

Short Communication

A globally important wild yak *Bos mutus* population in the Arjinshan Nature Reserve, Xinjiang, China

PAUL J. BUZZARD, HUI BIN ZHANG, DONG HUA XÜ and HOW MAN WONG

Abstract The wild yak *Bos mutus* is one of the most charismatic members of the Tibet/Qinghai Plateau fauna, and 19th century explorers to the plateau described vast herds. Overhunting, in particular, has greatly reduced wild yak populations and forced them into remote areas. The species is categorized as Vulnerable on the IUCN Red List and as a Class 1 protected animal in China. Introgression with domestic yaks is another threat, and the wild yak population of the Arjinshan Nature Reserve is particularly important because Uigher herders in and around Arjinshan do not have the tradition of raising yaks. We provide information on the status of the wild yak in Arjinshan based on observations in 1993 and on vehicle surveys during 1998–2009 and point samples from 2009. The steppes of north-east Arjinshan are the most important area, and we saw c. 1,700 yaks there in winter 2008. We saw more yaks in the north-east on similar routes driven in winter 2008 compared to winter 2005, suggesting that the wild yak population in Arjinshan is stable or increasing.

Keywords Arjinshan, *Bos mutus*, China Eastern Kunlun Mountains, wild yak, Xinjiang

The wild yak *Bos mutus* is one of the most charismatic members of the Tibet/Qinghai Plateau fauna, and 19th century western explorers described vast herds of them (Przewalski, 1876; Rockhill, 1891). For example, Rockhill (1891) remarked that the hills and plain ‘...were literally black with yak; they could be seen by the thousands’. Overhunting, competition with domestic livestock and loss of habitat have greatly reduced wild yak populations, and they are presently limited to the remote areas of the Plateau, primarily in China and in India, on steppes and slopes at elevations from 3,200 m to the vegetation limit at 5,400 m (Schaller, 1998). The total wild yak population may be as low as 10,000 (Harris & Leslie, 2008). The species is categorized

as Vulnerable on the IUCN Red List and as a Class 1 protected species in China (Harris & Leslie, 2008).

Yaks have been domesticated for at least 4,500 years and there are > 14 million domestic yaks (Wiener et al., 2003). Introgression with domestic yaks is a threat to wild yaks (Harris & Leslie, 2008) and, in reference to this threat, the wild yak population of the Arjinshan Nature Reserve is particularly important for wild yak conservation. Local Uigher herders do not have the tradition of raising yaks, and thus there are no domestic yaks in the vicinity of Arjinshan. This situation is probably unique among all of the protected areas that contain wild yak. Schaller (1998) estimated 80,580 domestic yaks in the Changtang Reserve in Tibet, and at Yeniugou, Qinghai, a white-faced yak was observed in a wild herd, suggesting introgression (Harris & Loggers, 2004).

The wild yak population in Arjinshan Nature Reserve was estimated to be 10,000 in 1986 (Butler et al., 1986) but in the early 1990s illegal hunting by gold miners and others greatly reduced wild yak and other wildlife populations in the Reserve (Wong, 1998). Schaller (1998) stated there was no reliable estimate of the population of wild yak in Arjinshan Nature Reserve and that probably no more than 2,500 remained in all of Xinjiang. Here we use observational data from 1993, vehicle surveys during 1998–2009 and point samples from 2009 to provide information on the status of the yak in Arjinshan Nature Reserve.

Arjinshan National Nature Reserve in Xinjiang is on the northern edge of the Tibet/Qinghai Plateau and contiguous with the Changtang and Kekexili Nature Reserves in Tibet and Qinghai, respectively (Fig. 1). Butler et al. (1986) and Achuff & Petocz (1988) provided detailed descriptions of the geography and vegetation of Arjinshan, where there are steppes at 4,000–4,600 m and mountains with permanent snow above c. 5,500 m. The climate of the area is continental, dry and cold. Average daily minima during our winter studies were -21.8 and -26.1°C, and maxima averaged 2.4 and -9.1°C (Yishakipati and Kardun, c. 4,000 m). Summer maxima and minima averaged 21 and -3.4°C (chiru calving grounds south-west of Arjinshan, c. 4,600 m; Bleisch et al., 2009). Precipitation is rare and sparse and frequently falls as snow or sleet even in summer.

Our summer surveys were of 4–29 days duration between 16 June and 18 July. Winter surveys were of 9–20 days between 30 November and 29 December except for 2001 (26–29 January 2002) and 2008 (4–9 March 2009). Spring surveys were on 21 and 22 April 2002.

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In north-east Arjinshan we drove vehicle surveys on roads and trails to the Yishakipati herder settlement, from Yishakipati to the Karchuka spring and from Yishakipati to a seasonal herder camp at Sijiquan (Fig. 1). We also drove 4–6 parallel, 17-km off-road transects at the chiru winter rutting grounds at Sijiquan (Buzzard et al., 2008). We surveyed the barren desert in the west while travelling to and from the chiru calving grounds below the north face of Mt Muztagh Ullugh, south-west of Arjinshan, in the summers of 1998, 2001 and 2006 (Bleisch et al., 2009). We surveyed the remote centre of Arjinshan to Dajiuba in October 1993 and in the summers of 1999 and 2001.

We drove 20–35 km hour⁻¹ during vehicle surveys on roads and trails that were relatively straight; on off-road transects we used a global positioning system to maintain straight-line travel. When a group of yaks was located we stopped and recorded the size of the group with 10× binoculars. Robust line transect sampling, as applied by Fox & Bårdsen (2005), was not appropriate because yak distribution is too clumped and sampling biases too great to allow accurate density measurements (Schaller et al., 2007). We combined data from repeatedly driven trails and off-road transects and calculated indices of the number of yaks seen per km driven (Schaller et al., 2007).

For monitoring purposes we initiated a radial point count programme during winter 2008 at Yishakipati (37°18.34' N, 090°20.56' E) and three locations at Sijiquan: (1) a seasonal herder campsite (36°55.05' N, 90°17.46' E), (2) start of the K4 transect (36°54.00' N, 90°00.98' E) and (3) start of the K6 transect (36°54.00' N, 89°56.63' E). To avoid interference with vehicle transects we only counted

yaks to the south: from 130° to 240° at the herder camp and from 90° to 270° at the other points. We used a spotting scope (20–60×) and recorded only wild yaks within 3 km at Yishakipati and 5 km at the other sites, because of limiting topography. Counts lasted 15–20 minutes in the late afternoon (17.00–19.45) at the herder camp and K6 and in the morning at K4 (11.00) and Yishakipati (8.00–9.00).

The greatest numbers of wild yaks and the highest indices of yaks per km were in the north-east of Arjinshan during winter vehicle surveys from Yishakipati to Karchuka (Table 1) but by spring most yaks had left this location. There were also large numbers of yaks around Sijiquan, with more in summer than winter. In both areas we observed large herds (> 100).

We did not observe yaks over 93–130 km between the northern border of Arjinshan and Yishakipati in the winter of 1998, the spring of 2002 and the summers of 2000, 2002, 2003 and 2006. In the winters of 1999, 2001 and 2005 we saw 4–25 yaks and in winter 2008 we saw 104.

At the Yishakipati point sample we saw 135 yaks on 4 March and 92 on 5 March 2009. At the Sijiquan point samples we observed 240–255 wild yaks at the herder camp during 5–7 March 2009. At the start of K4 and K6 on 7 March 2009 we observed 250 and 55 yaks, respectively.

On 4 October 1993 near Dajiuba we recorded three large herds of wild yaks totalling at least 800. In summer 1999 we observed only five male wild yaks in 49 km, and in the summer of 2001 over 186 km we observed only 172 yaks, including at least six infants, in herds of 36, 48, 25 and 60, and three solitary bulls, near Dajiuba. In the west along



FIG. 1 Arjinshan Nature Reserve showing the Yishakipati herder settlement, Karchuka spring, Sijiquan, Dajiuba and Mt Muztagh Ullugh. The inset shows the location of the main map in China.

TABLE 1 Vehicle surveys for the wild yaks *Bos mutus* in the north-east of Arjinshan Nature Reserve, with survey effort in km, number of yak herds (with range and mean \pm SD of herd size) and total number of individual yaks seen and the number of individual yaks seen per km, from Yishakipati to Karquka and to and around Sijiquan (Fig. 1).

Season	km	Herds			Individuals	
		No.	Range	Mean \pm SD	Total	Per km
Yishakipati to Karquka						
Winter 1998	64	6	4–63	28.0 \pm 24.8	168	2.6
Winter 1999	63	4	1–21	11.0 \pm 8.0	42	0.7
Winter 2001	72	8	4–88	25.3 \pm 27.1	202	2.8
Winter 2002	68	4	4–13	7.0 \pm 4.0	26	0.4
Winter 2005	53	8	4–129	36 \pm 45.6	289	5.5
Winter 2008	35	76	1–164	6.7 \pm 17.5	509	14.5
To and around Sijiquan						
Winter 1998	143	1			22	0.2
Winter 1999	190	6	1–62	16.0 \pm 24.0	97	0.5
Summer 2000	589	13	1–157	15.5 \pm 42.7	202	0.3
Summer 2003	141	69	1–198	7.0 \pm 23.5	467	3.3
Summer 2004	36	11	1–60	21.0 \pm 20.9	234	6.5
Winter 2005	242	4	10–150	56.0 \pm 66.0	225	0.9
Winter 2008	142	87	1–22	4.2 \pm 4.6	362	2.5

c. 300 km we found only the remains of 1–2 yaks, and yak dung, in 1998, 2001 and 2006.

Our surveys show that wild yaks in Arjinshan Nature Reserve are not present at the levels seen by early explorers to the Plateau, who saw herds of thousands (Przewalski, 1876). We saw herds of > 100 , however, some of which were of both sexes. In comparison, 70% ($n = 120$) of the wild yaks seen by Schaller (1998) in 1997 were lone bulls or bachelor herds. We found that the steppes in the north-east of the Reserve were the most important area for wild yaks in winter. Combining data from vehicle transects and point samples we saw a minimum of c. 1,700 wild yaks in the north-east in winter 2008, suggesting that Schaller's (1998) estimate of 2,000–2,500 wild yaks for all of Xinjiang is probably still accurate. We saw more yaks in winter 2008 compared to winter 2005 during similar vehicle surveys in the north-east, suggesting that the wild yak population in Arjinshan is stable or increasing. Because of the large number of yaks seen in winter 2008 and the isolation of the Arjinshan population from the domestic yak, we conclude that this population is of global importance.

Wild yak populations in other areas also seem to be stable or increasing. Schaller et al. (2007) travelled in November 2006 across the north-east Changtang and the northern Kekexili and saw 977 wild yaks in 1,692 km, including c. 800 yaks in Kekexili. Buzzard (2004) drove approximately the same route in Kekexili in November 2004 and saw only 502 yaks. In Yeniugou, Qinghai, Harris & Loggers (2004) saw a total of 1,700 and 1,300 wild yaks in

September 2002 and 1997, respectively, in c. 340 km of vehicle, foot and horseback surveys.

Population monitoring is essential for making effective management decisions. The China Exploration & Research Society and Arjinshan Nature Reserve Management are establishing a monitoring programme, and we recommend that point counts and vehicle surveys be conducted in January of each year when yaks are most concentrated at low altitudes. Although logistics are difficult in high remote areas such as Arjinshan, it is important to conduct subsequent surveys at the same times and along the same routes to monitor population trends because there are daily and seasonal yak movements along gradients of altitude (Schaller, 1998; this study). Point counts and surveys are most important in north-east Arjinshan but it is also necessary to survey the remote south, which has not been systematically surveyed, and the centre, where the large herds we saw in 1993 have not been seen on subsequent surveys.

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References

- ACHUFF, P. & PETOCZ, R. (1988) *Preliminary Resource Inventory of the Arjin Mountains Nature Reserve, Xinjiang, People's Republic of China*. WWF, Gland, Switzerland.
- BLEISCH, W.V., BUZZARD, P.J., ZHANG, H.B., XÜ, D.H., LIU, Z.H., LI, W.D. & WONG, H.M. (2009) Surveys at a chiru calving ground adjacent to the Arjinshan Nature Reserve, Xinjiang, China. *Oryx*, 43, 191–196.
- BUTLER, J., ACHUFF, P. & JOHNSTON, L. (1986) *Arjin Mountains Nature Reserve, Xinjiang, People's Republic of China*. IUCN/WWF, Gland, Switzerland.
- BUZZARD, P.J. (2004) *Wildlife Surveys in the Kekexili Nature Reserve, Qinghai, China*. Unpublished Report to Fauna & Flora International, Cambridge, UK.
- BUZZARD, P.J., BLEISCH, W.V., XÜ, D.H. & ZHANG, H.B. (2008) Evidence for lekking in chiru. *Journal of Zoology*, 276, 330–335.
- FOX, J.L. & BÄRDSSEN, B.J. (2005) Density of Tibetan antelope, Tibetan wild ass and Tibetan gazelle in relation to human presence across the Chang Tang Nature Reserve of Tibet, China. *Acta Zoologica Sinica*, 51, 586–597.
- HARRIS, R.B. & LESLIE, D. (2008) *Bos mutus*. In 2008 IUCN Red List of Threatened Species. <http://www.iucnredlist.org> [accessed 5 April 2009].

- HARRIS, R.B. & LOGGERS, C.O. (2004) Status of Tibetan plateau mammals in Yeniugou, China. *Wildlife Biology*, 10, 91–99.
- PRZEWAŁSKI, N. (1876) *Mongolia, the Tangut Country, and the Solitudes of Northern Tibet*, 2 volumes. Sampson, Low, Marston, Searle and Rivington, London, UK.
- ROCKHILL, W. (1891) *The Land of the Lamas*. Century Press, New York, USA.
- SCHALLER, G.B. (1998) *Wildlife of the Tibetan Steppe*. University of Chicago Press, Chicago, USA.
- SCHALLER, G.B., KANG, A., HASHI, T.D. & CAI, P. (2007) A winter wildlife survey in the northern Qiangtang of Tibet Autonomous Region and Qinghai Province, China. *Acta Theriologica Sinica*, 27, 309–316.
- WIENER, G., HAN, J. & LONG, R. (2003) *The Yak*, 2nd edition. Food and Agriculture Organization of the United Nations, Bangkok, Thailand.
- WONG, H. (1998) A brief history of CERS and the Arjin (Altun) Mountain Nature Reserve. *China Exploration and Research Society (CERS) Newsletter*, 2, 14–18.

Biographical sketches

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