	50	37	1506	40.70 \pm 71.63	1.51
Aqqik Kul	May 2001	1200	60	54	1028	19.04 \pm 27.01	0.86
	Oct 2011	1200	60	31	1104	35.61 \pm 45.83	0.92
	May 2012	1200	60	46	980	21.30 \pm 26.56	0.82
Whale Lake	May 2001	1200	60	32	696	21.75 \pm 23.12	0.58
	Oct 2011	1200	60	19	768	40.42 \pm 38.97	0.64
	May 2012	1200	60	27	638	23.63 \pm 27.1	0.53

Table II.- Kiang population size and density estimates (\pm SD) in different surveys in the Arjin Mountain Nature Reserve, China.

Date	Area surveyed (km ²)	Distance traveled (km)	Number of group	Number of Kiang seen	Mean group size \pm SD	Kiang density/km ²
May 2001	6300	315	191	3933	20.59 \pm 32.66	0.62
Oct 2011	6300	315	108	4107	37.75 \pm 48.12	0.65
May 2012	6300	315	164	3873	23.76 \pm 39.81	0.61
Mean \pm SD	6300	315	154.33 \pm 42.34	3971 \pm 121.54	27.73 \pm 39.79	0.63 \pm 0.23

respectively within 6,300 km² of the reserve (Table II), but it is not justified to extrapolate these numbers to the total area of 45,000 km² and come to a highest observed density estimation of 27,000-29,000 Kiangs, given that somewhere under one third of the reserve is considered to be suitable Kiang habitat (Achuff and Petocz, 1988; Ablimit, 2004). Extrapolating our findings to one third of the reserve (Kiang's habitable zone), the estimated

population will come to 8,500 to 9,500 animals. We, however, couldn't precisely confirm that this is the total number of Kiang within the reserve. This was because there were number of factors affecting the Kiang's population density including human settlement, infrastructure development and livestock husbandry. Furthermore, there will be a tendency to underestimate population size when using sign or sightings as the primary source of information

Table III.- Number of Kiang, groups, means (\pm SD) group sizes, and animals/100 km² observed in different sites the Arjin Mountain Nature Reserve, China.

Sites	Number of group	Number of Kiang seen	Mean group size \pm SD	Kiang seen /100km ²
At Atkhan	15	30	2.00 \pm 1.13	1.25
Kara Qokka	48	511	10.65 \pm 8.40	21.29
Kara Dong	28	218	7.78 \pm 5.36	14.53
Ixak Patti	66	1633	24.74 \pm 18.09	90.72
Ayak Kum	97	4307	44.40 \pm 67.42	143.57
Aqqik Kul	131	3112	23.76 \pm 32.73	86.44
Whale Lake	78	2102	26.95 \pm 29.632	53.39
Total	463	11913	27.73 \pm 39.79	411.39

Table IV.- The intensity of potential threats in different sites on the base of field observation, literature review and interview.

Sites	Habitat fragmentation ¹			Human density	Competition with livestock	Poaching	Predation	Population trend ²
	Fences	Roads	Mining					
At Atkan	++	+++	+++	+++	+++	-	-	Decline
Kara Dong	+	++	++	++	++	-	-	Decline
Kara Qokka	+	++	+++	++	+++	-	-	Decline
Ixak Patti	+	++	+	+++	++	-	-	Unknown
Ayak Kum	++	+	+	+	+	+	*	Increased
Aqqik Kul	+	++	-	+	+	+	*	Increased
Whale Lake	+	+	*	+	+	+	+	Increased

+++ heavy ; ++ moderate ; + low ; - none ; * unkown

¹Mainly caused by pastoral fencing, road construction and mining.

²Derived from comparisons between current and previous studies (see Introduction).

(Jackson *et al.*, 2006). Our strength in this study was that we also took the observation and opinion of the local people, resident reserve wardens and local institution through our questionnaire survey which tallies with our findings from sighting.

The population density was variable depending on the sites (Tables I, III). For example, At Atkhan had the lowest observed density due to the high level of disturbance and other operational threats including human-settlement, road construction, and asbestos and iron mines located inside the reserve. Kiangs were scattered with lower population density in sites such as Kara Dong (0.12-0.17/km²) and Kara Qokka (0.19-0.23/km²), where the pastoralists use the grazing areas with their large numbers of herds. On the other hand, with less disturbed areas such as in Ayak Kum (1.33-1.51/km²), Aqqik Kul (0.82-0.92 km²), Ixak Patti (0.81-1.05/km²) and Whale Lake (0.53-0.64/km²) (Tables I, III) the herds of Kiangs were densely distributed with larger numbers, due to availability

of more suitable habitat, thicker vegetation cover and low human disturbance.

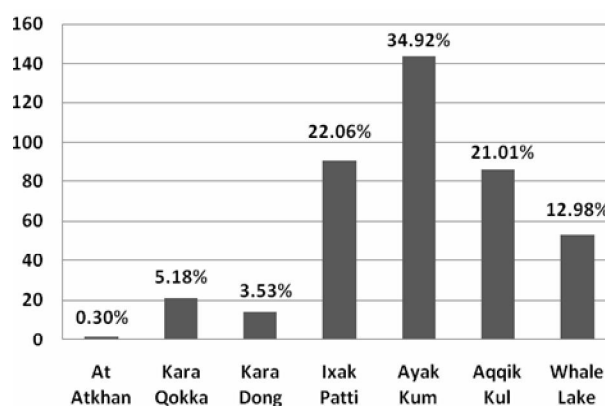


Fig. 2. Population percentage of Kiangs in different sites (Kiang seen/100km²)

Other possibilities for the difference in population density among different sites were the

limited water resources and topographic features, as these factors have been reported to directly affect the Kiang population in the reserve (Gao, Gu 1989). Containing about 91% of the total Kiang population, Ixak Patti, Ayak Kum and Aqqik Kul, and Whale Lake, are favored among the Kiang (Table III, Fig.2).

The results also showed that mean group size of Kiangs in autumn (37.75 ± 48.12 in Oct 2011) was considerably larger than that of spring (20.59 ± 32.66 , 23.76 ± 39.81 in May 2011 and May 2012 respectively) (Table II), implied that large congregation may form on good pasture during the fall and winter (Schaller 1998). For the precise estimation of Kiang's population dynamics in the entire reserve, it was recommended to repeat the study in the remaining part of the Kiang's habitable zone area to generate a more robust, scientifically conducted population estimate.

Conservation status and threats

The Kiang is a Category I Key National Protected Species in China. Its main distribution range in Xinjiang is within the Arjin Mountain Nature Reserve. In spite of conservation efforts, however, the species is still threatened, and the intensity of the potential threats varied between sites (Table IV). As a result of changes in rangeland use policy, ethnic nomad groups build fences across valleys and hills, which will affect the Kiang by causing injuries, casual deaths and food deficit. Further, this area witnessed a continuing influx of iron and asbestos miners from Qinghai Province to move into the reserve also. Consequently, Kiangs are now absent or scattered in some areas associated with heavy human disturbances. However, over the last decade, government intervention to the miners and progressive wildlife protection policy measures, such as the elimination of gold mines, resulted in a significant recovery of Kiang populations, in some areas like Aqqik Kul (Table I, Fig. 2), where the densities of wildlife were reported to be very low (Bleisch 1999). Predation has not been a key threat following the drastic decline of predators such as snow leopard in Xinjiang (Turghan *et al.*, 2011). Poaching still remains a threat in remote mountainous areas like Aqqik Kul and Whale Lake, particularly in winter. Our present study confirms

that the real conservation issue for Kiang at present is related to intensifying conflicts between livestock herding practices and mining activities resulted in increasing human presence and movements in key wildlife areas along with increasing livestock numbers (Fox and Tsering 2005). We recommend that threats such as fencing of grasslands, intensified competition with domestic livestock, road construction, mining and poaching be closely monitored to avoid destructing conserved wildlife and their natural habitats, especially the Kiangs. We also recommend the use of distance-based density estimates as a state variable when between-site comparisons are important

CONCLUSIONS

In this study, 8,500-9,500 Kiangs were estimated for the Arjin Mountain Nature Reserve of 4,5000 km². For the precise estimation of the entire reserve area we recommend repeated study in the habitable zone of Kiang's in the reserve. The initiatives taken by the government's line agency for the protection and conservation of Kiang is not sufficient which needs further strengthening in particular to monitoring of Kiang and the status of their habitats. Because of the difficulties of law enforcement in remote mountainous areas, however, the species is still threatened and its population appears to be fragmented. We recommend that threats such as fencing, intensified competition with domestic livestock, road construction, mining and poaching be addressed and monitored to avoid damage to wildlife including Kiangs in the reserve.

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