SEASONAL MIGRATION OF TIBETAN ANTELOPE (*PANTHOLOPS HODGSONII*) AND ITS RELATION WITH SPATIAL PATTERNS OF RELATIVE PRIMARY PRODUCTIVITY (NDVI)

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ABSTRACT: In this study, the migration of the Tibetan antelope – chiru (*Pantholops hodgsonii*), endangered inhabitant of the Tibetan Plateau is investigated. For the first time, nine (9) female chiru were captured, fitted with satellite-based ARGOS platform transmitter terminal (PTT) and tracked distantly. Satellite tracking of the migrating chiru was succesfull; all tracked individuals are used a breeding site in surrounds of the lake Huiten (or Zhuonai lake) that is located in the National Reservation of Huh-Xil, China (situated 4900 m ~ 5100 m above sea level). The satellite data are clearly showed exact locations of summer (calving), intermediate and winter pastures; and also provided data on the Tibetan antelope's temporal distribution pattern. Annual range consisted of core area (used for 9 months); calving ground (used for the short time - 8 to 20 days); and temporal pastures that used during migration to and from calving ground. So far, seasonal migration cycle was about 3 months. The driving mechanism of the Tibetan antelope migration is not understood. To find out a relation of the seasonal migration to relative primary productivity of pastures we used a normalized difference vegetation index (NDVI) derived from satellite imagery. A preliminary analysis of the obtained data showed that summer habitat selection is closely associated with conditions of pastures. Relative productivity differed between winter and summer (calving) grounds. Only a calving ground has a highest year-around NDVI values and the summer peak of primary productivity in that area was during its use by breeding Tibetan antelopes. Our results show that during breeding season the Tibetan antelopes prefer high altitude (more than 4900 m asl) habitats with high primary productivity.

INTRODUCTION

The Tibetan antelope, commonly called the chiru (*Pantholops hodgsonii* Abel, 1826) is endemic bovid species of the Tibetan plateau. Due to its highly valued wool the antelopes were heavily hunted in Tibet and the population number is sharply declined. Since early 90s hunting on Tibetan antelopes has been prohibited and several reserves to protect its habitats were established in China (Shaller, 1998; Leslie and Schaller, 2008). Because of its distribution in highly elevated and harsh environment of Tibetan plateau the biology and ecology of this unique species remain poorly understood. Despite the fact that seasonal migration of chiru and some of its calving places (Huiten or Zhuonai lake) were known as early as from 19th century (Prjevalskii, 1879); many details of such behavior are remains understood. Recent studies in China revealed presence of several calving

places and indicated that female antelopes are may travel up to 250 km from winter pastures to a summer calving sites (Schaller and Junrang, 1988; Schaller, 1998; Schaller et al., 2006; Bleisch et al., 2009; Buho et al., 2011). Also it was found that the infrastructure development including railway construction in the Tibetan plateau might be the main factors that threaten this species now and in the future (Xia et al., 2007).

MATERIALS AND METHODS

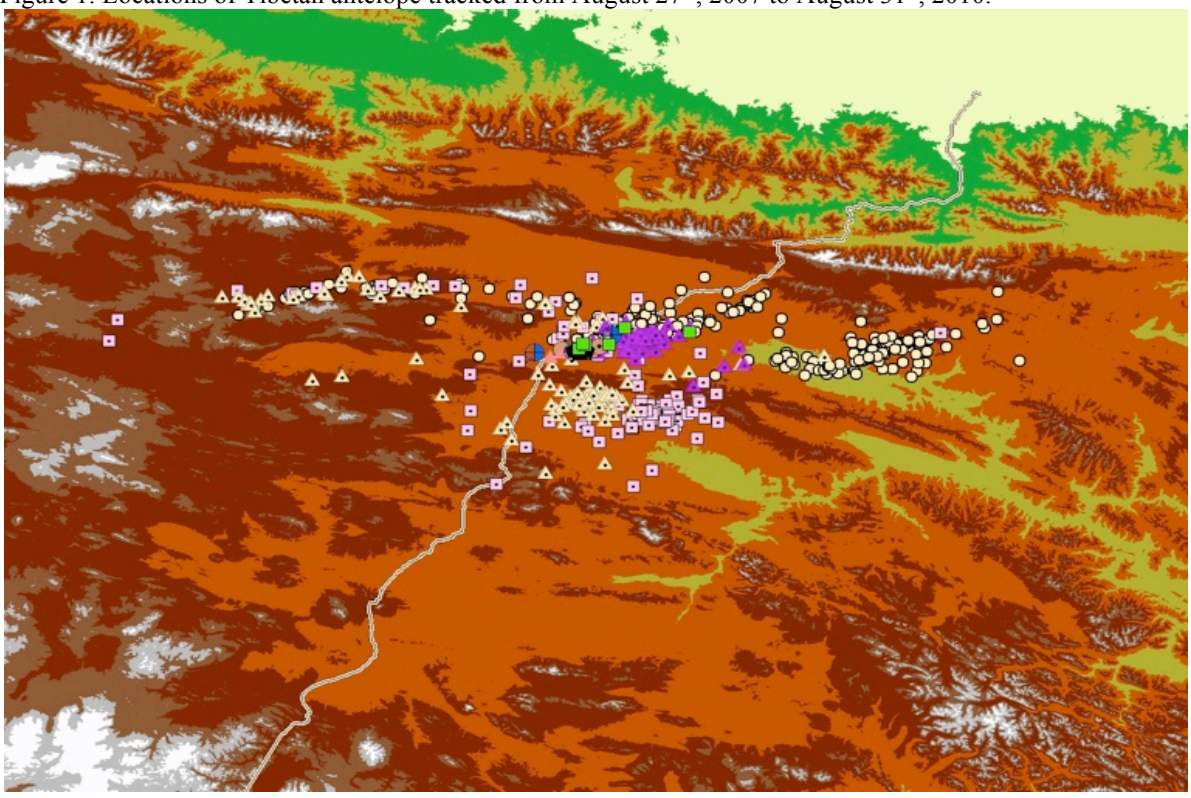
In this study we used a data obtained from the three year (from 27th August 2007 to August 31st 2010) satellite tracking of nine (9) female antelopes using satellite-based ARGOS platform transmitter terminal (PTT) tracking data. The antelopes were captured using nets, sexed, measured and collared with Argos satellite transmitters (model ST-20 A-3210) Telonics Inc., USA. The programming, analysis and differentiation of a location data, as well as its correction were described previously (Buho et al., 2011).

The relative primary productivity or NDVI (normalized difference vegetation index) values were calculated using satellite imagery from LANDSAT TM. The NDVI data for the locations of two chiru individuals that showed relatively constant patterns of seasonal migration during tracking from August 2007 to August 2009 were downloaded via Internet. All available data for three sites, including a) summer calving ground at lake Huiten, b) transitional zone along Qinghai-Tibetan railway (QTR) and Golmud-Lhasa highway (GLH); and c) winter pastures in northern and southern part of Huh-Xil area were downloaded. Monthly average for NDVI were calculated using all image pixels from all areas of each of the three habitat types.

RESULTS AND DISCISSION

Satellite tracking of the migrating chiru was successful; all but one tracked individuals are used a breeding site in surrounds of the lake Huiten (or Zhuonai lake) that is located in the National Reservation of Huh-Xil, China (situated 4900 m ~ 5100 m above sea level). The satellite data are clearly showed exact locations of summer (calving), intermediate (transitional during migration) and winter pastures; and also provided data on the Tibetan antelope's temporal distribution pattern (Fig. 1). During the observation period, only winter pastures were used for the most of year (in average 9 months); so called summer calving ground were used for the short time from 8 to 20 days; and temporal pastures that used during migration to and from calving ground. As it was found in a previous study the seasonal migration cycle has been limited to 3 months period beginning from May and ending in August.

Figure 1. Locations of Tibetan antelope tracked from August 27th, 2007 to August 31st, 2010.



Relative productivity differed between winter and summer (calving) grounds. Only a calving ground has a highest year-around NDVI values and the summer peak of primary productivity in that area was during its use by breeding Tibetan antelopes. However, the differences were not statistically significant and differed by individual chiru (depending on the site of wintering). Average NDVI values for this tree habitats during the same periods were: at calving site 0.363; at transitional zone 0.31; at winter pastures 0.316, respectively. Although, all the tracked individuals of chiru are used the same calving ground in surrounds of lake Huiten the wintering pastures were different. For this reason the NDVI values of winter pastures for different antelopes were better or lower than that in surrounds of the lake Huiten (Fig. 2 and 3). For example average NDVI for chiru ID 36 was 0.304 at calving ground and 0.305 at winter pasture, i.e. was almost the same.

Figure 2. Seasonal dynamics of normalized difference vegetation index (NDVI) in summer calving and winter main pastures of the Tibetan antelope ID #35.

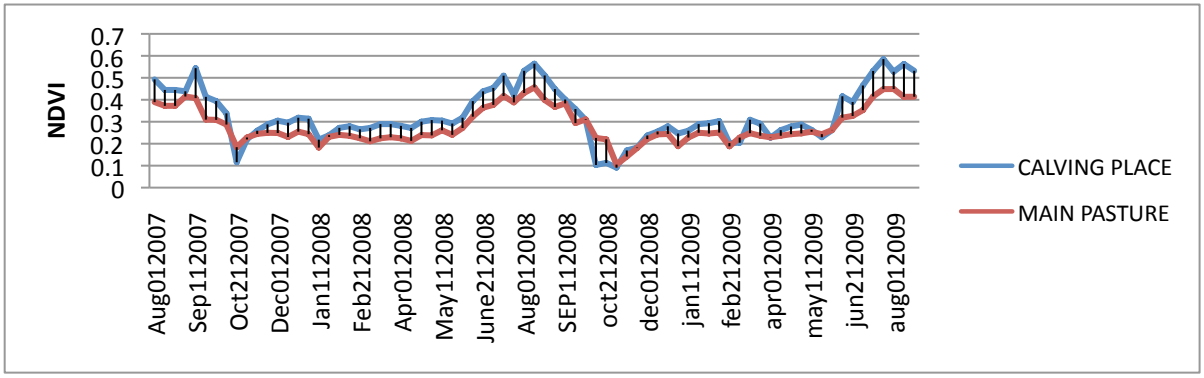
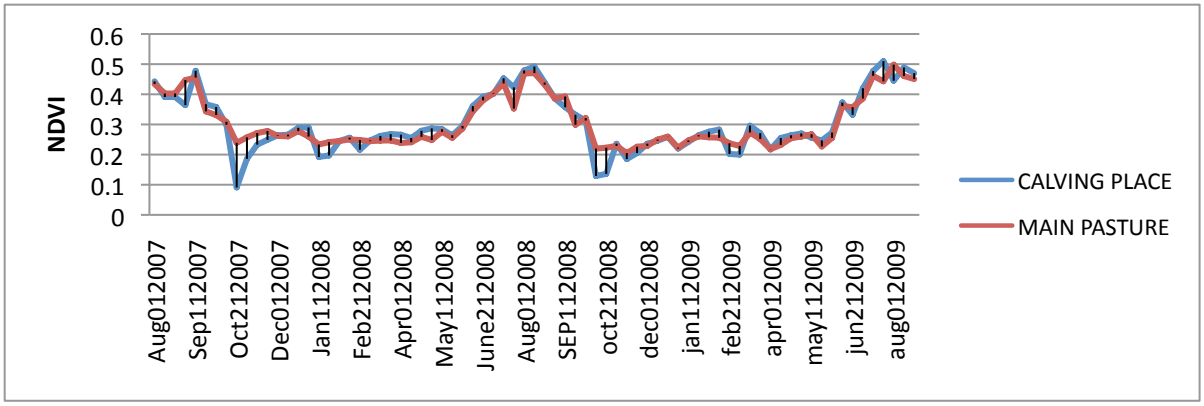


Figure 3. Seasonal dynamics of normalized difference vegetation index (NDVI) in summer calving and winter main pastures of the Tibetan antelope ID #36.



So far, our results show that during breeding season the Tibetan antelopes prefer high altitude (more than 4900 m above see level) habitats with high primary productivity. We conclude that the relative primary productivity in calving grounds of Huh-Xil reserve (surrounds of lake Huiten) higher or similar to that of winter pastures. Schaller et al. (2006) also showed the similar pattern with biomass productivity at calving and wintering sites in the western Kunlun mountains (Xinjiang, China).

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