Summer diet of domestic sheep and saiga in the Caspian lowland pastures

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Abstract. The materials on the qualitative and quantitative composition of forage plants in the diets of the protected species Saiga tatarica and domestic sheep Ovis aries on the territory of the Chernye Zemli (northwestern part of the Caspian lowland) are presented. Data on the diet of two species of animals were obtained using the method of cuticular micro histological analysis of excrement. In the summer ration of both animal species, 24 plant species were noted, of which 4 species were preferred by both sheep and saigas. The share of cereals in the saiga's diet was 30%, while the share of cereals in sheep is twice as high. Both species of animals preferred Poa bulbosa from cereals, the proportion of which in their summer diet was 26-38%. Herbs account for 27% of the saiga's diet and 35% for domestic sheep. The most preferable species for saigas in summer was Carex stenophylla, with a 42% share in the diet.

1. Introduction
On the territory of the Republic of Kalmykia, the Caspian lowland is divided into two parts: northern - Sarpinskaya lowland and southern - Chernye Zemli. The area of the Black Lands is about half of the area of Kalmykia (3.5 million hectares). The territory of the Black Lands is a low-lying plain with rare weakly expressed elevations, depressions and flat-bottomed depressions, massifs of overgrown sands to varying degrees. The climate of the territory is sharply continental - summers are dry and hot, winters with little snow, sometimes with severe frosts. Pasture ecosystems are concentrated in the Black Lands, where various types of farm animals are grazed. Domestic sheep (Ovis aries L.) predominate in the species structure of grazed animals. This region is also home to the European saiga population (Saiga tatarica L.). In 1950-60, the number of saigas in the region was 700-800 thousand individuals, the species was a commercial object. Since the late 90s of the last century, the saiga population has been declining and in 2014 amounted to only about 5 thousand individuals. The reasons for the decline in the number of saigas, scientists say poaching, an increase in the wolf population, changes in vegetation in the habitat of saigas [1]. In 2015, the saiga was included in the list of rare and endangered wildlife in the Republic of Kalmykia, and in 2020 - in the new list of the Red Book of the Russian Federation. In recent years, thanks to the nature conservation activities of the staff of the Chernye Zemli biosphere reserve, the population of this species began to increase [2], but is still much lower than the potential one.

The aim of the study is to identify the diet of the saiga and domestic sheep. The study will reveal the qualitative and quantitative composition of plants consumed by domestic sheep and saigas included in the list of rare and endangered wildlife objects in the Republic of Kalmykia and the Russian Federation.
Comparing the diets of a domestic animal and a wild animal will determine if there is competition for food plants between these species.

2. Materials and research methods
Field material was collected in the summer season of 2020 on the territory of the Chernye Zemli - in the southern part of the Caspian Lowland within the borders of the Republic of Kalmykia. In accordance with the botanical and geographical zoning, this region belongs to the northern subzone of the desert zone [3]. Fresh samples of sheep droppings were collected at a key site in the conservation area of the reserve, and samples of saiga droppings were collected at the same key site and in the core of the Chernye Zemli nature reserve. Coordinates of the key area: N 46°09′24″, E 046°12′38″. The qualitative and quantitative composition of plants consumed by animals was determined using the method of micro histological cuticular analysis of excrement [4, 5, 6]. Photographs of cuticle fragments from animal excrement were taken on a Nicon Eclipse E 200 microscope with 500x magnification. Species identification of plant fragments from excrement was carried out using our own electronic database of reference samples of cuticle patterns for plant species of the study area. The ratio of plant species in the diet of animals was assessed by the frequency of occurrence of cuticle fragments of each plant species in a sample of droppings. During the study, 6 samples of saiga droppings and 3 samples of domestic sheep droppings collected in August 2020 were analysed, of which 343 cuticle fragments of plants eaten by sheep and 648 cuticle fragments of plants eaten by saigas were isolated. Latin names of plants are given in the summary [7]. Statistical analysis was performed using standard methods using the Excel Windows 2010 package.

3. The main part
Grazed species of domestic animals are selective in eating plants on pastures. When grazing cattle, feather grass is first of all grazed, sheep prefer forbs when grazing, they choose smaller specimens of plants and seedlings [8]. The diet of camels is dominated by forbs represented mainly by ruderal annuals - species of the genera Sisymbrium, Atriplex [9].

The spring and summer of 2020, due to moisture conditions, turned out to be arid for the study area; aerial bulbs of Poa bulbosa prevailed in the vegetation cover of the protected zone of the reserve during the period of observations and counts, and the height of long-growing cereal plants Agropyron fragile and Stipa sareptana (species usually not consumed by sheep and saigas in the summer) did not exceed 5-8 cm. The species composition of plants in the key site included only 20 plant species in the current summer season. Based on the identification of cuticle fragments, 24 plant species were identified in the diets of both animal species, of which 17 species are found in the diet of the saiga, and 20 species in the diet of domestic sheep (table 1). We divided the species of plants that form the vegetation of pastures into economic and botanical groups: cereals (species of the Poaceae family), sedges (species of the Cyperaceae family) and forbs - species of the remaining families.

Table 1. Diet of saiga and domestic sheep in the summer season of 2020.

| Name of species and food groups of plants | Diet, % | Saiga | Domestic sheep |
|------------------------------------------|---------|-------|----------------|
| Poa bulbosa                               | 27.2±5.5| 38.5±5.8 |
| Agropyron fragile                         | 0.3±0.2 | 14.6±0.7 |
| Stipa sareptana                           | 0.7±1.0 | 4.1±1.4 |
| Anisantha tectorum                        | 0       | 0.3±0.7 |
| Eragrostis minor                          | 0.1±0.2 | 1.2±0.4 |
| Unidentified cereal fragments             | 1.9±0.7 | 0.6±0.6 |
| Total cereals                             | 30.2±4.5 | 59.2±7.3 |
| Carex stenophylla                         | 42.4±1.7 | 5.8±0.7 |
| Total sedges                              | 42.4±1.7 | 5.8±0.7 |
The share of species from the group of cereals was 59.2 ± 7.3% in the summer diet of domestic sheep. Among the plants of this group, *Poa bulbosa* dominates in the diet of the sheep; animals consumed not only dry stems, but also bulbs (thickened shoot bases formed by the sheaths of the lower leaves). Such bulbs are a storage organ, they remain on the soil surface after breaking off the upper parts of the stem. It should be noted that the life form *Poa bulbosa* is an ephemeral; this species develops in early spring, when there is a sufficient supply of moisture in the soil, and dries up by the beginning of summer, therefore, during the period of our observations, *Poa bulbosa* was represented in the plant cover by separate dried stems and bulbs. Of other species of the Poaceae family, about 15% of the summer diet was *Agropyron fragilis*, 4% - *Stipa sareptana*, slightly more than 1% - *Eragrostis minor*.

The share of forbs in the diet of sheep was 35%, while the share of species of the Chenopodiaceae family is high - about 22%. Sheep more often chose the summer-autumn annual *Ceratocarpus arenarius* - 12.2%, the share of other species of the Chenopodiaceae family from 2.6 to 3.8%. Species of the genus *Artemisia* (*A. austriaca, A. arenaria*) accounted for more than 7% of the species composition of the diet, the share of other herb species was less than 1%. The animals willingly consumed the only species from the Cyperaceae family, distributed in the key site - *Carex stenophylla*, whose share in the diet was 5.5%.

In the diet of saigas, the share of cereals is two times lower in comparison with the diet of sheep, but, like that of sheep, the share of *Poa bulbosa* in the diet is high - 26.2%. The share of forbs in the summer diet of saigas is 27.4%. Species of the genus *Artemisia* (*A. austriaca, A. lerchiana, A. arenaria*) dominate in the diet of saigas; *Ceratocarpus arenarius* and *Trigonella orthoceras* account for over 2%. *Carex stenophylla* accounted for over 40% of the summer ration of animals. Our data showing a significant proportion of *Carex stenophylla* in the diet of saigas in the summer season confirm the results of previous studies [1].

The diet of the saiga in the summer of 2020 includes fewer species compared to the diet of domestic sheep, since animals have the opportunity to choose food plants based on their taste preferences and overcoming long distances. Saiga droppings used for the analysis were collected not only from the key sheep grazing area, but also from the Chernye Zemli nature reserve. The sheep grazed in a limited area of sparsely vegetated pastures and ate the plant species that were available. It is known that sheep prefer

| Plant Species                        | Share in Domestic Sheep | Share in Saiga       |
|--------------------------------------|-------------------------|----------------------|
| *Artemisia austriaca*                | 11.9±4.5                | 7.2±3.0              |
| *Artemisia lerchiana*                | 3.1±2.3                 | 0                    |
| *Artemisia arenaria*                 | 1.5±0.9                 | 0                    |
| *Achillea leptophylla*               | 0.4±0.3                 | 1.5±0.9              |
| *Centarea diffusa*                  | 1.3±0.7                 | 0.9±0.4              |
| *Salvia stepposa*                   | 0                      | 0.6±0.5              |
| *Ceratocarpus arenarius*             | 2.4±0.9                 | 12.2±4.4             |
| *Galium humifusum*                  | 0.3±0.3                 | 0.6±0.5              |
| *Atriplex tatariaca*                 | 0.7±0.4                 | 3.8±1.8              |
| *Salsola tatarica*                  | 0.1±0.1                 | 2.6±0.5              |
| *Phlomis pungens*                   | 0                      | 0.3±0.3              |
| *Prangos odontalgica*               | 0.1±0.1                 | 0                    |
| *Trigonella orthoceras*              | 2.8±3.1                 | 0                    |
| *Bassia hyssopifolia*                | 0.4±0.6                 | 3.2±2.5              |
| *Alhagi pseudalhagi*                 | 0                      | 0.3±0.3              |
| *Medicago romanica*                 | 0                      | 0.3±0.3              |
| *Lepidium perfoliatum*               | 0                      | 0.3±0.3              |
| *Polygonum aviculare*               | 0                      | 0.6±0.5              |
| Unidentified forbs fragments         | 2.4±0.7                 | 0.6±0.5              |
| Total forbs                          | 27.4±4.7                | 35.0±7.0             |
| **Total**                            | 100                     | 100                  |
herb species, and cereal plants (species of the genera *Stipa*, *Agropyron*) are usually consumed only at the germination stage, and in adult plants, leaves are used at the stage of their regrowth in early spring or during the secondary vegetation of plants in autumn. Due to systematic fires in the Chernye Zemli in the last decade of the last century, plant communities dominated by the subshrub *Artemisia lerchiana* were replaced by phytocenoses dominated by species of the genus *Stipa*. Despite the fact that *Agropyron fragile* and *Stipa sareptana* species are coarse and difficult to digest food in summer, sheep were forced to consume these species due to the insignificant presence of forbs in the pasture, and there was no opportunity to move to other pasture areas.

4. Conclusion
Sheep consumed all plant species that were available in the pasture - 20 species, and the number of species consumed by saigas on a shared pasture with sheep - 13. Of this number of common species, for 9 plant species the share in the diet of saiga or domestic sheep is less than 1%, that is, these 9 species did not prefer both types of animals. Therefore, the number of plant species that both are preferred is 4. These are the species: *Poa bulbosa*, *Carex stenophylla*, *Artemisia austriaca*, *Ceratocarpus arenarius*. The listed species are the most common in the Chernye Zemli, they are present on all pastures in the region. Of these, *Poa bulbosa* and *Carex stenophylla* are ephemeroids, *Artemisia austriaca* is a perennial herb, *Ceratocarpus arenarius* is an annual plant. Thus, the diet of saigas and sheep in the summer season is similar, but there is no competition for food plants between the two species. The absence of competition among saigas with sheep for fodder plants and the protection activities of the staff of the Chernye Zemli reserve will allow the saiga population to increase its numbers.

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