

Winter pasture conditions and forage use by Argali (*Ovis ammon*) in Gobi Gurvan Saykhan National Park

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Abstract

Conservation of Argali sheep (*Ovis ammon*) presents a significant challenge to biologists and conservation managers in Mongolia. Argali are endangered and available data suggest that their numbers are declining. However, the mechanisms causing this decline are poorly understood. Recent research suggests that declines in Argali sheep numbers may be due in part to competition with domestic livestock for forage.

Following privatization of herd ownership in 1991, livestock numbers increased dramatically across Mongolia. With this increase, many herders expanded grazing onto more marginal rangeland resulting in increased competition with wild ungulates and displacement of Argali from their former population strongholds. Although protected areas encompass a considerable number of these strongholds, livestock grazing is permitted within all protected areas and overgrazing is an increasing concern.

In this study, we examined winter pasture conditions and forage use of Argali in the Gobi Gurvan Saykhan National Park. Visual documentation of plant species selected by Argali was conducted in the field using a spotting scope. Following each observation, we visited the forage site in order to identify all above ground plant species, determine canopy cover, and assess winter conditions using Shennikov's method (1964). We examined a total of 22 Argali forage sites in November 1999. Within the sampled areas, total vegetation canopy cover averaged 50–60%. *Agropyron cristatum*, *Stipa* spp., *Artemisia frigida*, and *Arenaria capillaris* were the most dominant plant species.

Argali were observed to select the following plant species as winter forage: *Stipa* spp., *Festuca lenensis*, *Agropyron cristatum*, *Koeleria macrantha*, *Poa attenuata*, *Carex duriuscula*, *Carex korshinskyi*, *Allium eduardii*, *Kochia prostrata*, *Amygdalus pedunculata*, *Caragana pygmaea*, *Stellaria dichotoma*, *Bupleurum bicaule*, *Caryopteris mongolica*, *Ajania fruticulosa*, *Artemisia santolinifolia*, and *Artemisia frigida*. The results obtained by this study will serve as a baseline for the development of more comprehensive studies on Argali habitat use and availability. Further studies will support the development of management objectives for the conservation of the species and its habitat.

Keywords Argali, *Ovis ammon*, winter pasture, forage selection, foraging behavior.

Introduction

At present, Mongolia's protected area network includes 13.4% of its total land base or 20.9 million ha. Various studies conclude that the Mongolian protected area network incorporates 40% of the rare fauna and flora habitat and 70% of the endangered and threatened species, which are listed in the Mongolian Red book including for instance Argali (*Ovis ammon*) and ibex (*Capra sibirica*, Myagmarsuren, 1999).

The Mongolian Red book summarizes the available information about Argali at the time as follows. "Older Argali male and yearling mortality often occurs during severe winter conditions. [...] Argali tend to move to different habitat by following better snow conditions, water, and available pasture in the rolling hills, plateaus, steppe hills, and gentle slopes" (Shiirevdamba et al., 1997: pp. 62–63).

Previous studies examined limited aspects of Argali ecology, classification, and population size. Habitat use and foraging behavior of this species are still poorly understood. We initiated this study to collect baseline information on winter pasture conditions and forage use, as this is essential information for sound Argali management in Mongolia.

Study area

This study was conducted in the Gobi Gurvan Saykhan National Park in Ömnögobi Aymag. Field work was conducted in Dungenee Valley of Gobi Gurvan Saykhan National Park. This valley is located in the eastern half of Bayandalay Sum and about 17.6% of this sum territory or 1,867 km² are inhabited by Argali (Amgalanbaatar et al., 2002).

Gobi Gurvan Saykhan National Park was established in 1993 and encompasses 2.2 million ha. The larger part of the park is covered by desert steppe but it includes also alpine meadows, mountain steppe, mountain shrub, semi-desert shrub, and desert shrub (Bedunah & Schmidt, 2000). Elevation varies from 1,000 m to 2,835 m and the eastern extension of the Altay Mountains significantly influence weather conditions.

Winters are generally cold, with dry and windy springs, dust storms are common. Summers are hot and monsoon rains bring the majority of annual precipitation. On average, 75% of all precipitation falls in three months from June to August. Temperatures range from 40 °C in the summer to -42 °C in winter (Bedunah & Schmidt, 2000).

Several nationally and globally threatened and endangered species inhabit the park (Reading et al., 1997). The most common wild ungulates in the park are Argali, ibex, goitered gazelle (*Gazella subgutturosa*), and Mongolian gazelle (*Procapra gutturosa*). The park has relatively large populations of grey wolf (*Canis lupus*), snow leopard (*Uncia uncia*), lynx (*Lynx lynx*), and five species of eagles (*Aquila* spp.) that are potential predators on livestock (Reading et al., 1998, 1999).

A number of rare plant species that could be negatively affected by human activities have been identified in the park (Shiirevdamba et al., 1997). Some of these species, such as *Amygdalus mongolica*, *Juniperus sabina*, *Potaninia mongolica*, *Incarvillea potaninii*, *Caryopteris mongholia*, *Populus diversifolia*, and *Cistanche salsa*, are either utilized extensively by livestock or by herders for fuel wood (or both), which may result in a significant decrease of these species without proper management (Bedunah & Schmidt, 2000).

Methods

Direct Observation

To determine the selection of plant species by Argali, we used direct observations (Litvaitis et al., 1994). Visual evaluations of plant species (including the species or parts of species) that were selected by Argali were conducted using spotting scopes. Direct observations were also used to develop a better understanding of foraging time.

This method was employed for 14 days during the field research. During direct observations, we recorded the individual plants and plant parts. Based on these observations we determined the most selected plant species by Argali for winter forage according to Johnson's (1980) rank preference index.

Geobotanical Assessment

Following each direct observation, we visited each of the forage sites in order to identify all above ground plant species, determine canopy cover, and assess winter conditions using Shennikov's method (1964). However, as determination of *Stipa* species in winter proved difficult we refrained

from determining the species level for *Stipa*. The dominant species in the mountains of the Gobi Gurvan Saykhan are *Stipa krylovii* and to a lesser extent *Stipa gobica* (Wesche et al., in review).

At each site, we conducted 10 replicates of geobotanical assessments on plots 20 cm x 50 cm in size. Within each sample plot, we identified all above ground plants. We recorded species and estimated canopy coverage of grasses/forbs and shrubs together using percentage classes of coverage.

Results & Discussion

Plant communities on 22 Argali forage sites were analyzed after observing foraging Argali and determining herd structures. These sites were representative of the following communities. *Stipa-Festuca-Agrophyron*, *Artemisia*-gramineous, forb-*Stipa-Agrophyron*, and *Artemisia frigida-Agrophyron-Stipa* community.

Argali populations were found at an average altitude of 2,080–2,368 m, primarily grazing on the southern slopes and lower northern slopes of hills and mountains with low or no snow coverage. Snow coverage during this period averaged between 5 and 7 cm in areas with relatively low snow coverage and between 45 and 60 cm in some valleys and ravines.

Generally, the following communities dominated southern midridge and lower portions of the hills and mountains: *Stipa-Festuca-Agrophyron*, forb-*Stipa-Agrophyron*, and *Artemisia frigida-Poa*-gramineous. We estimated an average canopy coverage of 40–45 % in these areas. Dominant plants were *Agropyron cristatum*, *Stipa* spp., *Artemisia frigida*, and *Arenaria capillaris*. The following gramineous-forb community dominated north sides of hills and mountains: plant canopy coverage was approximately 55–60 % and was dominated by *Agropyron cristatum*, *Koeleria macrantha*, *Festuca lenensis*, and *Allium eduardii*.

The summarized findings for each of the dominant communities and Argali forage usage within these communities during our study are described as follows:

Stipa-Festuca-Agrophyron community

Table 1: Description of the *Stipa-Festuca-Agrophyron* community recorded (N 43° 29.406', E 103° 53.730', 2,287 m). SR = Species Richness, S = South, N = North.

Location	Cover	SR	Dominant Species
S, lower aspect	50–55 %	5	<i>Agropyron cristatum</i> , <i>Stipa</i> spp.
S, midridge	30–35 %	6	<i>Agropyron cristatum</i> , <i>Festuca lenensis</i> , <i>Arenaria capillaris</i>
S, upper aspect	5–10 %	5	<i>Arenaria capillaris</i> , <i>Agropyron cristatum</i> , <i>Stipa</i> spp.
N, upper aspect	15–20 %	4	<i>Agropyron cristatum</i> , <i>Stipa</i> spp., <i>Festuca lenensis</i> , <i>Koeleria macrantha</i> , <i>Allium eduardii</i>

Within this community a total of 14 plant species were recorded. In this area we observed one herd with 12 individuals. Observations were conducted from 10:52 AM and 1:04 PM for a total of 2 hours and 12 minutes. During this time, rams spent 12.6 % of their time standing, 84.3 % lying down, 0.3 % fighting, 0.3 % walking, 2.1 % smelling, and 0.4 % performing other activities. Female Argali spent 13.0 % of their time standing and 87.0 % lying down.

Artemisia-gramineous community

Within this community a total of 16 plant species were recorded. In this area one Argali herd comprising of 53 individuals was observed.

Table 2: Description of the *Artemisia*-gramineous community recorded (N 43° 31.025', E 103° 56.331', 2,367 m). SR = Species Richness, S = South.

Location	Cover	SR	Dominant Species
S, lower aspect	40–45 %	2	<i>Artemisia santolinifolia</i> , <i>Dracocephalum fruticosum</i>
S, midridge	30–35 %	5	<i>Agropyron cristatum</i> , <i>Stipa</i> spp., <i>Koeleria macrantha</i>

Forb-*Stipa*-*Agropyron* community

Within this community a total of 14 plant species were recorded. One Argali herd comprising of 12 individuals was observed.

Table 3: Description of the Forb-*Stipa*-*Agropyron*-community recorded (N 43° 30.910', E 103° 54.707', 2,250 m). SR = Species Richness, S = South.

Location	Cover	SR	Dominant Species
S, lower aspect	40–45 %	5	<i>Artemisia frigida</i> , <i>Agropyron cristatum</i>
S, midridge	45–50 %	7	<i>Festuca lenensis</i> , <i>Arenaria capillaris</i> , <i>Agropyron cristatum</i>
S, upper aspect	40–45 %	5	<i>Thymus gobicus</i>

Artemisia frigida-*Agropyron*-*Stipa* community

Within this community a total of 11 plant species were recorded. In this area we observed one herd with 7 individuals. Observations were conducted from 3:20 PM and 3:50 PM (30 minutes in total). During this time, the Argali were primarily feeding upon *Agropyron cristatum*, *Koeleria macrantha*, *Festuca lenensis*, *Stipa* spp., and *Allium eduardii*.

Table 4: Description of the *Artemisia frigida*-*Agropyron*-*Stipa*-community recorded (N 43° 31.431', E 103° 56.014', 2,313 m). SR = Species Richness, N = North.

Location	Cover	SR	Dominant Species
N, midridge	35–40 %	6	<i>Agropyron cristatum</i> , <i>Artemisia frigida</i> , <i>Stipa</i> spp., <i>Arenaria capillaris</i> , <i>Allium eduardii</i>
N, upper aspect	15–20 %	5	<i>Thymus gobicus</i>

The above-mentioned communities included 50 different plant species in 41 genera and 18 families. From these, Argali were selecting as a winter forage the green, vegetative parts of 18 plant species in the following families: *Gramineae*, *Compositae*, *Liliaceae*, *Cyperaceae*, *Leguminosae*,

Rosaceae, *Caryophyllaceae*, *Verbenaceae*, *Umbelliferae*, and *Chenopodiaceae*. More specifically, the following plants were selected as forage: *Stipa* spp., *Festuca lenensis* Drob., *Agropyron cristatum* (L.) Beauv., *Koeleria macrantha* (Ldb.) Schult., *Poa attenuata* Trin., *Carex duriuscula* C.A. Mey, *Carex korshinskyi* Kom., *Allium eduardii* Stearn., *Kochia prostrata* (L.) Schrad., *Amygdalus pedunculata* Pall., *Caragana pygmaea* (L.) DC., *Stellaria dichotoma* L., *Bupleurum bicaule* Helm., *Caryopteris mongolica* Bge., *Ajania fruticulosa* (Ldb.) Poljak., and *Artemisia santolinifolia* Turcz. ex Bess.

Artemisia frigida Willd., *Agropyron cristatum*, *Koeleria macrantha*, *Festuca lenensis*, *Stipa* spp., and *Allium eduardii* were the most selected species. Furthermore, *Agropyron cristatum*, *Artemisia frigida*, *Carex duriuscula*, *Allium eduardii*, *Thymus gobicus*, and *Artemisia santolinifolia* retain their green parts during wintertime. In conclusion, through this winter study we were only able to obtain baseline information, which will help us design further, more detailed studies of Argali winter pasture conditions and forage use.

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