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Ecological features of saiga *Saiga tatarica* L. var. *tatarica* of Betpakdaly population of the Central Kazakhstan

In the article the ecological features and biological characteristics of saiga — *Saiga tatarica* L. var. tatarica of Betpakdaly population dwelling in semi-deserts and dry steppe zones are considered. Comparing to appearance, Saiga is quite different from other animals living in steppe area. Its external and internal appearance, nasal part structure, behavior and fodder resources are described in the article. The map of migration of saiga on Betpakdaly is shown; also some plant species of steppe zone eaten by saiga in different seasons of year are presented. So, saiga in Kazakhstan eats perennial and annual herbaceous plants which referred to 17 families and 81 species. Gender and age structure, population dynamics of saiga of Betpakdaly population of Central Kazakhstan are shown.

Keywords: Betpakdaly population, saiga, steppe, population, area, age structure, antlers, chase.

As a result of population decrease (from more than 1 million in the end of 1990s to 22,000 in 2003), saiga's preservation became a current problem. In 2006, saiga was included in the list of International Union for Conservation of Nature and Natural Resources (IUCN), in 2002 saiga was in an extremely dangerous situation, CR is a kind being in «critical situation». Therefore, the project about Betpakdaly population is quite current and it helps to explore population dynamics of these disappeared animals.

This animal dwells mainly in plain areas, deserts, semi-deserts and steppes. In the beginning, it settled down a large territory in steppes and semi-deserts of Eurasia: from the foot of Carpathians and Caucasus till Dzungaria and Mongolia. Nowadays, saiga dwells in only Kazakhstan and Uzbekistan, sometimes it can be noted in Turkmenia, in Russia (Kalmykia, Astrakhan Region, Altai Republic) and Western Mongolia.

Saiga's population critically decreased from 1.22 million in 1993 to 22,000 in 2003. The main reason of decreasing is massive poaching along all of the saiga's area during all seasons of year. There are steppe and semi-desert animals shown (Fig. 1) that live in a herd gathering [1].

Figure 1. Saiga – *Saiga tatarica* – Betpakdaly population

There is only species in the genus — *Saiga tatarica* Linaeus.

There are 3 large saiga groups in Kazakhstan: betpakdala (Betpakdaly and nearest territory), ustyurt (Ustyurt and nearest territory) and Ural (between the Ural and the Volga Rivers). Animals of these groups don't mix; registration is taken separately in each group.

The area occupies steppes of CIS from the eastern lowhills of the Carpathians to the Altai base lowhills and beyond till Dzungaria and western Mongolia. The present area covers steppes and semi-deserts of Kalmykia and Kazakhstan, Great Lakes Depression of the North-western Mongolia. Saiga is herd animal.

Its nose makes it different from other genera of subfamily Caprinae. Muzzle is inflated and pulled out a lot into a small proboscis, which hangs down a little.

Saiga's body is similar to large sheep. Head is held horizontally in calm condition. Eyes are large. The front part of the muzzle is swollen and arched. Nose deeply falls into lower jaw, divided by longitudinal groove, its gravel, massive, agile and generally like a small proboscis with wide nostrils; it leans down and passively swings while running in calm condition; short and round ears. In summer, body color is yellowish-red; flanks are sand-yellow; the lower side of the neck, chest, abdomen, perineum are yellowish-white; a narrow, dark, reddish-brown streak stretches from nape to edge of the tail clearly; limbs are sand-yellow, tail is brownish-brown, naked below; cheeks, ears and the end of muzzle yellow-sand; forehead and crown are dark and red and a little white. In late autumn, coloring becomes pale, brownish sandy tint that brightens by the end of winter. Adult males get their whispers gray-black. Generally, saiga's hair is white, so animals become almost white. Young saiga (under 1 year old) may have more intense coloration.

Saiga's nasal cavity is covered with many hairs through which air can go and dust is delayed. In cold weather, the air is slightly warmed in the nasal cavity. These animals — the inhabitants of the northern type of deserts and semi-deserts, have specific adaptations developed because of cold frost (40^0 under 0^0). In the summer, hair length is about 1.5-2 on the back; in winter, it's 4,5-7 cm, that means it is increased more than 3 times. Winter hair is thicker than summer (76 % and more), and air cavities are contained within it. In winter, saiga's fur is dense, finely undulating. Individual hairs are engaged with each other and make it resistant against inflation by the wind. Even while heavy winds and frosts, animals do not use shelters and lay down on the snow. Muzzle is well- laid down. Ears are small, rounded, strong, overgrown on both sides. By the winter, the animals get fat layer 20–30 mm thick. They run trotting.

The length of the intestinal tract of saiga is about 20 m (duodenum — 2.8 m, small intestine — 10.5 m and large intestine — 6.5 m), which is higher than the body length 14–16 times as much.

Liver weight of a male may be from 450 to 810 g (average 750 g), female — from 320 to 670g (average 620g). Kidneys — 158–220 (215) g (male) and 109–152 (148) g (female). The heart — 250–288 (275) (male) and 220–243 (238) g (female). Weight of a gallbladder is 12,1–13,4 (11.5) g, spleen 38–44 (41) g and lungs 265–366 (362) g.

Diploid number of chromosomes is 60.

Molt. Fur of juvenile saiga begins turning into a constant one at the age of 15–25 days. Slightly wavy hair falls down and old adult attire grows by July 10–15. Saigas moult in spring and autumn.

The spring molt of males and females begins in late May. But in 1967, 1975, 1977 due to late and cold spring it started in early May and completely finished from 30 June to 5 July. Most malnourished animal's time were just beginning to fade at the same. Priority of molting: the bow, around the eyes, around the mouth, front and rear legs, then — crown, cheeks and the front part of the back and in the last instance — hips, neck and belly. The duration of the spring molt is about 60t days. In the lower reaches of the Volga, molting occurs 10–15 days before.

Autumn molt begins in late September — early October and it ends depending on the onset of cold weather in November — December, i.e. it lasts for 60–75 days. In 1965, saiga finished autumn molting after the 20th of October, in 1966, 1977 and 1978. — In mid-November. Male's and female's molting usually occurs simultaneously. Its priority is as the same as in the spring. Young animals finish it 5–10 days after it happens to adult ones.

Genital symptoms of saiga are outwardly well-distinguished from other plains animals. While running, they hold their heads in horizontal position. They often run amble without vertical oscillations of the body. Some animals do jumping up (under 45^0) while running. In winter, their coloration is almost white, and staying away you can notice a dark collar on the neck only (especially for males). They prefer to join herds. Their hoof prints are different from the gazelles' ones: they are wider and more rounded. The trace length of adults is not above 65 mm, width is about 50 mm. Males are larger than females. Saiga's droppings, «nuts», 10–12 mm in length and thickness of 9–10 mm; they are larger than the gazelles'. Maturation of the animals is most often taken in lows in winter; in the summer, they prefer open spaces for it, especially large takyrs. Large groups of saigas gather near water.

Saiga in Kazakhstan eats a variety of plants at least 17 families and 81 species (Fig. 2). Species composition of plants is changed in different seasons of year; it depends on the timing of vegetation, richness and accessibility (Table 1).

In early spring (March — Mid April), saigas eat at least 11 species of plants. In spring, plants contain 75–80 % of water, and animals don't have to look for watering place.

In March, sagebrushes are eaten generally, cereals are used in food all the time (in spring — 45 % of eaten food is cereals). In late spring (April – May), 29 species of plants were noticed as used in food.

In spring, they also readily eat Artemisia marschaliaana, Rheum, Rumex, Allium, Tulipa schrenkiana.

Table 1

Species composition of plants eaten in different seasons of year

9 **Spring**		
10 **Month**	11 **Plant name**	12 **Containing in stomach, %**
13 14 15 March	16 *Artemisia terrae-albae, Artemisia pauciflora, Artemisia nitrosa, Sonchus arvensis*	17 От 40 до 70
	18 different species *of Poaceae*	19 45
	20 *Ephedra distachya*	21 35
22 23 24 25 26 27 April-May	28 *Eremopyrum orientale*	29 32
	30 *Eremopyrum triticeum*	31 18
	32 *Poa bulbosa*	33 26
	34 *Rheum tataricum*	35 50
	36 *Alyssum desertorum*	37 80
	38 *Descurainia sophia*	39 35
	40 *Artemisia scopiformis*	41 42
	42 *Limonium suffruticosum*	43 23
	44 *Rumex marschallianus, Inula britanica, Allium globosum, Tulipa schrenianum*	45 Quite frequently
46 **Summer**		
47 48 49 50 51 June-August	52 *Agropyron fragile*	53 42
	54 *Eremopyrum orientale*	55 22
	56 *Eremopyrum triticeum*	57 22
	58 *Bromus inermis*	59 19
	60 *Poa bulbosa*	61 56
	62 *Festuca valesiaca*	63 65
	64 *Artemisia scopiformis*	65 75
	66 *Salsola foliosa*	67 90
	68 *Alyssum desertorum*	69 35
70 **Autumn**		
71 72 73 74 75 October-November	76 *Salsola praecox*	77 99
	78 species from *Poaceae family*	79 12
	80 *Ephedra distachya*	81 47
	82 different species *of Artemisia*	83 45
	84 *Limonium suffruticosum, Limonium gmelinii, Dodartia orientalis, Sonchus arvensis, Cirsium, Tanacetum santolina, Alyssum desertorum, Capsella bursa-pastoris, Lepidium perfoliatum*	85 Quite frequently

In summer, food value becomes less. Saigas have to move more in order to find better watering places and fields, eating not less than 58 species of plants.

In autumn (October – November), species composition contains at least 19 plants.

Saigas prefer juicy herbs as food: *Salsola praecox* (99% в the contents of the stomachs), *Poaceae plants* (12%), *Ephedra distachya* (47%), different species of *Artemisia* (45%). In fodder is often *Limonium gmelinii, Limonium suffruticosum, Dodartia orientalis, Sonchus arevensis*, more rare — *Cirsium, Tanacetum santolina, Alyssom desertorum, Capsella bursa-pastoris, Lepidium perfoliatum*. At the end of the autumn, food becomes even more monotonous: animals often move and gather in bush thistle.

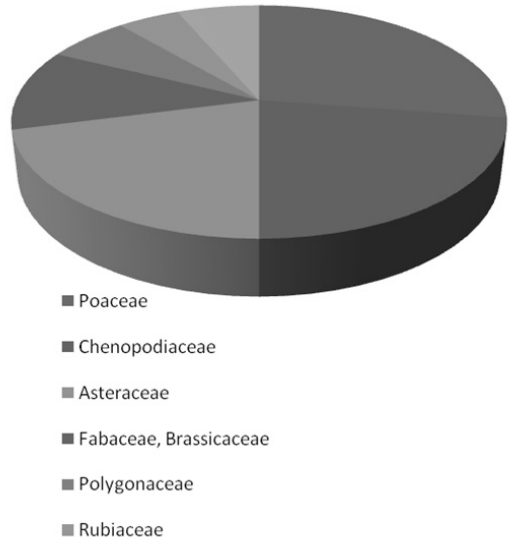

Figure 2. Plant families eaten by saigas

Little saigas (3–4 days old) begin eating grass, when they're 10 days old — *Alyssum desertorum, Rheum tataricum, Tulipa schrenkiana* are about 10% of used food. When saigas are 15 days old, 95% of their ration is greenery *(Artemisia austriaca, Agropyrum fragile, Eremopyrum and Rheum tataricum)*. At the age of a month, ration of little saigas isn't different from adult ones. The mass of all that can be kept in stomach changes during whole day: in the winter for males — 1.5-6.9 kg, for females — 2.1-5.8 kg; in the winter for males — 2-5.7, for females — 1.5-4.5 kg. They eat and get fat intensively between 4–8 a.m. and 4–8 p.m.

In Kazakhstan, in the autumn the water is stored only in the rivers and deep lakes, especially in drought years. That time saigas experience great difficulties and tens of thousands come to preserved watering places. Hey drink, taking turns throughout the day and even at night. It is especially hard for them, when water freezes but snow is absent. In this case, animals make great transitions in search of water or snow. They frequently visit roads where they look for different grooves, lick and gnaw ice, come to low-lying places where snow is blown away by the wind and it lasts longer among the vegetation. During this period, they rescue frost, which is sometimes a relatively thick layer of vegetation cover. Sometimes these animals have to break through the ice hooves to quench their thirst. In winter, saigas quench their thirst with snow, grabbing it with food.

In summer, saigas drink water for 1.5-4 min. Ungulates that were harvested between 0 and 2 a.m., the liquid in stomach (contents were squeezed through a cheesecloth) for males and females, respectively, in June — 62 and 59%, in July — 42 and 50%, in August — 73% and 66% in September — 53 and 59% of the contents. Calves (little saigas) drink 2–3 liters of water a day in captivity.

Saigas come to watering place attentively, they follow female leader. They drink water near bank or sift through stream of water. Saigas do it one-by-one, then adult males — first in order — run away to steppe.

During lambing and the first 10–15 days after the birth of lambs animals graze almost all day. In the summer, they have rests all days. During the grazing, animals keep moving. For example, on July, 22th the animals from one herd (200 saigas) passed 5–6 km for 3 hours while eating.

During the period of huge migration of saiga, daily activity changes. In winter, vacation is shorter. In November, antelopes graze from dawn to dusk. In winter, animals have to spend much more time grazing than in summer.

Saigas scratch snow with their front hooves as long as find soil lying or lay on snow. They do it 8 times a day in summer, perhaps they lay in position they laid before. It takes 35–50 cm place in diameter.

Saiga males reach puberty at the age of 18–19 months. Males can participate in chase (rut) at the same age, but among females — first years only 5.2–20 % are pregnant. There are two saiga peaks of sexual activity, but only one of them is accompanied while rutting. Highest spermatogenesis occurs in late December (the average weight of the testes — 44.1 g) and in June (weight 27.1 g). Perhaps in the distant past the ancestors of saiga lived in warmer climates, and they had two breeding seasons — spring and summer.

Saigas are typical polygamous animals. Creating of harems takes place in the second half of November. In the first decade of November — harems of up to 30 females were 70.3 in the second — 86 and in the third — 83.7%. Normal harem in Kazakhstan is about 30 females. At Barsakelmes, harem's size is 10–12, in the area between the Volga – Ural — 10–15, and in Kalmykia — 2–6 females.

Complex environmental factors contributes to offensive mass mating: the formation of harems, light conditions, cold, animal fatness. Mass rut of saiga in Betpakdaly took place from December to January.

Saiga's chase occurs in the territory of Kazakhstan in the main wintering areas, in the broad valleys, overgrown with *Artemisia, Salsola, Vicia*, or in extensive takyrs. Harems are located 50–200 m from each other. A male is constantly near females, it makes t characteristic sounds resembling grunt. Under yearlings are expelled from herd and live separately. While fights, owners of harems hurt each other. Normally, mating takes place at night and lasts for a few seconds. During the rut, males' hardly fed and strongly grow, they get thin, weaken.

Females reproduce in plain areas, sparse vegetation and soft soil. During the calving females are kept at a distance of 15–100 m apart and newborn density is from 4 to 25 animals (about 5–7) per 1 ha.

Saiga's pregnancy continues 131–141, an average of 138 days. Saiga's duration of pregnancy changes from west to east. In early May (1–7), females reproduce in Kalmykia, Kazakhstan, and 10 days later in Mongolia. Females give birth lying down, often at night or early in the morning. Eat placenta. At first, helpless lambs are born, but 0.5–1 hour later they are able to leave generic maturation.

In late April, the mass of milk glands is about 150, for lambs — 600–800 g. Females feed infants early (at 5-6 a.m.), then -. 12–9 p.m. Saiga's milk is yellow Saiga, salty, it contains 5.8% fats, 3.31% lactose, and various amino acids. A captive saiga at the age of 2–3 days drinks 40–50 cm^3 of milk once, at the age of 1 week — 350–400 cm^3, and at the age of 1 month 0.9–1 l.

A female feeds only its lambs. If lambs are 2, it tries to take care of both of them. After 20–30 minutes of feeding it stays away. Lambs lie curled up or stretched out their necks on the ground. Young and adult animals run amble. In the evening, you can watch the original game of lambs in large herds.

Before birth, their average weight is 1843 g (120 days old), they look like newborn lamds. They grow up most intensively during first 30 days, then between 4 and 18 months, and by 2.5 years old growth almost stops. Weight changes depending on the fatness.

Only males have horns. They are usually translucent, yellowish-white, length is about 30 cm, irregular shape, two-thirds at the bottom of transverse annular beads are arranged almost vertically on the head, and their form is black cones (height — 1 cm) that appear at the age of 1 month. By 6–7 months old, they grow up to 9–13 cm, and at the age of 8–9 months black leathery cover disappears in part. Animals get their horns light and smooth by the age of 3 years. Age of animals is not determined by number of rings.

Sex ratio of embryos is 1: 1, and neonatal 1: 0.9. We explain this fact that male activity is often watched during reproducing. The number of males changes depending on cold weather (after death while chase period), as well as amount of their shooting. In the spring, in March – May, there is an integration of herds. Most of the males (in March) join large herds of 50–300 animals or clusters of 20–40 thousand animals to migrate to the North. Females join herds of 50 animals (48.6%), from 51 to 300 animals (46%). In April, we see herds of 400 animals and occurrence increases to 37.9%. In early May, they form clusters (3–6 thousand animals), and during mass calving (for 2–10 days), saigas join herds hardly [2].

Betpakdaly areal (Fig. 3) extends from the Mugodzhary mountains in the west to about Ayagoz in the East, ie its length is about 1,500 km. Consideration is currently being conducted only in the western part — in Torgau, Zhilanshike, Aral Karakum, where main livestock animals concentrate. At the same time, we know that saiga antelopes in small quantities are found in the rest of the range — in Betpakdaly, Northern and Southern Balkhash region, in the western part of the East Kazakhstan region, etc. and carrying out the integration of the entire territory is necessary in order to clarify the current state of Betpakdaly population (Fig. 4, Table 2) [2].

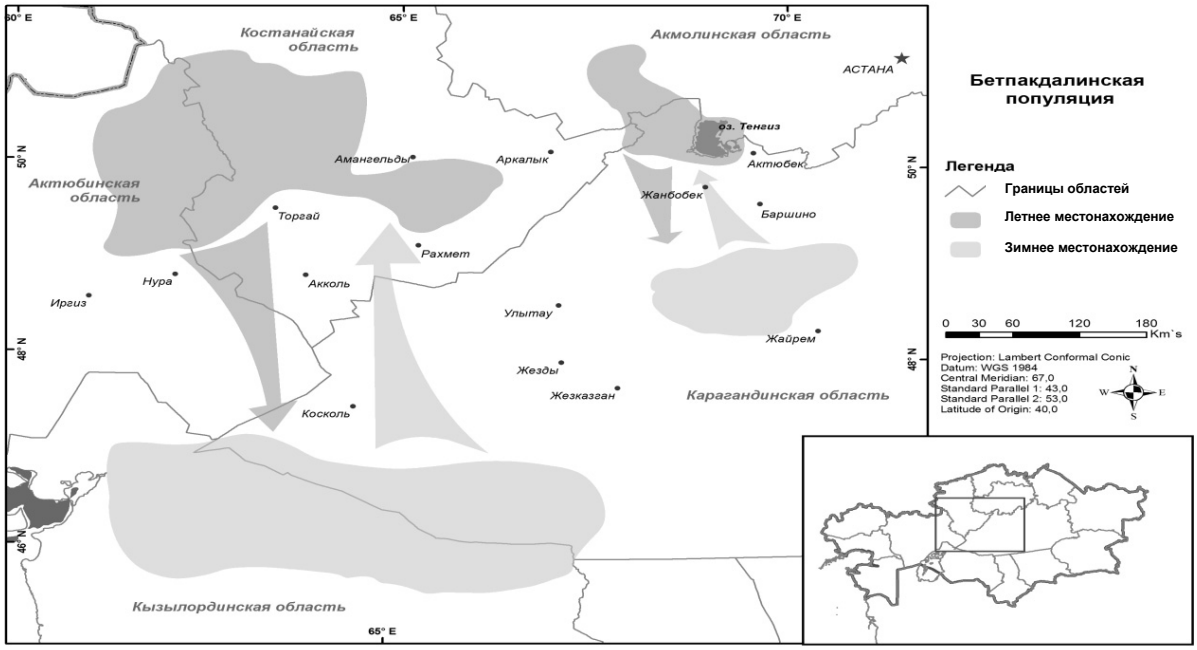

Figure 3. Saiga's areal

To define population of these animals in the large territory is very difficult using devices that are usually used, so aviation is more convenient way to carry it out.

Saigas are quite active animals, they move from one place to another so that to take some experiments being on foot is practically impossible.

One of the ecological features of saiga was a large migration in 2012 to Russian Federation (Engels city), it happened for the first time. More likely, the reason was season spring-summer drought. Plus, it's explored that the saigas areal extends to the North, especially it occurred more intensively for previous 10 years because of climate thaw [3].

Figure 4. Ground stocktaking of Betpakdaly population

Table 2

Saiga population 2007–2016

86 Year	87 Population (thousands)			
	88 Betpakdaly	89 Ustyurt	90 Uralskiy	91 In summary
92 2007	93 22.8	94 16.4	95 15.6	96 54.8
97 2008	98 32.3	99 10.4	100 18.3	101 61.0
102 2009	103 45.2	104 9.2	105 26.6	106 81.0
107 2010	108 53.4	109 4.9	110 27.2	111 85.5
112 2011	113 78.0	114 6.1	115 17.9	116 102.0
117 2012	118 110,1	119 6.5	120 20.9	121 136.6
122 2013	123 155,2	124 5.4	125 26.4	126 187.0
127 2014	128 216.0	129 1.7	130 39.0	131 256.7
132 2015	133 31.3	134 1.5	135 50.1	136 82.9
137 2016	138 36,2	139 1,9	140 70,20	141 108,3

Betpakdaly population is considered the largest of these three. In 2014, their amount reached 216,000, but in 2015 murrain occurred (from 226,000 to 31,300 animals) in spring, so 87% of saigas died for the first time (Table 2, 3).

Amount of saigas in Kazakhstan for 10 years decreased (50 times less) since 1992 to 2003 from about 1 million to more than 20,000 animals. Thanks to decisions taken to save species, amount of saiga gradually increased.

Radical changes have taken place as a result of mortality in Betpakdaly due to the mass death of females in the field concentration at lambing [4].

Saiga amount was about 300,000 in 2015, at the same time, in spring, animals lost 87% of their amount.

Table 3

Amount of Betpakdaly population since 2011 to 2016

142 Year	143 Amount of Betpakdaly population (thousands)
144 2011	145 78,0
146 2012	147 109,2
148 2013	149 155,2
150 2014	151 216,0
152 2015	153 31,3
154 2016	155 36,2

So, as next monitoring, male amount was 40%, that was extremely large amount for saigas (Fig. 5)

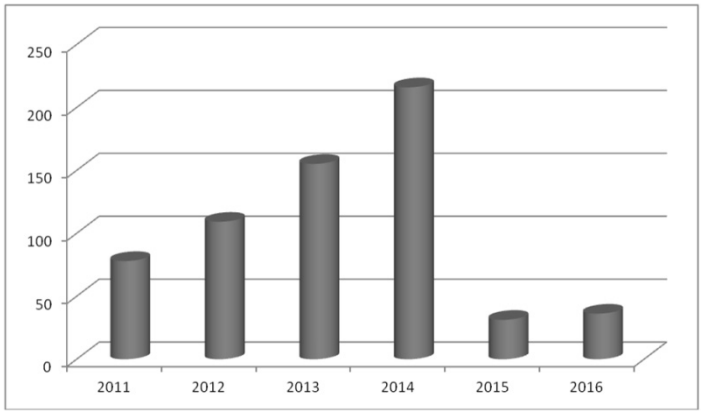

Figure 5. Saiga amount in Betpakdaly population

Share fingerlings were 13.8%, which shows a low success saiga breeding. Thus, at the moment it is not known how this relationship will affect estrus and breeding success in 2016 [5].

As a result of the aerial survey in 2016, the total number of saiga in Kazakhstan is 108,300 animals, Betpakdaly population numbers 36,200 animals, Ural population — 70,200 and Ustyurt population — 1,900 animals.

Destruction of natural habitats, disturbance of migration routes, using of chemicals in agriculture, strengthening factor of concern — all these problems, leading to the impoverishment of the animal world, for many sidelines compared to poaching. Nowadays, it is one of the most serious threats to wildlife in Kazakhstan, in particular for steppe and semi-desert areas. The most striking example of the consequences of poaching - a large reduction in the number of saiga in Kazakhstan.

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Орталық Қазақстандағы *Saiga tatarica* L. Бетпақдалалық популяциясының экологиялық ерекшеліктері

Мақалада жартылай шөлді және құрғақ далалы аймақта Бетпақдала популяциясында тіршілік ететін *Saiga tatarica* L. биологиялық және экологиялық ерекшеліктері қарастырылған, жалпы ақбөкендер сыртқы ерекшеліктері бойынша қоңыржай аймақтың басқа жануарларынан ерекшеленеді. Оның сыртқы, ішкі құрылысы, сол сияқты ақбөкенді басқа жануарлардан ерекше етіп көрсететін тұмсық бөлігінің құрылыстық, сонымен қатар тіршілік етуі, күзгі-қысқы түлеуі және көбею ерекшеліктері сипатталған. Суретте және картада Бетпақдала популяциясында ақбөкендердің таралу аймағы және көші-қон бағыты берілген, ақбөкендердің әр түрлі маусымда қорегі болып табылатын далалық аймақтың әр түрлі шөптектес өсімдіктерінің түрлері көрсетілген. Ақбөкендер негізі 17 тұқымдасқа жататын 81 түрлі өсімдіктермен қоректенеді. Орталық Қазақстанның Бетпақдала популяциясында *Saiga tatarica* L. ақбөкенінің жастық және жыныстық құрамының арақатынасы және сандық динамикасы диаграммада көрсетілген.

Кілт сөздер: Бетпақдала популяциясы, сайғақ, дала, саны, таралу аймағы, ұрғашысы, еркегі, таралу, мүйіз, көбею.

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Экологические особенности сайги *Saiga tatarica* L. Бетпакдалинской популяции Центрального Казахстана

В статье рассмотрены экологические особенности сайги *Saiga tatarica* L. Бетпакдалинской популяции, обитающей в полупустынях и в сухих степных зонах, а также дана их биологическая характеристика. Описаны внешнее, внутреннее строение и строение носовой части, которые отличают сайгу от других животных, а также поведение, гон и весенне-осенняя линька. Показаны ареал распространения сайгаков Бетпакдалинской популяции, их маршрут и миграция. Представлены несколько видов из ста степных трав, которые в разные сезоны года употребляются в пище сайгаками. Сайгаки в Казахстане питаются разнообразными растениями, которые относятся к 17 семействам и 81 виду. Показано соотношение возрастного и полового состава и представлена динамика численности сайги *Saiga tatarica* Бетпакдалинской популяции Центрального Казахстана.

Ключевые слова: Бетпакдалинская популяция, сайга, степи, численность, ареал, самка, самец, распространение, рога, гон.

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