Short Communication

Population increase at a calving ground of the Endangered Tibetan antelope *Pantholops hodgsonii* in Xinjiang, China

PAUL J. BUZZARD, HOW MAN WONG and HUIBIN ZHANG

Abstract Females in most populations of chiru or Tibetan antelope *Pantholops hodgsonii* migrate up to 350 km each year to summer calving grounds. These migrations characterize the Tibet–Qinghai Plateau. The Ullughusu calving grounds adjacent to the Arjinshan Nature Reserve in Xinjiang, China, are used by multiple chiru populations and this calving ground recovered from major poaching events in 1998 and 1999, with a population increase from 2001 to 2006. We used direct methods (vehicle/walking transects and radial point sampling) and an indirect method (faecal pellet counts) from 30 June to 4 July 2011 to assess the chiru population at this calving ground. We saw substantially more chiru with all methods in 2011 compared to 2006, demonstrating that the population has increased and suggesting that conservation efforts have been effective.

Keywords Arjinshan Nature Reserve, calving grounds, chiru, migration, *Pantholops hodgsonii*, population increase, Tibetan antelope

The chiru or Tibetan antelope *Pantholops hodgsonii* is endemic to the Tibet–Qinghai Plateau, inhabiting remote regions in China and parts of Ladakh, India. The species once had a vast range, from central Qinghai to Ladakh and from the Arjin Mountains of Xinjiang in the north as far south as Nepal (Leslie & Schaller, 2008). Despite the remoteness of chiru habitat, however, there was an upsurge in poaching during the 1980s and 1990s for the species' extraordinarily fine wool, known as shahtoosh, raising the threat of extirpation for many populations (Wright & Kumar, 1998; Harris et al., 1999; FFI, 2004). Competition with livestock has been and continues to be a threat while infrastructure development and fencing of pasture have become increasing problems (Xia et al., 2007; Fox et al., 2009). Chiru are categorized on the IUCN Red List as Endangered (Mallon, 2008), are on CITES Appendix 1, and on the list of first class protected species under China's Wildlife Law.

Schaller (1998) confirmed reports by early explorers such as Rawling (1905) that much of the total population is migratory and that the sexes live separately for most of the year, coming together during the winter rut. Chiru females migrate up to 350 km from relatively lush winter grounds to high desolate summer calving grounds, and these migrations characterize the plateau ecosystem, just as wildebeest *Connochaetes taurinus* migrations characterize the Serengeti ecosystem (Schaller, 1998).

Schaller (1998) traced the summer migratory route of females and was able to estimate accurately the timing of the birth season. The specific location of a calving ground, however, was not known until 1992 when HZ tracked large groups of females to a remote valley in the western part of the Arjinshan Nature Reserve and witnessed chiru giving birth at the Ullughusu calving ground adjacent to the Reserve (Bleisch et al., 2009). The chiru at this calving ground recovered from major poaching events in 1998 and 1999, with a population increase from 2001 to 2006 (Bleisch et al., 2009), and here we demonstrate a further population increase at the calving ground since 2006.

The Ullughusu calving ground is in high elevation valleys (4,500–5,000 m) to the north of Mount Muztagh Ullugh (6,973 m) and adjacent peaks (c. 36.5°N 87.3°E) adjacent to Arjinshan Nature Reserve (Fig. 1). This Reserve is a national level reserve and protects 45,000 km^2 in south-east Xinjiang Autonomous Region on the northern edge of the Qinghai–Tibet Plateau, straddling the eastern Kunlun Mountains. Since our studies began an area to the west of the Reserve, including the calving grounds, has been included in the new provincial level Mid-Kunlun Nature Reserve. Achuff & Petocz (1988) provide detailed descriptions of the region's geography and vegetation.

We conducted surveys from 30 June to 4 July 2011 to assess the density of chiru with both direct and indirect methodologies, as used previously (Bleisch et al., 2009). Direct methods involved radial point counts and line transects by vehicle and on foot; the indirect method involved faecal pellet counts. We did not include calves in the direct counts because they were often hidden near the groups and were difficult to detect at a distance.

In radial plot sampling we used a 20–60 × spotting scope to record group size within 3 km of the fixed hilltop

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TABLE 1 Comparison of multiple survey methods used in 2006 (Bleisch et al., 2009) and 2011. Values for radial point samples are chiru numbers (with densities per km^2) calculated using a cut-off of 3 km. Values for walking transects are chiru numbers seen on two transects (A, B). Pellet densities are for number of pellet groups in 3-km transects 0.004 km wide.

	Radial 2006	Radial 2011	Walking 2006	Walking 2011	Pellet 2006	Pellet 2011
27 June	540 (27.3)		333(B)		8,000(B)	
29 June	755 (38.1)		232(A)		7,500(A)	
30 June		1,883 (95.1)		299(A)		17,250(A)
1 July		1,653 (83.5)		598(B)		21,083(B)
2 July		1,079 (54.5)				

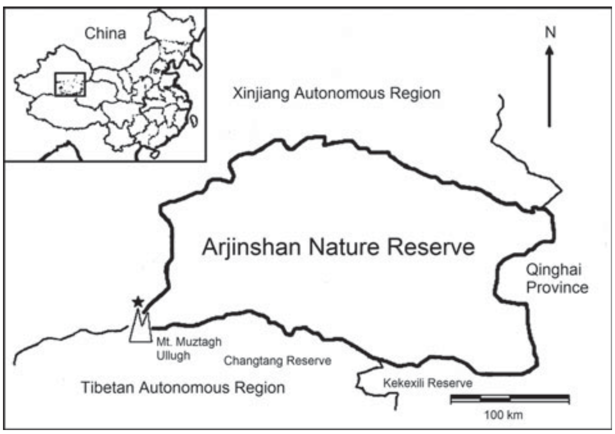

FIG. 1 Ullughusu chiru calving grounds (star) south-west of Arjinshan Nature Reserve, and surrounding features. The rectangle on the inset indicates the location of the main map.

observation point. We began observations at 07.00–08.00 and for c. 1 hour scanned the entire area around the observation point except for the area near our camp, including c. 70% of the field of view and sampling 19.8 km^2 ($\pi \times 3^2 \times 0.70$). We walked two 3-km transect lines, recording group sizes and estimating the distances to groups. We also recorded the angle of sighting and the observers' heading, using trigonometry to calculate the perpendicular distance from the animals to the transect line. We pooled data and analysed them using *Distance v. 6.0* (Thomas et al., 2010) to model the probability of detection and estimate chiru density, choosing the model with the lowest Akaike Information Criterion. We conducted vehicle transects, recording group size and estimating the perpendicular distances of groups to the line of travel. Vehicle transects were as straight as possible but changed direction as the terrain required. To facilitate comparisons between years we calculated the index of kilometric abundance (number of chiru seen per km) and estimated densities based on a 2-km strip width (Schaller et al., 2007).

After completing the walking transects we backtracked and recorded the number of chiru pellet clusters. The current year's pellets were clearly distinguishable from the much lighter previous year's pellets because chiru are at the site for only c. 1 month each year. We measured the perpendicular distance from the centre of the clusters to the transect, including only those pellet clusters within 2 m either side of the transect, thereby sampling an area of 0.012 km^2 (3×0.004 km).

We conducted three radial point samples within 3 days of observation days in 2006 (Table 1). We saw substantially larger numbers of chiru in 2011 compared to 2006 as well as an increase in density from 2006 to 2011 (Table 1; Mann–Whitney *U*, P = 0.10, 1-tailed). We walked two 3-km transects within 4 days of the same transects walked in 2006 and found higher numbers of chiru in 2011 compared to 2006 (Table 1). We pooled the data and found that estimated densities were also higher in 2011 compared to 2006 (62.1 vs 42.0 chiru km^{-2}, Bleisch et al., 2009). The densities of chiru pellet clusters were also considerably higher in 2011 compared to 2006 (Table 1). We observed 466 chiru on a 10-km vehicle transect on 2 July 2011 and this was also consistent with an increase since 2006. This trend was evident in the indices of kilometric abundance (46.6 vs 24.5 chiru per km) as well as in densities (23.3 vs 5.1 chiru km^{-2}; Bleisch et al., 2009).

We saw large numbers of calves in most herds and few cases of mortality. On 1 and 2 July 2011 we saw herds of 48 and 41 females with 34 and 29 calves, respectively. We observed four cases of calf mortality: one from an unknown cause and three calves killed by the same wolf.

This study demonstrates that chiru have increased at the Ullughusu calving grounds adjacent to Arjinshan Nature Reserve. We observed increasing trends in the population with all the methods used and, although there are potential biases, the biases generally arise from different factors in each method. The greater numbers in 2011 vs 2006 were determined with a variety of methods, increasing our confidence that the trends observed indicate real changes in population density.

Bleisch et al. (2009) estimated that the 2001 population at this calving ground was c. 4,000 in 750–1,000 km^2 of suitable habitat, comparable to a calving ground in western Kunlun (Schaller et al., 2006). We conservatively estimate that there were c. 6,000 females at the calving ground adjacent to Arjinshan Nature Reserve, based on the large increase in all sampling methods, compared to 2006. For example, we saw c. 2,300 females during radial samples and walking transects in 2011 on consecutive days vs c. 900 in 2006 (Table 1).

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Determining population size at calving grounds is difficult because frequent movement of animals can cause large daily variation in density estimates, inclement weather often hinders visibility and many areas are hard to access (Schaller et al., 2006). For example, we were not able to reach an important area north-west of Muztagh peak where we saw > 1,000 females in 2006 (P. Buzzard, unpubl. data).

Long distance migrations such as those of chiru are amongst the most awe inspiring phenomena in nature, and conserving these migrations is a priority (Harris et al., 2009). This study demonstrates the effectiveness of the conservation efforts for chiru. Anti-poaching efforts were intensified in 2000 in response to the threat of poaching (Xi & Wang, 2004), and work began with international conservation organizations to reduce the international shatoosh trade (Zhen, 2000). Annual summer monitoring at the Ullughusu calving grounds after 1999 did not discover any more poaching, and both direct and indirect indices indicate that chiru densities increased from 2001 to 2006 (Bleisch et al., 2009) and continued to increase to 2011. The high number of calves observed in 2011 suggests the potential for further increases. This study also demonstrates the value of using consistent cost-effective methods to monitor ungulate populations.

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Biographical sketches

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